CURRICULUM

Academic Year 2026 – 2027

V & VI Semester

B. E. DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BATCH 2024

RAMAIAH INSTITUTE OF TECHNOLOGY

(Autonomous Institute, Affiliated to VTU)
(Approved by AICTE, New Delhi & Govt. of Karnataka)
Accredited by NBA & NAAC with A^+ Grade

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 13 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained All India Rank 182 in "Scimago Institutions Rankings" for the year 2024.**
The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1584 top Engineering Institutions & 31st Rank for School of Architecture in India among 131 Architecture Institutions, for the year 2025.

About the Department

Year of Establishment	1984
Names of the Programmes offered	UG: B.E. in Computer Science and Engineering PG: M.Tech. in Computer Science and Engineering PG: M.Tech. in Computer Networks and Engineering Ph.D M.Sc.(Engg.) by Research

The Department of Computer Science and Engineering (CSE) has eminent emeritus professors, 15 faculties with the doctorate degree and 15 pursuing the doctoral studies. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department also conducts vocational courses and proficiency courses on fundamental and new programming languages and computer science concepts. These courses are conducted beyond college hours'/summer semester by the faculty of the department. Some of the faculty are involved in institutional level activities and actively involved in interdisciplinary research activities. The department has state of the art laboratories like SAP, IBM Centre of Excellence. Technical seminars, workshops and hackathons are conducted regularly for UG & PG students. The department encourages the students to conduct and participate in extra- curricular/sports activities. The alumni network is very active and regular meeting are conducted by the department. The department is accredited by Nation Board of Accreditation (NBA). The department has MoUs with leading IT Industries like SAP, IBM and HP. The department conducts subjects with more of hands- on sessions and encourages students to take up MOOC based online courses in NPTEL, IIT Bombay, Coursera, Udacity and edX.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To build a strong learning and research environment in the field of Computer Science and Engineering that promotes innovation towards betterment of the society

MISSION OF THE DEPARTMENT

1. To produce Computer Science graduates who, trained in design and implementation of computational systems through competitive curriculum and research in collaboration with industry and research organizations.
2. To educate students in technology competencies by providing professionally committed faculty and staff.
3. To inculcate strong ethical values, leadership abilities and research capabilities in the minds of students so as to work towards the progress of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

A B.E (Computer Science & Engineering) graduate of Ramaiah Institute of Technology should, within three to five years of graduation

PEO1 Pursue a successful career in the field of Computer Science & Engineering or a related field utilizing his/her education and contribute to the profession as an excellent employee, or as an entrepreneur

PEO2 Be aware of the developments in the field of Computer Science & Engineering, continuously enhance their knowledge informally or by pursuing graduate studies

PEO3 Be able to work effectively in multidisciplinary environments and be responsible members / leaders of their communities.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of

knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

PROGRAM OUTCOMES (POs):

The Outcomes of the Bachelor of Engineering in Computer Science & Engineering Programme are as follows:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and the world: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO10: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO11: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Understand the principles, architecture and organization of computers, embedded systems, and computer networks.

PSO2: Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems that include both hardware and software.

PSO3: Apply software design and development practices to develop software applications in emerging areas such as IoT, Data Analytics, Social Networks, Cloud and High-Performance Computing.

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2024-28

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	08	09	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	02	01	01	01	01	01	02	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Integrated Professional Core Course (IPCC)	--	--	04	04	03		04	--	15
Professional Elective Courses PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	□	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	--	13	17
Non Credit Mandatory Courses (NCMC)	--	--	--	--	□	--	--	□	--
Total Credits	**20**	**20**	**21**	**20**	**22**	**23**	**16**	**18**	**160**

B E in COMPUTER SCIENCE AND ENGINEERING
SCHEME OF TEACHING
Batch 2024

V SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	CS51	Software Engineering and Modelling	CSE	PCC	3	0	0	3	3	0	0	3
2	CS52	Artificial Intelligence and Machine Learning	CSE	IPCC	2	0	1	3	2	0	2	2
3	CS53	Finite Automata and Formal Languages	CSE	PCC	2	1	0	3	2	2	0	2
4	CS54	Data Communication and Networking	CSE	PCC	4	0	0	4	4	0	0	4
5	CSE55x	Program Elective Course – 1	CSE	PEC	3	0	0	3	3	0	0	3
6	CSL56	Data Communication and Networking Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
7	CSL57	Full Stack Development Lab	CSE	PCC	0	0	1	1	0	0	2	0
8	AL58	Research Methodology & Intellectual property rights	CSE	HSMC	3	0	0	3	3	0	0	3
9	CSAEC59/510	Ability Enhancement Course – V	Any Department	AEC	1	0	0	1	1	0	0	1
				Total	**18**	**1**	**3**	**22**	**18**	**2**	**6**	**18**
10	HS510	Environmental Studies	IEM	NCMC	0	0	0	0	1			

SI. No	Course Code	Course Name	Credits				Contact Hours/ Week
			L	T	P	Total	
1.	CSE551	Secure Programming	2	0	1	3	4
2.	CSE552	Computer Graphics and Virtual Reality	2	0	1	3	4
3.	CSE554	Advanced Algorithms	2	1	0	3	4
4.	CSE556	Object oriented Analysis and Design	2	0	1	3	4
5.	CSE557	Big Data Analytics	2	0	1	3	3

V Semester-List of Courses for Program Elective Course-1

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, HSMC:** Humanity and Social Science & Management Courses**, PEC:** Professional Elective Courses**, AEC–**Ability Enhancement Courses, **NCMC**: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing S-Self Learning

Note: IME55x, where x=1,2,3,4,5

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE **(no SEE).** However, questions from the practical part of IPCC can be included in the SEE question paper.

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

BE in COMPUTER SCIENCE AND ENGINEERING

SCHEME OF TEACHING

Batch 2024

VI SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	AL61	Management & Entrepreneurship	CSE	HSMC	3	0	0	3	3	0	0	3
2	CS62	Cloud computing and Microservices	CSE	PCC	3	1	0	4	3	2	0	3
3	CSE63x	Program Elective Course – 2	CSE	PEC	3	0	0	3	3	0	0	3
4	CSE64x	Program Elective Course – 3	CSE	PEC	3	0	0	3	3	0	0	3
5	CSL65	Penetration Testing and Secure Programming Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
6	CSL66	Microservices and DevOps Lab	CSE	PCC	0	0	1	1	0	0	2	0
7	CSOE0x*	Institutional Open Elective – 1	Any Department	IOE	3	0	0	3	3	0	0	3
8	CSP67	Mini Project	CSE	PW	0	0	4	4	-	-	-	
9	**CS68**	Technical Skill enhancement Course	Industry Expert	SDC	0	1	0	1	0	2	0	0
				Total	**15**	**2**	**6**	**23**	**15**	**4**	**4**	**15**

VI Semester-List of Courses for Programme Elective Course-2

SI. No	Course Code	Course Name	Credits				Contact Hours/Week
			L	T	P	Total	
1.	CSE631	Introduction to Deep Learning	2	0	1	3	4
2.	CSE632	Software Defined Networks	2	1	0	3	4
3.	CSE633	Linux Kernel Programming	2	0	1	3	4
4.	CSE636	Cryptography and Network Security	2	0	1	3	4
5.	CSE637	Distributed Systems	2	0	1	3	4

VI Semester-List of Courses for Programme Elective Course-3

SI. No	Course Code	Course Name	Credits				Contact Hours/ Week
			L	T	P	Total	
1.	CSE642	Wireless Sensor Networks	2	1	0	3	4
2.	CSE643	Natural Language Processing	3	0	0	3	3
3.	CSE644	Advanced DBMS	2	0	1	3	4
4.	CSE645	Edge AI and Automation	3	0	0	3	3
5.	CSE646	Block chain and Distributed App Development	2	0	1	3	4

List of Open Elective Courses

Sl. No	Course code	Course Name
1.	CSOE02	Mobile application Development
2.	CSOE04	Full stack Development
3.	CSOE05	Object Oriented Programming with C++
4.	CSOE09	Introduction to Artificial Intelligence and Machine Learning
5.	CSOE10	Introduction to Big Data Analytics
6.	CSOE12	Project Management with Git

Note: The above list of courses shall be offered during 6th and 7th semester for the students of branches other than CSE and ISE

Nomenclature, PCC: Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **PW:** Mini Project, **INT –**Internship

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: IME63x , where x=1,2,3,4,5
IME64x , where x=1,2,3,4,5
IMOE0x*, where x=1,2,..,… continued from previous

L –Lecture, T – Tutorial, P- Practical/ Drawing/ Project work

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

Institutional Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

1. The candidate has studied the same course during the previous semesters of the program.
2. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
3. A similar course, under any category, is prescribed in the higher semesters of the program.
4. The minimum students strength for offering open electives is 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to a group having **not more than 4 students.** The CIE marks shall be awarded by a committee constituted by of the Head of the concerned department. The CIE marks awarded for the Mini-project work shall be based on the

evaluation of project report, project presentation skill, and question and answer session as per the rubrics defined by the department. SEE will be conducted by the two examiners appointed by the Institute. SEE marks awarded for the mini project shall be based on the evaluation of project work report, project presentation skill and question and answer session.

Internship - All the students admitted shall have to undergo mandatory internship of 6 - 8 weeks during the intervening vacation of the IV & V semesters / intervening vacation of VI & VII semesters/ VII semester. **A Viva-Voce CIE examination** shall be conducted during VIII semester as per the rubrics defined by the department and the prescribed credits shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SOFTWARE ENGINEERING AND MODELLING	
Course Code: CS51	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Mr. Pradeep Kumar D and Dr Shilpa S Chaudhari	

Course Contents

Unit I

Introduction: Professional software development, Software engineering ethics. **Software processes:** Software process models, Process activities, coping with change, Process improvement. **Agile Software Development:** Agile methods, Agile development techniques, Agile project management.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Comparative analysis of software process models on the real-time case study application
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs68

Unit II

Requirements engineering: Functional and Non-functional requirements, Requirements engineering processes, Requirements elicitation, Requirements specification, Requirements validation, Requirements change. **Design Concepts** -Design Within the Context of Software Engineering, Design Concepts, The Design Model.

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Analysis of the real-time case study application
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs68

Unit III

Architectural Design: Architectural design decisions, Architectural views, Architectural patterns. Design and implementation: Object-oriented design using the UML, Design patterns, Implementation issues

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: High level and low level design of the analysed real-time case study application
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs68

Unit IV

Software testing: Development testing, Test-driven development, Release testing, User testing. **Software evolution**: Evolution processes, Legacy system, Software maintenance

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Designing test cases as per the requirement specification of the real-time case study application
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs68

Unit V

Project management: Risk management, Managing people, Teamwork. **Project planning:** Software pricing, Plan-driven development, Project scheduling, Agile planning. **Quality management**: Software quality, Software standards, Reviews and inspection**s**

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Review of the analysis and design of the real-time case study application.
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_cs68

Text Books:

1. Ian Sommerville, Software Engineering, 10th Edition, Pearson Education Limited 2016.
2. Roger S Pressman, Software Engineering- A Practitioner's approach ,9th Edition, McGraw-Hill Education, 2020

Reference Books:

1. Shari Lawrence Pfleeger, Joanne M. Atlee, Software Engineering Theory and Practice, Third Edition, Pearson Education, 2006.
2. Waman S Jawadekar, Software Engineering Principles and Practice, Tata McGraw Hill, 2004.
3. Douglas Bell, Software Engineering for Students, A Programming Approach, 4th Edition, Pearson Education.

Course Outcomes (COs):

At the end of the course, the students should be able to:

1. Explain professional software development practices, process models, ethical aspects, and apply agile principles and project management techniques in software engineering. (PO1,2,5,8,9, PSO1)
2. Analyse the functional and non-functional requirements and Design concepts for the given problem (PO1,2,3,5, PSO1, 2)
3. Develop architectural and detailed design using UML and design patterns. (PO1,2 3,5, PSO1, 2)
4. Perform development and testing activities using test-driven development, release testing, and user testing, and evaluate software maintenance strategies. (PO1,2,3,4,11, PSO1)
5. Plan and manage software projects considering risk, cost, time, and quality using both traditional and agile approaches. (PO1,5 9,11, PSO1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Report of High level and low level design of the analysed real-time case study application	10	CO1, CO2 & CO3
Presentation of Review of the analysis and design of the real-time case study application	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in First Evaluation +Marks scored in Second Evaluation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 & CO5

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	
Course Code: CS52	**Credits: 2:0:1**
Prerequisite: Knowledge of Algorithms, Probability, Statistics, Linear Algebra	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Rajarajeswari S	

Course Contents

Unit I

Introduction: What is AI? Intelligent **Agents:** Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving by search:** Problem Solving Agents, Example Problems, searching for Solution, Uninformed Search Strategies, Informed Search Strategies, Heuristic Functions.**Logical Agents:** Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, reasoning patterns in Propositional Logic, Agents Based on Propositional Logic. **First-Order Logic:** Syntax and Semantics, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

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- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement uninformed and informed search algorithms, knowledge-based agents, and logical reasoning using propositional and first-order logic.
- Link:https://www.nptel.ac.in/courses/106106226

Unit II

Knowledge Graphs and Ontologies: Representation of entities and relationships, RDF-style triples, ontology-based reasoning, rule-based inference, semantic relationships, and applications in question answering and intelligent agents.
Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, forward chaining, Backward chaining, Resolution.
Reasoning under Uncertainty: Need for uncertainty handling in AI, Conditional probability, Bayes' theorem, Bayesian networks, and Naive Bayes classifier.
Introduction to Machine Learning: What is Machine Learning, Key Terminology, Key tasks of Machine Learning, Well-posed learning problems, Different types of ML

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- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement knowledge graphs, rule-based inference, Bayesian reasoning, and Naive Bayes classification
- Link: https://www.nptel.ac.in/courses/106106139

Unit III

Supervised Learning: Classification and Regression. **Classification Algorithms:** Logistic Regression, Support Vector Machines, Naive Bayes, K-Nearest Neighbors.**Regression Algorithms:** Linear Regression and Polynomial Regression. **Hybrid Tree and Ensemble Algorithms**: Decision Trees, Random Forest, Gradient Boosting. **Model Validation and Evaluation Metrics:** Cross-validation, hyper parameter tuning, accuracy, precision, recall, F1-score, ROC-AUC, confusion matrix, and R^2 score.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement and evaluate supervised learning algorithms including regression, classification, decision trees, and ensemble methods
- Link : https://www.nptel.ac.in/courses/106102220

Unit IV

Unsupervised Learning: Need, characteristics, and difference between supervised and unsupervised learning.
Clustering Concepts: Similarity and distance measures, Euclidean distance, Manhattan distance, cosine similarity, intra-cluster distance, and inter-cluster distance.
Clustering Algorithms: K-Means Clustering, Hierarchical Clustering, DBSCAN.
Dimensionality Reduction Algorithms: Principal Component Analysis.
Association Rule Learning: Apriori Algorithm, support, confidence, and lift.
Anomaly Detection: Concept of anomalies, outliers, need for anomaly detection, and basic anomaly detection approaches.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement clustering, dimensionality reduction, association rule mining, and anomaly detection techniques.
- Link: https://www.nptel.ac.in/courses/106106139

Unit V

Deep Learning Overview: Neural networks, CNNs for computer vision and Transformers.
Basics of Natural Language Processing: Word embeddings, Attention mechanism, Transformer architecture overview.
Generative AI Concepts: Large Language Models, Prompt Engineering, Retrieval-Augmented Generation, Vector Databases such as Chroma and FAISS.
Reinforcement Learning Basics: Agent, environment, reward, policy, value function, Markov Decision Process, Q-learning, exploration vs. exploitation.
Explainable and Responsible AI: Conceptual ,Ethics/Bias
.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement neural networks, CNNs, Transformer-based applications, RAG systems, and basic reinforcement learning.
- Link: https://www.nptel.ac.in/courses/106108705

Text Books:

1. Stuart J Russel and Peter Norvig: "Artificial Intelligence - A Modern Approach", 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, Vineeth N Balasubamanian"Machine Learning", McGraw-Hill Education (Special Indian Edition), 2026.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: "Artificial Intelligence", 3rd Edition, Tata McGraw hill, 2011.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
3. Peter Harrington. "Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2016.
5. Saroj Kaushik, Artificial Intelligence, Cengage Learning.
6. Christoph Molnar, Interpretable Machine Learning: A Guide for Making Black Box Models Explainable, 3rd Edition.
7. Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 2019.

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Apply fundamental concepts of artificial intelligence to design intelligent agents and implement uninformed and informed search strategies for problem-solving. (PO-1,2,3,4,5,6,7,8 PSO-1, 2,3)
2. Analyse different types of machine learning systems and demonstrate the ability to perform an end-to-end ML project including data visualization, pre-processing, model selection, and validation. (PO-1,2,3,4,5,6,7,8 PSO-1, 2,3)
3. Implement and evaluate supervised learning algorithms such as linear regression, logistic regression, SVMs, and decision trees to solve classification and regression problems. (PO-1,2,3,4,5,6,7,8 PSO-1, 2,3)
4. Compare and apply ensemble methods and dimensionality reduction techniques, and perform unsupervised learning using clustering and Gaussian mixtures. (PO-1,2,3,4,5,6,7,8 PSO-1, 2,3)
5. Build and fine-tune neural networks using Keras and apply reinforcement learning techniques to decision-making tasks in simulated environments. (PO-1,2,3,4,5,6,7,8 PSO-1, 2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Lab program Implementation	10	CO1, CO2, CO3, CO4, CO5
Case Study Solving & Presentation with report	10	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Lab Component +Case Study presentation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 & CO5

FINITE AUTOMATA AND FORMAL LANGUAGES	
Course Code: CS53	**Credits: 2:1:0**
Prerequisite: Nil	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr.Monica R Mundada	

Course Contents

Introduction to Finite Automata: Structural representations, automata and complexity, the central concepts of automata theory; deterministic finite automata, nondeterministic finite automata, an application of finite automata, finite automata with epsilon transitions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://nptel.ac.in/courses/106105196

Unit II

Regular Expressions

Regular Expressions: Finite automata and regular expressions, applications of regular expressions, proving languages not to be regular, closure properties of regular languages, equivalence and minimization of automata.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://nptel.ac.in/courses/106105196

Unit III

Context–free grammars

Context–free grammars: Parse trees, applications, ambiguity in grammars and languages, definition of the pushdown automata, the languages of a PDA, Equivalence of PDA's and CFG's: CFG for PDA

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://nptel.ac.in/courses/106105196

Unit IV

Deterministic Pushdown Automata

Deterministic Pushdown Automata: Normal forms for CFGs-eliminating useless symbols, eliminating eplison - production, eliminating unit production, Chomsky Normal form, the pumping lemma for CFGs, Closure properties of CFLs

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://nptel.ac.in/courses/106105196

Unit IV
Turing Machine

The Turing machine: Notation for Turing Machine, Instantaneous Description for Turing Machine, Transition Diagrams of a Turing Machine, The Language of a Turing Machine, Turing Machines and Halting, Programming techniques for Turing Machines. Extensions to the basic Turing machine.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://nptel.ac.in/courses/106105196

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Problems on Deterministic Finite Automata
2.	Problems on Non- deterministic Finite Automata
3.	Problems on Conversion from NFA to DFA
4.	Problems on Regular expressions, conversion from RE to FA
5.	Problems on Conversion from FA to RE
6.	Problems on Equivalence and minimization of Automata
7.	Problems on CFG, parse trees, and ambiguity in CFG
8.	Problems on Push down automata
9.	Problems on Conversion from PDA to CFG
10.	Problems on Deterministic PDA
11.	Problems on Chomsky normal form for CFG
12.	Problems on Turing Machines
13.	Problems on Turing Machines variants
14.	Revision

Suggested Learning Resources

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman: Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2011.

Reference Books:

1. John C Martin: Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.
2. Michael Sipser: Introduction to the Theory of Computation, 3rd Edition, Thompson Course Technology, Boston, MA and Cengage Learning India Pvt.Ltd., 2014.

Video Lectures (e-Resources):

1. https://a.impartus.com/ilc/#/course/81462/295

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Demonstrate the principal and construction of various representation of regular languages including finite automata and regular expressions. (PO-1,2, 3, PSO-2)
2. Prove the various closure and decision properties of regular languages. (PO-1,2, PSO-2)
3. Write CFGs and PDAs Corresponding to CFLS and demonstrate their equivalence. (PO-1,2, 3, POS-2)
4. Prove the various closure and decision properties of CFLs. (PO-1,2, PSO-2)
5. Demonstrate the principles and construction of Turing Machine and it's variants. (PO-1,2,3, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2
Quiz –II	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DATA COMMUNICATION AND NETWORKING	
Course Code: CS54	**Credits: 4:0:0**
Prerequisite: NIL	**Contact Hours: 60L+60S**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Unit I

Data Communications, Networks, Network Types, Network Models: TCP/IP Protocol Suite, The OSI Model.

Application Layer: The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, User-Server Interaction-Cookies, Web Caching, The Conditional GET. File Transfer- FTP: FTP Commands and Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Access Protocols. DNS—The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages, Peer-to Peer Applications: P2P File Distribution.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105082
- Lab Component / Practical Topics: Wireshark Exercise on HTTP

Unit II

Transport layer: Multiplexing and Demultiplexing, Connectionless Transport-UDP: UDP Segment Structure, UDP Checksum, Go-Back-N, Selective Repeat, Connection-Oriented Transport-TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, TCP congestion control.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105082
- Lab Component / Practical Topics: Socket Programming

Unit III

Network Layer: Internet Protocol Version 4: IPv4 Addressing, Main and Auxiliary protocols,

Routing Algorithms: Distance-Vector (DV) Routing, Link-State Routing, Unicast Routing Protocols: Internet Structure, Routing Information Protocol, Open Shortest Path First.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- Lab Component / Practical Topics: Wireshark Exercise on IP, ICMP, DHCP

Unit IV

Data-Link Control: Framing: Character-Oriented Framing, Bit-Oriented Framing. Error Control: Types of Errors, Block Coding: Error Detection, Hamming Distance, Linear Block Codes: Parity-

Check Code. Cyclic Codes: Cyclic Redundancy Check, Point-to-Point Protocol, Media Access Control – Random Access- CSMA, CSMA/CD, CSMA/CA, Controlled access.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- Lab Component / Practical Topics: Error detection and correction using CRC and Hamming Code.

Unit V

Local Area Network: Ethernet: Standard Ethernet, WIFI, IEEE 802.11 project- architecture, MAC sub layer, addressing mechanism.

Physical layer: Signals - Analog signals, Digital signals. Signal Impairment -Attenuation and Amplification, Distortion, Data Rate Limits, Performance. Digital Transmission - Digital-to-Digital Conversion, Analog-to-Digital Conversion. Analog Transmission- Digital-to-Analog Conversion, Analog-to-Analog Conversion. Multiplexing: Frequency-Division Multiplexing, Time-Division Multiplexing.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- Lab Component / Practical Topics: Multiplexing concepts.

Suggested Learning Resources

Text Books:

1. Data Communications and Networking with TCP/IP Protocol Suite, Behrouz A. Forouzan, McGraw Hill, 6th Edition, 2021.
2. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 8th edition, Addison-Wesley, 2021.

Reference Books:

1. Data and Computer Communication, William Stallings, 10th Edition, Pearson Education, 2017.
2. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
3. Tanenbaum: Computer Networks, 4th Ed, Pearson Education/PHI, 2018.

Video Lectures (e-Resources):

- https://a.impartus.com/ilc/#/course/132166/636

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Describe the fundamentals of data communications and various application layer protocols used by TCP/IP reference model. (PO-1, 2, 3, 4, 10, PSO-1)
2. Differentiate between connection oriented and connection less services of transport layer (PO-1, 2, 3,4, 10, PSO-1)
3. Solve problems of IP addressing and routing using various routing protocols and algorithms. (PO-1, 2, 3, 4, 10, PSO-1)
4. Illustrate error control and media access control protocols of data link layer (PO-1, 2, 3, 4, 10, PSO-1)
5. Discuss different types of data transmission techniques. (PO-1, 2, 3, 4, 10, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

SECURE PROGRAMMING	
Course Code: CSE551	**Credits: 2:0:1**
Prerequisite: C Programming	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Shilpa Chaudri	

Course Contents

Unit I

The Software Security Problem - Security Features vs Secure Software; Secure SDLC; Common Software Vulnerabilities; OWASP Top 10 Overview; Vulnerability Classification, Secure Design Principles Introduction to Static Analysis -Capabilities and Limitations of Static Analysis; Solving Problems with Static Analysis, *Analyzing the Source vs. Analyzing Compiled Code*Performing a Code Review, Adding Security Review to an Existing Development Process, Static Analysis Metrics

- Pedagogy / Course delivery tools: PPT, Videos, Examples from CVE database
- Lab Component / Practical Topics: Use static analyzers (e.g., cppcheck, SonarQube) to scan sample C programs
  Link: NPTEL - Secure Programming.

Unit II

Input Validation and Secure Coding Practices - What to Validate, Validate All Input, Validate Input from All Sources, Establish Trust Boundaries, Strong Input Validation, Whitelisting vs Blacklisting, Input Length Validation, Numeric Bounds Checking, Parameterized Requests, Path Manipulation Vulnerabilities, Command Injection, Log Forging

- Pedagogy / Course delivery tools: Case-based code review, instructor-led examples
- Lab Component / Practical Topics: Conduct security review using GitHub PRs, generate SARIF reports
- Link: OWASP Secure Code Review Guide.

Unit III

Memory Safety, Integer Security and Error Handling - Introduction to Buffer Overflow, Exploiting Buffer Overflow Vulnerabilities, Buffer Allocation Strategies, Tracking Buffer Sizes, Dangerous String Functions, Bounded String Operations, Format String Vulnerabilities, Character Encoding Issues.Integer Overflow, Wrap-Around Errors, Truncation and Sign Extension, Signed and Unsigned Conversion, Detection and Prevention Techniques, Runtime Protection Mechanisms, Safer Programming Languages, Handling Errors with Return Codes, Exception Management, Resource Leak Prevention, Logging and Debugging Security, Secure Error Reporting.

- Pedagogy / Course delivery tools: PPT + Live attack demos
- Lab Component / Practical Topics: Write secure input handlers, reproduce buffer overflows and fix them
- Link: MITRE CWE Examples

Unit IV

Web Application and Service Security- Web Applications, Input and Output Validation for the Web, Browser Security Assumptions, Protecting Browsers from Malicious Content, HTTP Security Considerations, GET vs POST, Request Ordering, Request Provenance, Session Management, Session Identifiers, Session Timeout, Session Authentication, XML Security, Standards-Compliant XML Parsing, XML Validation, External References, Secure Document Queries, Web Service Security, WSDL Security Concerns, JavaScript Hijacking.

- Pedagogy / Course delivery tools: Hands-on error-based code walkthroughs
- Lab Component / Practical Topics: Add structured error handling and logging to C code
- **Link**: CERT C Standards

Unit V

Privacy, Secrets, Privilege and Secure Code Review - Privacy and Secrets, Privacy and Regulatory Considerations, Identifying Private Information, Handling Sensitive Data, Password Management, Secure Password Storage, Random Number Generation, Cryptographic Algorithms, Secure Handling of Secrets in Memory,Principle of Least Privilege, Managing Privileges, Filesystem Privileges, Privilege Escalation Attacks, Race Conditions, Insecure Temporary Files, Command Injection in Privileged Programs,Manual Source Code Auditing, Running Static Analysis Tools, Understanding Analysis Results, Auditing Security Issues.

- Pedagogy / Course delivery tools: OWASP case studies, MITRE ATT&CK mapping
- Lab Component / Practical Topics: Exploit and fix common OWASP vulnerabilities using DVWA or Juice Shop
- **Link**: OWASP Top 10 - 2023

Text Books:

1. Chess, B and West, J, Secure Programming with Static Analysis, Addison-Wesley, 2007
2. Frank Hissen “Secure Programming of Web Applications”, 2019
3. TamaghnaBasu Secure Programming with Python – 31 January 2017
4. McGraw, G., Viega, J. (2011). Building Secure Software: How to Avoid Security Problems the Right Way. Addison-Wesley.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Comprehend software security principles, vulnerabilities, Secure SDLC, static analysis, and secure code review practices (PO-1,2,3, PSO -1,3)
2. Apply secure input validation techniques and prevent common injection-based attacks (PO-1,2,3, PSO -1,3)
3. Analyze and mitigate memory, integer, and error-handling vulnerabilities in software systems. (PO-1,2,3, PSO -1,3)
4. Design secure web applications and web services using appropriate security mechanisms (PO-1,2,3, PSO -1,3)
5. Protect sensitive data, manage privileges securely, and perform secure code auditing using security analysis tools. (PO-1,2,3, PSO -1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 & CO3
Quiz –II/Project Implementation	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

COMPUTER GRAPHICS AND VIRTUAL REALITY	
Course Code: CSE552	**Credits: 2:0:1**
Prerequisite: Data Structures	**Contact Hours: 30L+15L+30S**
Course Coordinator: Dr. Seema S	

Course Contents

Unit I

Introduction: Applications of computer graphics, A graphics system, Images: Physical and synthetic, Imaging Systems, The synthetic camera model, The programmer's interface, Graphics architectures, Programmable Pipelines.

Graphics Programming: Programming two-dimensional applications, OpenGL application programming interface, Primitives and attributes, color, viewing, control functions, the gasket program, polygons and recursions, the three dimensional gasket, adding interactions, menus.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical: Topics Implementation of primitives with different color
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs178

Unit II

Geometric Objects and Transformations: Frames in OpenGL, Modeling a Colored Cube, Affine Transformations, Rotation, Translation and Scaling, Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGL Transformation Matrices.

From Vertices to Fragments: Basic Implementation Strategies, Four major tasks, Clipping,Line-segment clipping,

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Implementation of different transformations and line clipping
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs178

Unit III

Polygon clipping, Clipping of other primitives. Clipping in three dimensions, Rasterization, Bresenham's algorithm, Polygon Rasterization, Hidden-surface removal

Lighting and Shading: Light and Matter, Light sources, The Phong reflection model, Polygon shading, Light sources in OpenGL, specifying lighting parameters, Implementing a lighting model

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos
- Lab Component / Practical Topics: Implement polygon clipping, lighting and shading
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs178

Unit IV

Viewing: Classical and computer viewing, Viewing with a Computer, Positioning of the camera, Parallel Projections, Perspective projections, Perspective Projections with OpenGL, Perspective projection matrices.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, videos

- Lab Component / Practical Topics: Demonstration of Projection Types.
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs178

Unit V

Introduction to virtual reality: Classical components and design of a VR system, important factors in a VR system, types, advantages, VR input devices, graphics display interfaces, sound display and interface, haptic feedback, graphical rendering pipeline. applications of VR.

Object Modelling and Computer Architecture for Virtual reality: Modelling techniques in VR, PC graphics architecture and accelerators, distributed VR environment, Programming through VRML.

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation,videos
- Lab Component /Practical Topics: Demonstration of VRML
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs178

Laboratory Sessions

(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Drawing basic shapes using openGL primitives
2.	2D and 3D Sierpinski Gasket
3.	Interaction using mouse and keyboard
4.	Menu based program
5.	Line-segment clipping
6.	Brenham's line drawing algorithm
7.	Transformation of primitives
8.	Draw Color cube and allow the user to move the camera suitably to experiment with perspective viewing
9.	Double Buffering
10.	Lighting and shading
11.	VRML demonstration
12.	VRML based exercises

Text Books:

1. Edward Angel and Dave Shreiner: Interactive Computer Graphics - A Top-Down Approach with Shader-based OpenGL, 7th Edition, Pearson Education, 2014.
2. Rajesh K Maurya, Computer Graphics with Virtual Reality Systems, Second Edition, Wiley, 2014.

Reference Books:

1. Donald Hearn and Pauline Baker: Computer Graphics with OpenGL, 3rd Edition, Pearson Education, 2011.
2. F.S. Hill Jr.: Computer Graphics Using OpenGL, 3rd Edition, Pearson Education, 2009.

3. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes: Computer Graphics, 2nd Edition, Pearson Education, 2011

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Illustrate the concepts of graphics system architecture and OpenGL programming (PO-1, 2, 5,11, PSO-2)
2. Apply the geometrical transformations used in interactive computer graphics in different coordinate systems. (PO-1,2, 5,11, PSO-2)
3. Implement the different algorithms for clipping and rasterization of lines and polygons, and for hidden surface removal. (PO-1, 2, 5,11, PSO-2)
4. Demonstrate the geometrical transformations used in viewing and projection. (PO-1, 2, 5,11, PSO-2)
5. Appraise the hardware and software used in Virtual Reality Systems. (PO-2, 3, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Practical lab record	10	CO1,CO2, CO3, CO4 & CO5
Practical test	10	CO1,CO2, CO3, CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Practical Lab Record +Marks scored in Practical Test		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

ADVANCED ALGORITHMS	
Course Code: CSE554	**Credits: 2:1:0**
Prerequisite: Design and Analysis of Algorithms	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr Sangeetha J / Mamatha A	

Course Contents

Unit I

Characterizing Running Times: O-notation, ∧-notation, and ∪-notation, Asymptotic notations: formal definitions, Standard notations and common functions. **Recurrences and Solution of Recurrence equations**: The Substitution method, The recurrence – tree method, The master method. **Amortized Analysis**: Aggregate, Accounting and Potential Methods. (T1: Chapter 3,4.3 to 4.5, 16.1 to 16.3)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://nptel.ac.in/courses/106105164
  https://nptel.ac.in/courses/106104019

Unit II

Graph Algorithms: Bellman-Ford Algorithm, Single source shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Maximum bipartite matching (T1: Chapter 22.1, 22.2, 23.3, 24.3) **Trees:** B-trees, Red- Black trees. (T1 : Chapter 13,18). **Hashing:** General Idea, Hash Function, Separate Chaining, Hash Table without Linked Lists, Rehashing, Extendible hashing.(T2 : Chapter 5.1 to 5.5, 5.9)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link: https://nptel.ac.in/courses/106105164,
  https://nptel.ac.in/courses/106104019

Unit III

Number – Theoretic Algorithms: Elementary notations, GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem. (T1: Chapter 31.1 to 31.7) **Priority Queues (Heaps):** Binary Heap, Applications of Priority Queues, d-Heaps, Leftist Heaps, Skew Heaps (T2: Chapter 6.3 to 6.7)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link: https://nptel.ac.in/courses/106105164
  https://nptel.ac.in/courses/106104019

Unit IV

String Matching Algorithms: Naïve string matching, Rabin – Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm (T1: Chapter 32.1 to 32.4)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link : https://nptel.ac.in/courses/106104019

Unit V

Algorithmic Puzzles: Magic Square, n-queen's problem, Glove Selection, Ferrying Soldiers, Jigsaw Puzzle Assembly, A Stack of Fake Coins, Maximum Sum Descent, Hats of Two Colors, Pluses and Minuses, searching for a Pattern, Locker Doors, Palindrome Counting, inverting a Coin Triangle, Sorting 5 in 7. (T3- Mentioned Puzzles)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link : https://nptel.ac.in/courses/106104019

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Problems on Recurrences Solving using Substitution and recurrence tree method
2.	Problems on Recurrences Solving using master method
3.	Problems on Bellman-Ford Algorithm, Single source shortest paths in a DAG
4.	Problems on Johnson's Algorithm for sparse graphs, Maximum bipartite matching
5.	Problems on B-Trees
6.	Problems on Red Black Trees
7.	Problems on Hashing
8.	Problems on Chinese remainder theorem
9.	Problems on RSA
10.	Problems on Rabin – Karp algorithm
11.	Problems on String matching with finite automata
12.	Problems on Knuth-Morris-Pratt algorithm
13.	Problems on Algorithmic Puzzles
14.	Revision

Text Books:

1. T H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 4/e, PHI, 2022.
2. Mark Allen Weiss: Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson Education, 2014.
3. AnanyLevitin and Maria Levitin: Algorithmic Puzzle, Oxford University Press, 2011.

Reference Books:

1. Ellis Horowitz, SartajSahni, S Rajasekharan: Fundamentals of Computer Algorithms, University Press, 2007.

2. Alfred V Aho, John E Hopcroft, J D Ullman: The Design and Analysis of Computer Algorithms, Pearson Education, 2011.

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Devise recurrence relations and amortized cost of various operations. (PO- 1,2,4, PSO- 1,2)
2. Illustrate graph algorithms such as Bellman-Ford, Shortest path, and bipartite matching, B-trees, Red-Black trees and hashing techniques. (PO- 1,2,3, PSO-1,2)
3. Identify the methods for solving modular linear equations, Chinese remainder theorem and RSA cryptosystem, Describe the types of heaps such as Binary Heap, d-heaps, Leftist and skew heaps. (PO-1,6,9,10, PSO-1,2)
4. Assess the string-matching algorithms such as Rabin – Karp and Knuth- Morris-Pratt algorithm. (PO-1,2,3,6,9,10, PSO-1,2)
5. Create mathematical models, objective functions and constraints to solve algorithmic puzzles. (PO-1,2,4,9,10,11, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study/ Implementation and Analysis of Real World Algorithms/Applications	20	CO1, CO2, CO3, CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study/Demonstration		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

OBJECT ORIENTED ANALYSIS AND DESIGN	
Course Code: CSE556	**Credits: 2:0:1**
Prerequisite: Programming in an OO language	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. J Geetha	

Course Contents

Unit I

Introduction and Object Basics: An overview of object-oriented systems development - why object orientation? Object basics – objects, objects grouped in classes, object state and properties, object behavior and methods, object responds to messages, encapsulation and information hiding, class hierarchy, polymorphism. Object relationships and associations, aggregation and object containment. Object-oriented systems development life cycle – the software development process, building high-quality software, object oriented systems development - use-case driven approach. Case study – a small worked example illustrating objects, responsibilities and collaboration.

- Self-study: Case study – a small worked example illustrating objects, responsibilities and collaboration.
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Identify objects, classes, attributes, methods, and object relationships from real-world problem scenarios and implement basic object-oriented concepts.

Unit II

Modelling and UML: Static and dynamic models, Why modelling?, Introduction to the Unified Modeling Language, UML Diagrams, UML class diagram – Class notation, Object diagram, class interface notation, Binary Association notation, Association role, Qualifier, Multiplicity, OR Association, Association class, N-Array Association, Aggregation and Composition, Generalization, Use-case diagrams, UML Dynamic modelling – UML interaction Diagrams, UML state chart diagrams, UML Activity diagram, Implementation diagrams. Model management – Packages and Model organization, UML extensibility, UML meta model.

- Self study: Model management – Packages and Model organization, UML extensibility, UML meta model.
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Develop UML models (Use Case, Class, Sequence, Activity, and State diagrams) for a given software system using a UML modelling tool

Unit III

Object-Oriented Analysis – Identifying Use Cases.Why analysis is a difficult activity?

Business object analysis, use-case driven object-oriented analysis, business process modelling, the use-case model- Use cases under the microscope, Users and extends associations, Identifying the Actors, Guidelines for finding the Use cases. Developing effective documentation. **Object-Oriented Analysis Classification** - Classification theory and approaches for identifying classes – noun-phrase approach, use-case driven approach: Identifying classes and their behavior through sequence/collaboration modelling, Identifying object relationships, attributes and methods – Associations, Super-sub class relationships, a-part-of relationships Aggregation. Case study: Relationship Analysis for the ViaNet Bank ATM System

- Self Study: Case study - Relationship Analysis for the ViaNet Bank ATM System
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Perform object-oriented analysis by identifying use cases, classes, CRC cards, attributes, methods, and relationships for a case study

Unit IV

Object-Oriented Design and Design Principles: The Object-Oriented Design Process, Object-Oriented Design Axioms, Corollaries - Corollary 1: Uncoupled Design with Less Information Content, Coupling, Cohesion, Corollary 2: Single Purpose, Corollary 3: Large Number of Simpler Classes, Reusability, Corollary 4: Strong Mapping, Corollary 5: Standardization, Corollary 6: Designing with Inheritance, Achieving Multiple Inheritance via Single Inheritance System, Avoiding Inheriting Inappropriate Behaviors. Designing Classes: The Process, Class Visibility: Designing Well-Defined Public, Private, and Protected Protocols - Private and Protected Protocol Layers: Internal, Public Protocol Layer: External, Designing Classes: Refining Attributes - Attribute Types, UML Attribute Presentation, Designing Methods and Protocols - Design Issues: Avoiding Design Pitfalls, UML Operation Presentation. Case study – Designing methods for the ViaNet bank objects

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- Self Study: Case study – Designing methods for the ViaNet bank objects.
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Design and implement object-oriented software by applying SOLID principles, design heuristics, and mapping UML designs to code.

Unit V

Design Patterns.: What is a Design pattern? Describing design patterns, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern. Creational patterns – Factory Method, Abstract Factory, Singleton. Structural patterns – Adapter, Decorator, Composite, Facade. Behavioral patterns – Strategy, Observer, Command, Template Method. Patterns and software architecture, an introduction to architectural patterns (Layers, Model-View-Controller), and applying patterns to refactor the ViaNet / parking-lot design.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement and evaluate creational, structural, and behavioural design patterns in object-oriented applications.

Text Books:

1. Ali Bahrami, Object-Oriented Systems Development, McGraw-Hill, 2nd Edition. ISBN-13: 978-0070265127.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley. ISBN: 0201633612.
3. Sandi Metz, Practical Object-Oriented Design (POODR), 2nd Edition, Addison-Wesley. ISBN-13: 978-0134456478.
4. Martin Fowler, UML Distilled, 3rd Edition, Addison-Wesley. ISBN-13: 978-0321193681.
5. Craig Larman, Applying UML and Patterns, 3rd Edition, Prentice Hall. ISBN-13: 978-0131489066.
6. David J. Barnes & Michael Kölling, Objects First with Java, A Practical Introduction using BlueJ, 5th Edition, Pearson. ISBN: 978-0132492669.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Explain object-oriented concepts and the object-oriented software development life cycle. (PO-1,2, PSO-1)
2. Analyze software requirements and develop UML models using standard notation. (PO-1,2,3,5, PSO-1,2)
3. Design object-oriented systems using UML and design heuristics. (PO-1,2,3,5, PSO-1,2)
4. Apply object-oriented design patterns to develop reusable software solutions. (PO-1,2,3,5, PSO-1,2)
5. Implement object-oriented designs by mapping UML models to program code. (PO-1,2,3,5, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study Analysis and UML Documentation	10	CO1, CO2 & CO3
Design Pattern Implementation	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study Analysis and UML Documentation +Marks scored in Design Pattern Implementation		
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4 & CO5

Big Data Analytics	
Course Code: CSE557	**Credits: 2:0:1**
Prerequisite: Java and Python Programming	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

Unit I

Introduction to Big Data Analytics: Classification of Digital Data, Characteristics and Evolution of Big Data, Definition of Big Data, Challenges with Big Data. What is Big Data and Other Characteristics of Data. Why Big Data, Traditional Business Intelligence (BI) versus Big Data. Introduction Big Data Analytics**:** What is Big Data Analytics, Classification of Analytics, Top Challenges Facing Big Data, why is Big Data Analytics Important? Data Science, Data Scientist responsibilities, Terminologies Used in Big Data Environments.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Explore and analyse real-world big data datasets using Python to understand the characteristics and challenges of Big Data.
- Link: https://nptel.ac.in/courses/106104189

Unit II

Data Analytics with Hadoop: Basics of Hadoop: Data! Data Storage and Analysis, Data Format, Analyzing the Data with Hadoop, Data Flow. The Hadoop Distributed File System: The Design of HDFS, HDFS Concepts, Data Flow - Anatomy of a File Read - Anatomy of a File Write. Developing a MapReduce Application: MapReduce Workflows, writing a Unit Test, Anatomy of a MapReduce Job Run, Classic MapReduce (MapReduce 1), YARN (MapReduce 2), Failures, Job Scheduling, Shuffle and Sort

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Perform CRUD operations, indexing, querying, aggregation, and basic replication/sharding using MongoDB.
- Link: https://nptel.ac.in/courses/106104189

Unit III

Apache Spark Overview: Architecture and Installation: architecture overview, Installing Apache Spark, writing your first Spark program, Apache Spark cluster manager types, Running Spark examples. Transformations and Actions with Spark RDDs: What is an RDD, Constructing RDDs, Operations on RDD (Transformations, Actions), Passing functions to Spark (Scala, passing functions to Spark (Java), Passing functions to Spark (Python), Transformations, Set operations in Spark, Actions, Pair RDD's: Transformations and Actions, Partitioning, Accumulators, Broadcast Variables.

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- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Develop and execute MapReduce programs using Hadoop and HDFS for distributed data processing.
- Link: https://nptel.ac.in/courses/106104189

Unit IV

Machine Learning with Spark: What is machine learning? Why machine learning? Types of machine learning. Introduction to Spark MLLib: Need for pipeline API, Scala syntax for building pipeline, Predictions on test documents, Feature engineering, Feature transformation algorithms, Feature selection algorithms, Classification and regression, Clustering, Collaborative filtering, ML-tuning - model selection and hyperparameter tuning

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Spark applications using RDD transformations, actions, accumulators, and broadcast variables..
- Link: https://nptel.ac.in/courses/106104189

Unit V

Snowflake Architecture Overview: Traditional Data Platform Architectures, The Snowflake Architecture, The Cloud Services Layer, The Query Processing (Virtual Warehouse) Compute Layer, Virtual Warehouse Size, Creating and Using Virtual Warehouses, Centralized (Hybrid Columnar) Database Storage Layer. **Creating and Managing Snowflake Securable Database Objects:** Creating and Managing Snowflake Databases, Creating and Managing Snowflake Schemas, Introduction to Snowflake Tables, Creating and Managing Views, Extending SQL with Stored Procedures and UDFs, Introduction to Pipes, Streams, and Sequences.

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- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Develop and evaluate machine learning models using Spark MLlib for classification, regression, clustering, and model tuning.
- Link: https://nptel.ac.in/courses/106104189

Text Books:

1. Seema Acharya and Subhashini C, **Big Data and Analytics**, Wiley India, 2019
2. Tom White, "**Hadoop: The Definitive Guide**", Third Edition, O'Reilley, 2012.
3. Muhammad Asif Abbasi, Learning Apache Spark 2, Packt Publishing, 2017
4. J. K. Avila, Snowflake: The Definitive Guide. Sebastopol, CA, USA: O'Reilly Media, 2022

Reference Book:

1. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4. Alan Gates, "Programming Pig", O'Reilley, 2011

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Explain the concepts, characteristics, challenges, and applications of Big Data Analytics (PO-1, 2, 3, PSO-1,2)
2. Analyze the Hadoop ecosystem, HDFS architecture, and develop MapReduce applications for distributed data processing (PO-1, 2, 3,5,10, PSO-1,2)
3. Apply Apache Spark programming concepts using RDDs, transformations, actions, and cluster management for large-scale data processing (PO-1, 2, 3,5,10, PSO-1,2)
4. Develop machine learning pipelines using Spark MLlib by applying feature engineering, classification, regression, clustering, and model tuning techniques (PO-1, 2, 3,5,10, PSO-1,2)
5. Understand the Snowflake architecture and create and manage databases for data storage and processing. (PO-1, 2, 3, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Dataset Analysis Case Study	10	CO1, CO2 & CO3
Big Data Implementation (Hadoop/Spark/MongoDB)	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Dataset Analysis Case Study +Marks scored in Big Data Implementation (Hadoop/Spark/MongoDB)		
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4 & CO5

DATA COMMUNICATION AND NETWORKING LABORATORY	
Course Code: CSL56	**Credits: 0:0:1**
Prerequisite: Data Communication and Networking Course	**Contact Hours: 15P**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Sl. No.	Topics Covered
1.	Compilation/installations of tools like NS3, Wireshark, etc
2.	Study of TCP/IP Protocol Suite using Network Utilities
3.	HTTP, DNS and TCP Packet Analysis
4.	Analysis of DHCP, ARP and ICMP Protocols
5.	TCP Client–Server Communication using Socket Programming
6.	UDP Client–Server Communication using Socket Programming
7.	IPv4 Addressing, Subnetting and Static Routing
8.	Dynamic Routing using RIP and OSPF
9.	Ethernet Switching, VLAN and Inter-VLAN Routing
10.	Error Detection and Correction using CRC and Hamming Code
11.	Performance Analysis under Different Traffic Loads of TCP and UDP Networks
12.	Congestion Control and Throughput Analysis
13.	Wi-Fi Performance Measurement and Analysis

Suggested Learning Resources

Reference Books/ Web Links:

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 5th edition, Addison- Wesley, 2009.
2. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: Unix Network programming, The sockets networking API, Addison-Wesley Professional, 2004
3. Wireshark, “Wireshark”, 2021 https://www.wireshark.org/
4. Ns-3, “ns-3manual,” 2022
1. https://www.nsnam.org/docs/manual/html/index.html

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Analyse the performance of various application layer protocols using packet sniffer and packet analyser. (PO-1, 2, 3, 4, 5, PSO-1)
2. Develop an understanding of computer networking basics using programming languages like C/C++/Java / Python. (PO-1, 2, 3, 4, 5, PSO-1)
3. Design and simulate the network scenarios using NS3. (PO-1, 2, 3, 4, 5, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

Full Stack Development Lab	
Course Code: CSL57	**Credits: 0:0:1**
Prerequisite: Programming	**Contact Hours: 15P**
Course Coordinator: Dr. J Geetha	

Course Contents

There shall be a minimum of 2 exercises conducted on each of the following topics:

1. HTML5
2. Advanced CSS
3. Java Script
4. Advanced java Script
5. Inheritance In java Script
6. Scopes and Closures
7. Develop a Server side programming using java Script : Node.Js
8. Implement CRUD Operation using MongoDB and Node.Js
9. Develop a Client Side Application using React
10. Implement MERN Stack.

Reference Books:

1. Web Application Design and Implementation: Apache 2, PHP5, MySQL, JavaScript, and Linux/UNIX Steven A. Gabarro, December 2006, ©2007, Wiley-IEEE Computer Society Press.
2. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016 3. KrasimirTsonev, "Node.js by Example Paperback", May 2015.
3. Web link for Angular4.0: https://angular.io/
4. Web link for Node.js : https://nodejs.org/en/
5. Web link for MongoDB: https://www.mongodb.com

Course Outcomes (COs):

At the end of the course students should be able to:

1. Develop interactive web pages using HTML5, CSS, and JavaScript. (PO-1,2,3,5,7, 8,9,10,11, PSO-2)
2. Build server-side applications and perform CRUD operations using Node.js and MongoDB. (PO-1,2,3,5,7, 8,9,10,11, PSO-3)
3. Create full stack applications using React and the MERN stack (PO-1,2,3,5,7, 8,9,10,11, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2, CO3
Lab Test-II	10	CO1, CO2, CO3
Weekly Evaluation-Lab Record/project Implementation	30	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of weekly evaluation +Project + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)	50	CO1, CO2, CO3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	
Course Code: AL58	**Credits: 3:0:0**
Prerequisite: NIL	**Contact Hours: 45L+45S**
Course Coordinator: -Veena G S	

Course Contents

Unit I

Research Methodology:

Introduction: Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Conceptualizing Research, Critical and Creative Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments, and Attributions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments. **Experimental Designs:** Introduction to Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit III

Method of Data Collection: Primary and Secondary Data Collection.

Sampling Design: Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design.**Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors, Level of Significance. Procedure for Hypothesis Testing: Mean, Variance, Proportions. Chi-square Test, Analysis of Variance (One Way ANOVA), and Covariance (ANOCOVA)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit IV

Intellectual Property Rights

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. TRIPS Agreement, Patent Cooperation Treaty (PCT). **Patents:** Brief history of Patents-Indian and Global Scenario, Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. Non Patentable Inventions. Rights Conferred to a Patentee, Basmati Rice Patent Case.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Unit V

Design: What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design. **Trademarks:** Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements, Types of Reliefs, Case Studies. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights, Case studies

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Text Books:

1. C. R Kothari, Gourav Garg, Research Methodology – Methods and Techniques. New Age International Publishers.
2. Dr. B L Wadehra – Law relating to Intellectual property. Universal Law Publishing Co.
3. Dipankar Deb, Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Possess the knowledge of research and conduct a literature review. (PO-8, PO-10, PO-12)
2. Apply the knowledge of research design and design of experiments. (PO-4, PO-8, PO 10, PO-12)
3. Analyse data collection methods, analysis, and sampling design. (PO-4, PO-8, PO-10, PO-12)
4. Understand the global and Indian scenarios of patents and patent applications. (PO-8, PO-10, PO-12)
5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs. (PO-8, PO-10, PO-12)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test – 1	30	CO1, CO2, CO3
Internal test – 2	30	CO4, CO5
The average of the two internal tests will be taken for 30 marks		
Other Components		
Assignment	10	CO1, CO2
Quiz	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

NOSQL	
Course Code: CSAEC59	**Credits: 1:0:0**
Pre – requisites: Fundamentals of Database Management Systems	**Contact Hours: 15L+15S**
Course Coordinator: Akshatha Kamath	

Course Content

Unit I

Introduction: Why NoSQL? The Value of Relational Databases, RDBMS vs NoSQL, CAP Theorem, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL. Introduction and CRUD Operations in MongoDB

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- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics- Install MongoDB and perform CRUD operations on document databases.
- Link:https://www.coursera.org/learn/introduction-to-nosql-databases.

Unit II

Key–Value Store Databases: Introduction to NoSQL and Key–Value Databases, Key–Value Data Model, Characteristics, Advantages, and Applications, Introduction to NoSQL and Key–Value Databases, Key–Value Data Model Characteristics, Advantages, and Applications, Redis Fundamentals: Introduction to Redis, Features and Architecture of Redis, Persistence, Replication, and Clustering Basics, Data Types in Redis, Redis Commands: Database Commands, Key Commands String, List, Set, Hash, and Sorted Set Commands, Key Expiration and TTL.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement key-value operations using Redis, including data types and key expiration (TTL).
- Link: https://redis.io/docs/latest/

Unit III

Cassandra Database Fundamentals and CQL: Cassandra: Architecture & Replication Factor Strategy, Features, Cassandra Keyspace: Create, Alter & Drop Keyspace in Cassandra. Cassandra Table — Create, Alter, Drop & Truncate. Cassandra Query Language (CQL): CQL Types, Numeric Data Types, Textual Data Types, Time and Identity Data Types, Other Simple Data Types, Collections, Tuples

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Create keyspaces and tables in Cassandra and perform CRUD operations using CQL
- Link: https://cassandra.apache.org/doc/latest/cassandra/architecture/overview.html

Unit IV

Neo4j Data Modeling and CQL Clauses: Data modeling in Neo4j, Neo4j CQL Read/Write Clauses: Set Clause, Delete Clause, Remove Clause, Foreach clause, Match clause, Where clause, Count Function, Order by clause, Limit, skip, String Functions, Aggregate Function.

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- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Model graph data and execute Cypher queries in Neo4j.
- Link: https://neo4j.com/docs/

Unit V

Graph Databases: Introduction, Features, Graph data in a relational database, querying graph data using MySQL, Neo4j in NoSQL space, Key-value stores, Column-family stores.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Develop a simple graph database application and compare NoSQL database models.
- Link: https://neo4j.com/docs/getting-started/graph-database/

Suggested Learning Resources

Textbooks:

1. Manu Sharma, "MongoDB Complete Guide", 1e, bpb publication, 2023.
2. Jeff Carpenter and Eben Hewitt, "Cassandra: The Definitive Guide", 3rd Edition, O'Reilly Media, Inc., April 2020.
3. Eric Redmond and Jim R. Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the Nosql Movement", O′Reilly; 1st edition, 2012.

References:

1. Kristina chodorow, "MongoDB: The Definitive Guide", 2e, O'REILLY, 2013.
2. Kyle Banker, Peter Bakkum, Shaun Verch, Doug Garrett and Tim Hawkins, "MongoDB in Action" by 2e, Manning publication, 2016.

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understand basics of NoSQL, MongoDB commands and queries. (PO-1,2,3,5 PSO-1,2)
2. Illustrate Cassandra architecture and differentiate between a storage structure, node. (PO- 1,2,3,5 PSO-1)
3. Apply Create, update and delete data from Cassandra using the Cassandra Query Language (CQL) (PO-1,2,3,5 PSO-1,2,3)
4. Understand the Graph Databases and query graph data using MySQL. (PO-6, PO-8)
5. Apply Create, update and delete data from Neo4j and Hive using Query Language. (PO-6, PO-8)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Case study	10	CO1, CO2, CO3
Assignment	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Assignment		
Semester End Examination (SEE)	50	CO1, CO2, CO3 CO4, CO5

PROMPT ENGINEERING	
Course Code: CSAEC510	**Credits: 1:0:0**
Pre – requisites: Basic Python programming and AI/ML concepts	**Contact Hours: 15L+15S**
Course Coordinator: Dr Geetha J/Brunda G	

Course Contents

Unit I

The Five Principles of Prompting: Overview of the Five Principles of Prompting, Give Direction, Specify Format, Provide Examples, Evaluate Quality, Divide Labor, **Introduction to Large Language Models for Text Generation:** What Are Text Generation Models?, Vector Representations: The Numerical Essence of Language, Transformer Architecture: Orchestrating Contextual Relationships, **Probabilistic Text Generation**: The Decision Mechanism.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement and compare the five principles of prompting for text generation using Large Language
- Models.Link : https://www.promptingguide.ai/

2.

Unit II

Standard Practices for Text Generation with ChatGPT: Generating Lists, hierarchical List Generation, When to Avoid Using Regular Expressions, Generating JSON, YAML, Filtering YAML Payloads, Diverse Format Generation with ChatGPT, Mock CSV Data, Explain It like I'm Five, Universal Translation Through LLMs, Ask for Context, Text Style Unbundling, Identifying the Desired Textual Features, Generating New Content with the Extracted Features, Extracting Specific Textual Features with LLMs, Chunking Text and Stratergies **Role Prompting**: Benefits of Role Prompting, Challenges of Role Prompting, When to Use Role Prompting, GPT Prompting Tactics, Avoiding Hallucinations with Reference.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement text generation techniques using ChatGPT, including role prompting, structured data generation, text chunking, translation, and hallucination reduction.
- Models.Link : https://www.promptingguide.ai/

Unit III

Advanced Techniques for Text Generation with LangChain: Introduction to LangChain, Environment Setup, Chat Models, Streaming Chat Models, LangChain Prompt Templates, LangChain Expression Language (LCEL), Using Prompt Template with Chat Models, OpenAI Function Calling, Parallel Function Calling, Function Calling in LangChain, Extracting Data with LangChain, Creating Few-Shot Prompt Templates, Fixed-Length Few-Shot Examples, Formatting the Examples, Selecting Few-Shot Examples by Length, Limitations with Few-Shot Examples, Saving and Loading LLM Prompts.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement LangChain-based prompt engineering using chat models, prompt templates, LCEL, function calling, data extraction, and few-shot prompting.

- Models.Link : https://www.promptingguide.ai/

Unit IV

Vector Databases with FAISS and Pinecone: Retrieval Augmented Generation (RAG), Introducing fEmbeddings, Document Loading, Memory Retrieval with FAISS, RAG with LangChain, Self-Querying, **Autonomous Agents with Memory and Tools:** Chain-of-Thought, Agents, Reason and Act (ReAct),Reason and Act Implementation, Using Tools, Using LLMs as an API (OpenAI Functions), Comparing OpenAI Functions and ReAct, Use Cases for OpenAI Functions, ReAct, Use Cases for ReAct, Agent Toolkits, Understanding and Using Memory, Long-Term Memory, Short-Term Memory, Memory in LangChain

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement RAG using FAISS/Pinecone and LangChain, and develop autonomous agents using ReAct, tools, function calling, and short-/long-term memory.
- Models.Link : https://www.promptingguide.ai/

Unit V

LangFuse / LangSmith and LLM Observability -LLM Observability: Need for monitoring, debugging, and evaluating LLM-powered applications in production. **Integrating LangFuse with LangChain:** Setup and configuration of LangFuse for tracing LangChain pipelines. Token consumption, response latency, and cost tracking with respect to token usage. LangFuse setup in labs; executing a LangChain request and tracing it through LangFuse, with the chain visualized end-to-end on the LangFuse dashboard.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Integrate LangFuse/LangSmith with LangChain for LLM tracing, monitoring, and evaluation.
- Models.Link : https://www.promptingguide.ai/

3.

Text Book:

1) Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, Published by O'Reilly Media, Inc. in 2024, ISBN: 9781098153434

Reference Books and Links:

- The Art of Prompt Engineering with Chatgpt: A Hands-On Guide: 3 (Learn AI Tools the Fun Way!) by Nathan Hunter published in 2023.
- Prompt Engineering: The Art of Asking Hardcover by Yaswanth Sai Palaghat in 2023.
- "Prompt Engineering Guide", https://www.promptingguide.ai/
- "Prompt Engineering", OpenAI, https://platform.openai.com/docs/guides/promptengineering/strategy-test-changes-systematically

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Identify and analyze the principles of prompt engineering and the fundamental mechanisms of large language models for text generation. (PO-1,2,4,5,11, PSO-2)
2. Construct and evaluate effective prompts using advanced prompting strategies for text generation, transformation, structured output, and hallucination mitigation. (PO-1,2,3,5,7,11, PSO-2,3)
3. Design and implement LLM-based applications using LangChain, incorporating prompt templates, LCEL, function calling, data extraction, and few-shot prompting. (PO-1,2,3,5,11, PSO-2,3)
4. Design and implement Retrieval-Augmented Generation and autonomous agent systems using vector databases, tools, function calling, and memory mechanisms. (PO-1,2,3,4,5,7,11, PSO-2,3)
5. Integrate and evaluate LLM observability frameworks with LangChain applications for tracing, monitoring, debugging, and optimization of token usage, latency, and cost. (PO-1,2,3,4,5,7,11, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Lab/Project Based Learning	20	CO1, CO2, CO3, CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Lab Component		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

ENVIRONMENTAL STUDIES	
Course Code: HS59	**Credits: 0:0:0**
Prerequisite: -	**Contact Hours: 14L**
Course Coordinator: -	

Course Content

Unit I

Environment, Ecology and Biodiversity

Definition, scope, and importance. Multidisciplinary nature of Environmental studies. Food chain and food web. Energy flow and material cycling in the ecosystem. Biodiversity and threats to biodiversity. Concept of sustainable development: Definition, objectives, and applications.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Models
- Link: https://youtu.be/I_bnGkviWOU
  https://youtu.be/Ar04qG1P8Es

Unit II

Natural resources

Forest resources: Ecological importance of forests. Water resources: Global water resources distribution. Mineral resources: Environmental effects of extracting and processing Mineral resources. Food resources: Effects of modern agriculture. Land resources: Soil erosion and Desertification.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/vsXv3anIBSU
  https://youtu.be/1rOVPqaUyv8

Unit III

Energy sources

Growing energy needs. Conventional and non-conventional / Renewable and Non-renewable energy sources. Bio Energy-Ethanol and Bio mass energy. Energy of the future – Hydrogen fuel cells and Nuclear energy. Environmental Impact Assessment (EIA): Definition, Objectives and benefits. Step by step procedure of conducting EIA.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Animations, Models
- Link: https://youtu.be/mh51mAUexK4
  https://youtu.be/XS-eXqppf_w

Unit IV

Environmental pollution

Definition, Causes, Effects and control measures of Water pollution, Air pollution and Soil/ land

pollution. Management of Municipal Solid Waste and treatment methods of municipal solid waste.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/NRoFvz8Ugeo
  https://youtu.be/DAQapF-F4Vw

Unit V

Environmental protection

Global warming and Climate change, Acid rain, Ozone layer depletion. Salient features of Environmental Protection Act, Air & Water Acts. Functions of Central and State Pollution Control Boards.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Open source softwares
- Link: https://youtu.be/iV-BvYwl4Y8

https://youtu.be/BYqLRGawoH0

Text Books:

1. Dr. S M Prakash – Environmental Studies, Elite Publishers, 2007.

Reference Books:

1. P. Venugopala Rao – Principles of Environmental Science & Engineering Prentice Hall of India, 1st edition, 2006.

Web links and video Lectures (e- Resources):

1. https://youtu.be/I_bnGkviWOU
2. https://youtu.be/vsXv3anIBSU
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/NRoFvz8Ugeo

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)
3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO4, CO5
Average of the two internal test shall be taken for 30 marks		

Other components		
Assignment – MCQ, Objectives	10	CO1, CO2
Assignment – Quiz, Group presentation	10	CO3, CO4
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

VI SEMESTER

MANAGEMENT & ENTREPRENEURSHIP	
Subject Code: AL61	**Credits: 3:0:0**
Pre requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinators: Dr. M Shilpa/ Dr. M Rajesh	

Course Content

Unit I

Introduction to Management: Definition of Management, Its nature and purpose, Contributions of F.W. Taylor and Henry Fayol to management theory, Functions of managers. **Planning:** Types of plans, Steps in planning, the planning process, Management by Objectives (MBO) **Organizing:** The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, Principle of span of management, the structure and process of organizing

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_mg33/preview
  https://www.digimat.in/nptel/courses/video/110107150/L01.html

Unit II

Staffing: Situational factors affecting staffing. **Leading:** Human factors in managing, definition of leadership, Ingredients of leadership **Controlling:** Basic control process, Critical control points and standards, Control as a feedback system, Feed forward control, Requirements for effective controls.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://nptel.ac.in/courses/110107150

Unit III

Introduction to Entrepreneurship: The Foundations of Entrepreneurship: What is an Entrepreneurship? The benefits of Entrepreneurship, The potential drawbacks of Entrepreneurship; Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation and Entrepreneurship, Creative Thinking, Barriers to Creativity

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.youtube.com/watch?v=Hgj_kRrvbhQ&list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb

Unit IV

The Entrepreneurial Journey: Crafting a Business Plan: The benefits of creating a business plan, the elements of a business plan; Forms of Business Ownership and Buying an Existing Business: Sole proprietorships and partnership. **Launching the Business:** Franchising and the Entrepreneur: Types of Franchising, the benefits of buying a Franchise

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M

8EGZbmNUuUM7Vh2GkdbB1R
https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PSm81k9U8NjaVJkR

Unit V

Small Scale Industry: Definition, Characteristics, types, role of SSI in Economic Development, steps to start SSI- Govt. Policy towards SSI, Institutional support- TECKSOK, KIADB, KSSIDC, KSIMC, DIC, NSIC, SIDBI, KSFC.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.nptel.ac.in/courses/110/105/110105067/

Text Books:

1. Harold Koontz, H. Weihrich, and A.R. Aryasri, Principles of Management, Tata McGraw-Hill, New Delhi, 2004.
2. Essentials of Entrepreneurship and Small Business Management – Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)
3. Management and Entrepreneurship by K. R. Phaneesh, Sudha Publications, Bangalore

References:

1. Innovation & Entrepreneurship – Peter Drucker (Harper, 2006)
2. Entrepreneurship: The Art, Science, and Process for Success – Charles Bamford & Garry Bruton (McGraw-Hill, 2015)
3. Managent and Enterpreneuship-NVR Naidu, T Krishna Rao, I.K. International Publishing House Pvt. Ltd.@ 2008
4. Poornima M Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2006.

Course Outcomes (COs):

At the end of the course, student will be able to

1. Plan and organize for the manpower in the given type of organization (PO-6,9,11)
2. Use staffing Leading and controlling functions for the given organization. (PO-6,8,9,10)
3. Analyze the advantages and potential drawbacks of Entrepreneurship. (PO-6,7,8)
4. Develop a basic business plan and analyze the benefits of buying Franchise. (PO-3,5,7,8,11)
5. Identify the various institutions that provide financial support to small scale industries. (PO-6,11)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30marks.		
Other components		

Quiz	10	CO1, CO2,CO3
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Cloud Computing and Microservices	
Course Code: CS62	**Credits: 3:1:0**
Prerequisite: Basic knowledge of programming, networking, Linux, databases, virtualization, REST, Git, containers, APIs, and web technologies	**Contact Hours: 45L+15T+45S**
Course Coordinator: Dr.J Geetha	

Course Contents

Unit I

Cloud Computing Foundations: Evolution and Characteristics of Cloud Computing, Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community, Virtualization: Hypervisors, Containers vs VMs, Introduction to major cloud platforms: AWS, Azure, GCP.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Create an EC2/VM instance, explore cloud dashboards, Compare VMs vs Containers
- Links: https://nptel.ac.in/courses/106105167

Unit II

Cloud Infrastructure and Services: Compute, Storage, and Networking in Cloud, Object Storage (S3/GCS), Block and File Storage, Load Balancers, Auto-scaling Serverless Computing (AWS Lambda, GCP Cloud Functions) Cloud Databases: RDS, DynamoDB, Firebase.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Upload/download data to S3/GCS, - Launch a serverless function (Lambda), Use Load Balancer & Auto-scaling demo
- Links: https://nptel.ac.in/courses/106105167

Unit III

Microservices Architecture Design: Monolithic vs Microservices Architecture, Principles of Microservices: SRP, Bounded Contexts, Domain-Driven Design, Inter-service Communication: REST, gRPC ,API Gateway, Service Discovery, Circuit Breaker Pattern Versioning and Service Contracts

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Create 2 RESTful microservices (e.g., product & order), Implement API Gateway using NGINX/Postman, Inter-service communication demo
- Links: https://docs.docker.com/get-started/

https://spring.io/microservices

Unit IV

Containers and Orchestration: Docker: Images, Containers, Volumes, Docker Compose,Kubernetes Basics: Pods, Deployments, Services, ConfigMaps Container Networking and Service Exposure,Cloud-native deployment using Kubernetes,Intro to Service Mesh and Sidecars.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Build Docker images, Use Docker Compose for multi-container apps, Deploy app on Minikube/K8s cluster
- Links: https://kubernetes.io/docs/tutorials/

Unit V

Cloud-Native Design and 12-Factor App: introduction to Cloud-Native Applications,12-Factor App Methodology: Best practices for building scalable, maintainable microservices,Stateless Processes, Config via Environment, Port Binding, Logs, Admin Tasks, Observability in Microservices: Logging, Monitoring, and Tracing, Case Studies: Netflix, Uber, Amazon Microservices Patterns,Cloud-Native Deployment and Dev/Prod Parity using Containers

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: - Implement 6 of the 12-Factor principles (env config, logs, port binding, etc.), - Monitor microservice using Prometheus + Grafana, - Use .env and logging best practices
- Links: https://12factor.net

Text Books:

1. Thomas, E., Zaigham, M., & Ricardo, P. (2013). Cloud computing concepts, technology & architecture
2. Newman, S. (2021). Building microservices: designing fine-grained systems. " O'Reilly Media, Inc
3. Domingus, J., & Arundel, J. (2022). Cloud Native DevOps with Kubernetes. " O'Reilly Media, Inc.
4. The Twelve-Factor App – https://12factor.net (Online Reference)

Reference Books/Links:

1. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw Fill, 2010.
2. Cloud Computing A hands - on approach – Arshdeep Bahga & Vijay madisetti Universities press.
3. https://docs.rightscale.com/cm/designers_guide/cm-cloud-computing-system-architecture-diagrams.html

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Explain cloud computing concepts, service models, deployment models, and virtualization technologies. (PO-1,2, PSO-1,2)
2. Apply cloud infrastructure services for compute, storage, networking, databases, and serverless applications. (PO-1,2,3,5, PSO-1,2)
3. Design microservices-based applications using REST APIs, API Gateway, and service communication principles. (PO-1,2,3,5, PSO-1,2)
4. Deploy containerized applications using Docker and Kubernetes in cloud-native environments. (PO-1,2,3,5, PSO-1,2)
5. Develop cloud-native applications by applying the 12-Factor App methodology and observability practices. (PO-1,2,3,5, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Cloud Deployment Case Study	10	CO1, CO2 & CO3
Cloud-Native Mini Project	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Cloud Deployment Case Study +Marks scored in Cloud-Native Mini Project		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 & CO5

Penetration Testing and Secure Programming Laboratory	
Course Code: CSL65	**Credits: 0:0:1**
Prerequisite: Nil	**Contact Hours: 15P**
Course Coordinator: Dr. J Geetha/ Dr. Sangeetha V	

Course Contents

List of problems for which student should develop program and execute in the Laboratory

- **Vulnerability Assessment and Penetration Testing Labs:**
- **Operating System Vulnerability Analysis: -**Assess vulnerabilities in common operating systems using tools like Nessus or OpenVAS.
- **Network Scanning: -**Perform network discovery using tools like NMAP, analyse open ports, and identify potential vulnerabilities.
- **Network Exploitation: -**Attempt to exploit identified vulnerabilities on network services, such as gaining unauthorized access to a vulnerable server.
- **Password Cracking, Ping Flood and Synflood Attacks.**
- **Database Vulnerability Assessment**: -Identify security weaknesses in databases such as MySQL or PostgreSQL using vulnerability assessment tools.
- **Web Application Vulnerability Scanning: -**Use automated web vulnerability scanners like Burp Suite or OWASP Zap to identify security flaws in web applications.
- **Web Application Penetration Testing: -**Manually exploit vulnerabilities like SQL injection, Cross-Site Scripting (XSS), and Cross-Site Request Forgery (CSRF) in web applications.
- **Social Engineering: -**Conduct various social engineering attacks, like impersonation, pretexting, and tailgating, to assess human vulnerabilities.
- **Phishing Simulation: -**Design and execute a phishing campaign to evaluate users' susceptibility to social engineering attacks.

Text Book:

1. Messier, Ric, CEH v11 Certified Ethical Hacker Study Guide + Practice Tests Set, 2nd Edition, November 2021, Wiley & Sons Ltd, ISBN: 978-1-119-82539-5

Course Outcomes (COs):

At the end of the course, student will be able to:

1. Learn techniques for maintaining access and pivoting within a compromised network (PO-1,2,3,5,6,7,8,12 PSO -1,2,3)
2. Perform network discovery using tools like NMAP, analyse open ports, and identify potential vulnerabilities. (PO -1,2,3,5,6,7,8,12 PSO- 1,2,3)
3. Conduct various social engineering attacks, like impersonation, pretexting, and tailgating, to assess human vulnerabilities (PO -1,2,3,5,6,7,8,12 PSO -1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2, CO3
Lab Test-II	10	CO1, CO2, CO3
Weekly Evaluation-Lab Record/project Implementation	30	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of weekly evaluation &Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)	50	CO1, CO2, CO3

Microservices and DevOps Lab	
Course Code: CSL66	**Credits: 0:0:1**
Prerequisite: Nil	**Contact Hours: 15P**
Course Coordinator: Dr.J Geetha	

Course Contents

Topic 1: Monolithic Decomposition & Multi-Stage Containerization

- **Microservices Concept:** Designing decoupled architecture boundaries (e.g., *User Service* vs. *Product Service*) and developing independent REST/gRPC APIs using frameworks like Node.js or Spring Boot.
- **DevOps Integration:** Writing optimized **Multi-Stage Dockerfiles** to build minimal, highly compressed production runtime images; mastering container layer optimization.

Topic 2: Declarative Infrastructure & Configuration Management

- **Microservices Concept:** Separating application environment configuration from base source code logic (adhering to the 12-Factor App methodology).
- **DevOps Integration:** Utilizing **Ansible Playbooks** or **Terraform scripts** to dynamically provision virtual machine configurations and runtime environmental dependencies automatically.

Topic 3: Multi-Container Networking & Isolated State Storage

- **Microservices Concept:** Implementing the "Database-per-Service" pattern (e.g., connecting a transactional service to PostgreSQL and an inventory service to MongoDB).
- **DevOps Integration:** Orchestrating complex local multi-container communication links, isolated back-end networks, and persistent storage volumes using **Docker Compose**.

Topic 4: Automated Continuous Integration (CI) & Testing Pipelines

- **Microservices Concept:** Ensuring code quality and preventing integration conflicts across distributed team repositories.
- **DevOps Integration:** Creating an automated pipeline workbook utilizing **GitHub Actions** or **Jenkins** to pull branches, auto-compile binaries, and run automated Unit/Integration test suites (JUnit/PyTest) on Git commit events.

Topic 5: Asynchronous Event-Driven Architectures & Message Brokers

- **Microservices Concept:** Decoupling long-running backend logic from client-facing requests by designing a publisher-subscriber model (e.g., *Order Service* publishing an event to process *Shippings* asynchronously).
- **DevOps Integration:** Deploying, configuring, and tuning distributed event-handling infrastructure like **Apache Kafka** or **RabbitMQ** inside your architecture layout.

Topic 6: Production Cluster Orchestration & Deployment Layouts

- **Microservices Concept:** Transitioning workloads from localized single-system setups to resilient, highly-scalable cluster infrastructures.
- **DevOps Integration:** Translating container states into standard **Kubernetes Manifest Declarations** (Pods, Deployments, Services, ConfigMaps) and initializing them onto local **Minikube** cluster ecosystems.

Topic 7: GitOps Continuous Delivery (CD) & Live Observability

- **Microservices Concept:** Centralizing logs, health telemetry, and performance metric tracing across distributed systems.
- **DevOps Integration:** Configuring declarative automated GitOps sync states using **ArgoCD**, alongside tracking system resource usage, requests per second, and performance errors using **Prometheus and Grafana** metric dashboards.

Note: Each Lab Session is of two hours' duration/week

Textbooks

1. Chris Richardson: Microservices Patterns: With examples in Java, First Edition, Manning Publications, 2018.
2. Len Bass, Ingo Weber, Liming Zhu: DevOps: A Software Architect's Perspective, First Edition, Addison-Wesley, 2015.
3. Dan C. Marinescu: Cloud Computing: Theory and Practice, Third Edition, Morgan Kaufmann / Elsevier, 2022.

Reference Books

4. Sam Newman: Building Microservices: Designing Fine-Grained Systems, Second Edition, O'Reilly Media, 2021.
5. Thiago Maior: The Cloud DevOps Engineer's Guide: Build, automate, and scale cloud-native CI/CD pipelines, First Edition, Packt Publishing, 2024.
6. Deepak Gaikwad, Viral Thakkar: DevOps Tools from a Practitioner's Viewpoint, First Edition, Wiley Publications, 2019.
7. Gaurav Agarwal: Modern DevOps Practices: Implement and secure DevOps in the public cloud, Second Edition, Packt Publishing, 2023.

Course Outcomes (COs):

At the end of the course students should be able to:

1. Design and implement isolated microservice architectures using domain-driven design, separate databases, and synchronous/asynchronous APIs. (PO-1,2,4, PSO- 2,3)
2. Automate application containerization and virtual environment workflows using multi-stage Dockerfiles and configuration scripts (PO-1,2,4, PSO- 2,3)
3. Build automated CI/CD deployment pipelines on local clusters using GitOps tracking and real-time observability dashboards. (PO-1,2,4, PSO- 2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2, CO3
Lab Test-II	10	CO1, CO2, CO3
Project	30	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of weekly evaluation &Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C)	50	CO1, CO2, CO3

INTRODUCTION TO DEEP LEARNING	
Course Code: CSE631	**Credits: 2:0:1**
Prerequisite: Machine Learning	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr J Sangeetha / Dr S Rajarajeswari	

Course Contents

Unit I

Introduction: What is a Neural Network? Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures. **Rosenblatt's Perceptron:** Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment, **Tensors**: Mathematical Foundations of Tensors, Tensor Operations and Computational Graphs.

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Perceptron and tensor operations using Python/TensorFlow or PyTorch.
- Link: https://nptel.ac.in/courses/106101215

Unit II

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Back Propagation and Differentiation.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Implement Perceptron and tensor operations using Python/TensorFlow or PyTorch
- Link: https://nptel.ac.in/courses/106101215

Unit III

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Dropout, Adversarial Training, Batch Normalization and Layer Noramlization . **Optimization for Training Deep Models:** Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions. Cliffs and Exploding Gradients, Basic Algorithms, Algorithms with Adaptive Learning Rates (Text Book 2 - Chapter 7 and Chapter 8)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Apply regularization techniques (Dropout, Batch Normalization, Early Stopping) and optimize deep learning models using different optimizers
- Link: https://nptel.ac.in/courses/106101215

Unit IV

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History

of Deep Learning, Conceptual overview of ResNet and Residual Connections.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Build and evaluate a Convolutional Neural Network (CNN) for image classification using TensorFlow or PyTorch.
- Link: https://nptel.ac.in/courses/106101215

Unit V

Sequence Modeling: Recurrent Nets: Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, The Long Short-Term Memory and Other Gated RNNs, **Transformers**: Architecture, self-attention, Multi-Head Attention, Positional encodings, Structural Overview of LLMs.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Lab Component / Practical Topics: Implement sequence models using RNN/LSTM and explore Transformer-based models for text or sequence prediction tasks.
- Link: https://nptel.ac.in/courses/106101215

Text Books:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Books:

1. Neural Networks and Deep Learning by Michael Nielsen
2. http://neuralnetworksanddeeplearning.com/

Video Lectures (e-Resources):

- https://a.impartus.com/ilc

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Illustrate the concepts and applications of neural networks and deep learning. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
2. Illustrate various types of learning work and its applications. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
3. Illustrate the Regularization and Optimization for Deep learning. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
4. Apply deep feed forward networks and convolutional to solve practical problems. (PO - 1, 2, 3, 4, 5, 10, 12, PSO – 2, 3)
5. Analyze sequence modeling architectures including recurrent neural networks, LSTMs,encoder-decoder models, Transformers, and the structural components of Large Language
   Models for sequence learning applications. (PO – 1, 2, 3, 4, 5, 10, 12; PSO – 2, 3).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study	10	CO1, CO2, CO3, CO4 and CO3
Report	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Report		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 and CO5

SOFTWARE DEFINED NETWORKS	
Course Code: CSE632	**Credits: 2:1:0**
Prerequisite: Data Communication Basics	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Shilpa Chaudri	

Course Contents

Unit I

How SDN Works - Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller- SDN controller core modules, SDN controller interfaces, Existing controller implementations, potential issues with the SDN Controller, SDN Applications, Alternate SDN Methods – SDN via APIs, Benefits and Limitations of SDN via APIs, SDN via hypervisor based overlay networks. **The Open Flow Specification** – Open Flow Overview – The Open Flow switch, The Open Flow Controller, The Open Flow protocol, The Controller-switch secure channel

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Installing Mininet on Ubuntu and windows Creating topologies in mininet

Unit II

Open Flow 1.0 and Open Flow Basics, Open Flow 1.1 Additions, Open Flow 1.2 Additions, Open Flow 1.3 Additions, Open Flow Limitations. Open flow 1.4 additions – Bundles, Eviction and vacancy events, enhanced support for multiple controller, optical port support, and flow table synchronization. OpenFlow 1.5 Additions -Enhanced L4–L7 Support, Pipeline Processing Enhancements, Egress Tables, Fitness for Carrier Use, Bundle Enhancements, Enhanced Support for Multiple Controllers, Enhanced Support for Tunnels, Enhancements to Flow Entry Statistics

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Using wireshark to see the contents of the open flow packets Using MiniEdit, Mininet's graphical user interface

Unit III

SDN Controllers- Introduction, General Concepts,VMware, Nicira, OpenFlow-Related, Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric, L3VPN, Path Computation Element Server, Plexxi, Plexxi Affinity, Cisco OnePK, Relationship to the Idealized SDN Framework.

Building an SDN Framework- Introduction, The Juniper SDN Framework, IETF SDN Framework(s), SDN(P), ABNO, Open Daylight Controller/Framework, API, High Availability and State Storage, Analytics, Policy

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Introduction to RYU Controller Implementing REST APIs

Unit IV

The Journey to Network Functions Virtualization (NFV) Era – NFV Architectural framework- Need for a framework, ETSI framework for NFV, understanding the ETSI framework, A closer look at ETSI's NFV framework, NFV framework summary, Benefits of NFV- Hardware flexibility, faster service life cycle, scalability and elasticity, leveraging existing tools, rapid development and vendor independence, validation of new solutions, amorphous service offering, operational efficiency and agility. **Virtualization of Network Functions**: Designing NFV Networks –NFV Design considerations, NFV transformation challenges, Virtualization of Network Infrastructure and Services – NFV for Routing infrastructure, virtualization of network security, virtualization of mobile communication networks

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Group Table implementation to perform specific actions on packets Collecting Packet Statistics from OpenFlow switch

Unit V

Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring - Introduction, Bandwidth Calendaring, Base Topology and Fundamental Concepts, OpenFlow and PCE Topologies, Example Configuration, OpenFlow Provisioned Example, Enhancing the Controller, Overlay Example Using PCE Provisioning, Expanding Your Reach: Barbarians at the Gate, Big Data and Application Hyper-Virtualization for Instant CSPF, Expanding Topology. **Use Cases for Data Center Overlays, Big Data, and Network Function Virtualization-** Introduction, Data Center Orchestration, Creating Tenant and Virtual Machine State, Forwarding State, Data-Driven Learning, Control-Plane Signaling, Scaling and Performance Considerations, Puppet (DevOps Solution), Network Function Virtualization - NFV in Mobility, Optimized Big Data

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Identifying different roles of Multicontrollers

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Installing Mininet on Ubuntu and windows
2.	Creating topologies in mininet
3.	Using wireshark to see the contents of the open flow packets
4.	Using MiniEdit, Mininet's graphical user interface
5.	Executing hub behaviour using pox controller
6.	Running a webserver in mininet
7.	Introduction to RYU Controller
8.	Implementing REST APIs
9.	Group Table implementation to perform specific actions on packets
10.	Collecting packet Statistics from OpenFlow switch
11.	Using Meter Tables to implement QoS
12.	Adding multiple actions for a flow using Flow Manager

Session No.	Topics Covered
13.	Discovering underlying Network Topology
14.	Identifying different role of Multicontrollers

Text Books:

1. Paul Goransson, Chuck Black, Timothy Culver: Software Defined Networks A Comprehensive Approach, Second Edition, Elsevier, 2014.
2. Thomas D.Nadeau & Ken Gray: SDN Software Defined Networks O'Reilly publishers, First edition, 2013.

Reference Books:

1. Chayapathi, Rajendra, Syed F. Hassan, and Paresh Shah. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1. Addison-Wesley Professional, 2016.

Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=CaukSKg_sI0
- https://www.youtube.com/watch?v=l3E-C1j-SJg
- https://nptel.ac.in/courses/106106243

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Identify the fundamental characteristics of SDN. (PO-1,3,4,9,11,12, PSO-2,3)
2. Compare the various OpenFlow specifications. (PO-1,3,4,9,11,12, PSO-2,3)
3. Illustrate implementation of SDN controllers and building of SDN framework. (PO-1,3,4,9,11,12, PSO-2,3)
4. Examine the NFV framework and Virtualization of Network Functions. (PO-1,3,4,9,11,12, PSO-2,3)
5. Illustrate use of SDN and NFV for bandwidth scheduling, data center orchestration and Network Access Control. (PO-1,3,4,9,11,12, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	C03, CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2 & CO3
Quiz –II	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

LINUX KERNEL PROGRAMMING	
Course Code: CSE633	**Credits: 2:0:1**
Prerequisite: Operating Systems	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Chandrika P	

Course Contents

Unit I

Introduction to the Linux Kernel- Obtaining the Kernel Source, The Kernel Source Tree, Building the Kernel. Debugging - Getting Started, Bugs in the Kernel, Debugging by Printing, Oops, Kernel Debugging Options. **Process Management** – process descriptor and task structure, process creation, The Linux Implementation of Threads, process termination.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Creating, adding, removing sample modules to Kernel
- Link: https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-linux/? v=c86ee0d9d7ed https://www.youtube.com/watch?v=aBh1DDiOMsI

Unit II

Process Scheduling – Multitasking, Linux's Process Scheduler, Policy, Linux scheduling algorithm, The Linux Scheduling Implementation, Preemption and Context Switching, Real-Time Scheduling Policies, Scheduler-Related System Calls.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Creating, adding, removing process related modules to Kernel
- Link: https://youtu.be/MkJfuI5_hjc

Unit III

Kernel Data Structures - What Data Structure to Use, When, **Interrupt Handlers** - Top Halves Versus Bottom Halves, Registering an Interrupt Handler. **Bottom Halves -** softirq, tasklets, Work Queues, The Timer Interrupt Handler.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Creating, adding, removing interrupt related activity modules to Kernel
- Links: https://www.youtube.com/watch?v=Y7z8vW__6cQ,

Unit IV

Memory Management – Pages, Zones, Getting Pages, kmalloc, vmalloc, slab layer, **The Process Address Space-** Address Spaces, memory descriptor. **The Page Cache-** Approaches to Caching.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Creating, adding, removing memory related activity modules to Kernel
- Links:https://www.udemy.com/course/memory-management-in-linux-kernel/?couponCode=NVDPRODIN35

Unit V

The Virtual Filesystem - Common Filesystem Interface, Filesystem Abstraction Layer, **Unix Filesystems**, **VFS Objects** and Their Data Structures, **The Superblock Object**, Superblock Operations, **The Inode** Object, Inode Operations, **The Dentry Object**, Dentry Operations, **Devices and Modules** - Device Types, modules.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Creating, adding, removing file system related activity modules to Kernel
- Links: https://trainingportal.linuxfoundation.org/courses/a-beginners-guide-to-linux-kernel-development-lfd103,https://www.youtube.com/watch?v=cnVoT1YNwnc

Text Books:

1. BILLIMORIA, Kaiwan N. Linux Kernel Programming: A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization. Packt Publishing Ltd, 2021.
2. BHARADWAJ, Raghu. Mastering Linux Kernel Development: A kernel developer's reference manual. Packt Publishing Ltd, 2017.
3. Robert Love, Linux kernel development, 3rd edition, 2010.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Examine the kernel components for building kernel image from kernel source (PO-1,2,3, PSO-2,3)
2. Implement kernel process and CPU scheduling to observe the process management (PO-1,2,3, PSO-2,3)
3. Design the interrupt handler considering kernel synchronization (PO-1,2,3, PSO-2,3)
4. Demonstrate memory management at kernel level (PO-1,2,3, PSO-2,3)
5. Apply device driver as kernel module (PO-1,2,3, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Project	20	CO1, CO2, CO3, CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Project Implementation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

CRYPTOGRAPHY AND NETWORK SECURITY	
Course Code: CSE636	**Credits: 3:0:0**
Prerequisite: Computer Networks and Data Communication	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Foundations of Cryptography in the Post-Quantum Era. Security Goals, Attacks, Services and Mechanisms, Techniques. Mathematics of Cryptography: Modular Arithmetic, Group Theory basics, Elliptic Curves. The Quantum Threat: Shor's and Grover's Algorithms and their impact on RSA/ECC. Post-Quantum Cryptography (PQC): Lattice-based, Hash-based and Code-based approaches; NIST PQC Standards (CRYSTALS-Kyber, CRYSTALS-Dilithium, SPHINCS+).

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Demonstrate different Cryptographic Attack forms, Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool.
- Link: https://nptel.ac.in/courses/106105162

Unit II

Advanced Symmetric, Asymmetric and Privacy-Preserving Cryptography. Symmetric Techniques Revisited: AES structure and analysis. Asymmetric Cryptosystems: RSA, ECC, Elgamal. Privacy-Preserving Cryptography: Homomorphic Encryption (Partial and Fully Homomorphic), Zero-Knowledge Proofs (zk-SNARKs), Secure Multi-Party Computation. Digital Signatures and Key Management for distributed and cloud-native systems.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement an ECC-based encryption scheme and demonstrate a simple Zero-Knowledge Proof protocol.
- Link: https://nptel.ac.in/courses/106105162

Unit III

Network Security and Zero Trust Architectures. Network Attacks, Firewalls, IDS/IPS. Transport and Application Layer Security: SSL/TLS, HTTPS, S/MIME. Zero Trust Architecture (ZTA): principles, micro-segmentation, continuous verification; Secure Access Service Edge (SASE). Software-Defined Perimeter and identity-centric network security for hybrid and remote-work environments.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Configure a Zero Trust access policy for a sample network and demonstrate intrusion detection using Snort or an equivalent tool.

- Link: https://nptel.ac.in/courses/106105162

Unit IV

Penetration Testing Methodology (PTES): Reconnaissance, Scanning, Exploitation, Post-Exploitation, Reporting. Vulnerability Assessment tools: Nmap, Nessus, OpenVAS, Burp Suite, Metasploit. AI-Assisted and Automated Penetration Testing: LLM-driven reconnaissance and exploit generation, autonomous red-teaming agents, and their ethical/legal boundaries.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Conduct an end-to-end penetration test on a lab network using Nmap and Metasploit, and generate a vulnerability assessment report.
- Link: https://nptel.ac.in/courses/106105162

Unit V

Cloud Security: shared responsibility model, cloud threat models, identity and access management, data security in multi-tenant environments. IoT and Embedded Systems Security: constrained-device cryptography, firmware security, device authentication. Blockchain-based Security Applications. Threat Intelligence and SOC Operations: threat hunting, SIEM. Digital Forensics and Incident Response: evidence collection, malware analysis basics, breach reporting.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Perform a cloud security configuration audit and vulnerability assessment on a sample deployment, and document a digital forensics and incident response workflow for a simulated breach.
- Link: https://nptel.ac.in/courses/106105162

Text Books:

1. William Stallings - Cryptography and Network Security, Pearson Education, 8th Edition, 2023
2. NIST Post-Quantum Cryptography Standardization documentation (FIPS 203, 204, 205), National Institute of Standards and Technology, 2024
3. Georgia Weidman - Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press, 2014

Reference Books:

1. Behrouz A. Forouzan, Debdeep Mukhopadhyay - Cryptography and Network Security, Tata McGraw-Hill, 3rd Edition, 2015
2. Bernard Menezes - Cryptography, Network Security and Cyber Laws, Cengage Learning, First Edition, 2018
3. Peter Kim - The Hacker Playbook 3: Practical Guide to Penetration Testing, Secure Planet LLC, 2018

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Analyze security goals, attacks and the impact of quantum computing on classical cryptographic schemes. (PO-1,8,9,10,11, PSO-2).
2. Apply advanced symmetric, asymmetric and privacy-preserving cryptographic techniques for secure and distributed systems. (PO-1,2,3,5,6,8,9,10,11, PSO-2).
3. Design and evaluate Zero Trust network security architectures for hybrid and cloud environments. (PO-1,2,3,5,6,8,9,10,11, PSO-2).
4. Conduct systematic penetration testing and vulnerability assessments, including AI-assisted techniques, following ethical and legal guidelines. (PO-1,3,5,6,8,9,10,11, PSO-1,2).
5. Evaluate cloud and IoT security architectures, and formulate a digital forensics and incident response strategy for a security breach. (PO-5,6,8,9,10,11, PSO-1).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study / Demonstrate Penetration Testing Tools	10	CO1, CO2 & CO3
Implementation of Cryptographic and Secure System Techniques	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Implementation of Cryptographic Techniques		
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4 & CO5

DISTRIBUTED SYSTEMS	
Course Code: CSE637	**Credits: 2:0:1**
Prerequisite: Operating System, Computer Network	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr Sangeetha V	

Course Contents

Unit I

Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Trends in Distributed Systems, Focus on Resource Sharing, Challenges. **System Models:** Introduction, Physical Models, Architectural Models, Fundamental Models. **Networking and Internetworking:** Introduction, Types of Network, Network Principles, Internet Protocols. **Interprocess Communication:** Introduction, The API for the Internet Protocols, External Data Representation and Marshalling, Multicast Communication, Network Virtualization: Overlay Networks.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement TCP/UDP socket-based client-server communication and multicast communication. Demonstrate data marshalling, serialization, and overlay network simulation for distributed resource sharing.
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs87

Unit II

Remote Invocation: Introduction, Request–Reply Protocols, Remote Procedure Call, distributed objects communication between distributed objects – RMI – JSON-RMI, Remote Method Invocation. **Indirect Communication:** Introduction, Group Communication, Publish–Subscribe Systems, Message Queues, Shared Memory Approaches.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Remote Procedure Call (RPC) and Java RMI-based client-server applications for remote method invocation. Develop publish–subscribe and message queue applications to demonstrate indirect communication in distributed systems
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs87

Unit III

Message ordering and group communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. **Global state and snapshot recording algorithms**: Introduction -System model and definitions, Snapshot algorithms for FIFO channels.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement FIFO, causal, and total message

ordering protocols in a distributed environment. Simulate distributed snapshot recording using the Chandy–Lamport algorithm to capture consistent global states.

- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs87

Unit IV

Distributed mutual exclusion algorithms: Introduction, Preliminaries,Lamports algorithm, Ricart-Agrawala algorithm. **Deadlock detection in distributed systems**: Introduction, System model, Preliminaries, Models of deadlocks, Knapp's classification of distributed deadlock detection algorithms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Lamport's and Ricart–Agrawala algorithms for distributed mutual exclusion. Simulate distributed deadlock detection algorithms and analyze deadlock scenarios using message-passing techniques.
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs87

Unit V

Peer-to-peer computing and overlay graphs: Introduction, Data indexing and overlays, Unstructured overlays, Chord distributed hash table, Content addressible networks (CAN), Tapestry, Some other challenges in P2P system design, Tradeoffs between table storage and route lengths, Graph structures of complex networks, Internet graphs, Generalized random graph networks, Small-world networks, Scale-free networks, Evolving networks. **Distributed shared memory:** Abstraction and advantages, Memory consistency models, Shared memory mutual exclusion, Wait-freedom, Register hierarchy and wait-free simulations, Wait-free atomic snapshots of shared objects.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement a Chord Distributed Hash Table (DHT) and simulate peer-to-peer overlay network operations. Develop distributed shared memory applications to demonstrate memory consistency, mutual exclusion, and wait-free synchronization.
- Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_cs87

Text Book:

1. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, **Distributed Systems: Concepts and Design, 6th Edition,** Pearson, 2021.
2. Ajay D. Kshemkalyani, and Mukesh Singhal "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2008 .

Reference Books:

1. Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems, 4th Edition, Maarten van Steen, 2024
2. Brendan Burns**, Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services,** O'Reilly Media, 2018.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Elucidate the foundations and issues of distributed systems. (PO-1,2,4,5,11,PSO-1,2)
2. **Demonstrate** the implementation of remote invocation and indirect communication techniques in distributed systems. (PO-1,2,3,4,5,11,PSO-1,2)
3. **Design** distributed applications using message ordering protocols and global snapshot recording techniques. (PO-1,2,4,5,6,7,11,PSO-1,2)
4. **Analyze** distributed mutual exclusion and deadlock detection algorithms to ensure synchronization and resource allocation in distributed systems. (PO-1,2,3,4,5,11,PSO-1,2)
5. **Apply** peer-to-peer overlay networks and distributed shared memory concepts to develop distributed applications. (PO-1,2,4,5,6,8,11,PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study with Implementation	20	CO1, CO2, CO3 ,CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study with Implementation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 & CO5

WIRELESS SENSOR NETWORKS	
Course Code: CSE642	**Credits: 2:1:0**
Prerequisite: Data Communication Basics	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Shilpa Chaudri	

Course Contents

Unit I

What are Wireless Sensor Networks? WSN, Sample Applications around the world, Types of WSN (Textbook 1- Chapter 1.1,1.2.1.3) **Anatomy of Sensor Node**: Hardware components, Power Consumption, Operating System and Concepts, Communication Stack (Textbook 1- Chapter 2.1,2.2,2.3,2.5)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Learn MATLAB usage

Unit II

Physical layer: Physical layer technologies, Overview of RF Wireless communication, modulation, Wireless channels effects. (Textbook 2- Chapter 4.1,4.2,4.4,4.5) **Medium Access Control:** Challenges of MAC, CSMA Mechanism, Contention Based and Reservation based Medium Access, Hybrid Medium Access (Textbook 2- Chapter 5.1,5.2,5.3,5.4,5.5)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Simulate Simple WSN scenario using MATLAB.

Unit III

Radio Communications: Radio Waves(modulation/Demodulation), properties of wireless communication, Medium Access protocols. (Textbook 1- Chapter 3.1,3.2,3.3) **Link Management**: Wireless links introduction, Properties, Error Control, Naming and addressing, Link estimation protocols, and Topology Control. (Textbook 1- Chapter 4.1-4.6)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Study Parameters for building WSN

Unit IV

Multi-hop Communication: Routing Basics, Routing Metrics, Routing Protocols. (Textbook 1- Chapter 5.1-5.3)

Data Aggregation and Clustering: Clustering Techniques, In-Network Processing and Data Aggregation, Comprehensive Sampling. (Textbook 1- Chapter 6.1-6.3)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Routing Metrics evaluation in WSN using MATLAB

Unit V

Sensing Techniques: Types of the sensor, Sensing coverage, High-level sensor, Special case: Human as a sensor, Actuators. (Textbook 1- Chapter 9.1-9.5) **Designing and Deploying WSN Applications**: Early WSN deployments, General Problems, General testing and validation, Requirement analysis, Top-down design Process, Bottom-up Implementation Process. (Textbook 1- Chapter 10.1-10.6)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation

- Lab Component / Practical Topics: Detection of bad nodes using MATLAB

Tutorial Sessions
(Each Session is of 2 Hours Duration/Week)

Session No.	Topics Covered
1.	Demonstration of different WSN Applications
2.	Study different OS associated with WSN
3.	Analyse communication stack and compare with other standards
4.	Associate Modulation and demodulation techniques with real time applications.
5.	Implement different CSMA Protocols
6.	Use MATLAB and simulate basics WSN environment
7.	Analyze the Radio waves applications
8.	Analyze Different topologies applicable in WSN
9.	Data Bucket Size in WSN
10.	Analyse routing metrics w.r.t WSN
11.	SVM training
12.	WSN with ACO code
13.	Detection of bad nodes in WSN
14.	Training SVM model

Text Books:

1. Anna Forster: Introduction to Wireless Sensor Networks, IEEE Press, Wiley Publisher, 2016.
2. Ian F. Akyildiz, Mehmet Can Vuran, Wireless Sensor Networks, Wiley Publishers, 2010.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, TaiebZnati :" Wireless Sensor Networks: Technology, Protocols, and Applications", Willey -Interscience ,2007
2. Rastko R. Selmic, Vir V. Phoha, Abdul Serwadda :" Wireless Sensor Networks: Security, Coverage, and Localization", Springer,2016
3. Philip John Sallis: "Wireless Sensor Networks: Insights and Innovations" , Intechopen,2017

Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105160/
- https://nptel.ac.in/courses/117104118

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios (PO-1,8,9,10,11,12, PSO-2).
2. To study different protocols at various layers and its differences with traditional protocols. (PO-1,2,3,5,6,8,9,10,111,12, PSO-2).
3. To study the design consideration of communication and link management. (PO-1,3,5,6,8,9,10,11,12, PSO-1,2).
4. Analyze the need of clustering and aggregation. (PO- 5,6,8,9,10,11,12, PSO-1).
5. Study anatomy of sensors and deployment in real time. (PO-1,2,3,5,6,8,9,10,11,12, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	C03, CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2 & CO3
Quiz –II	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 & CO5

NATURAL LANGUAGE PROCESSING	
Course Code: CSE643	**Credits: 2:0:1**
Prerequisite: Theory of Computation	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Chandrika Prasad	

Course Contents

Unit I

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; The State of the Art and The Near-Term Future; Regular Expressions and Automata; Morphology and Finite-State Transducers: Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement regular expressions, tokenization, stemming, and finite-state morphology using Python and NLTK
- Link: https://nptel.ac.in/courses/106105158

Unit II

N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; **Word Classes and Part-of-Speech Tagging:** Part-of- Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging;
Context-Free Grammars for English: Constituency, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Develop N-gram language models, perform Part-of-Speech tagging, and implement Context-Free Grammars using NLTK.
- Link: https://nptel.ac.in/courses/106105158

Unit III

Parsing with Context-Free Grammars: The Earley Algorithm; Features and Unification: Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints; Lexicalized and Probabilistic Parsing: Probabilistic Context-Free Grammars, Problems with PCFGs.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: implement CFG parsing (Earley/Chart Parser), probabilistic parsing, and feature-based grammar parsing.
- Link: https://nptel.ac.in/courses/106105158

Unit IV

Representing Meaning: First Order Predicate Calculus, Some Linguistically Relevant Concepts, Related Representational Approaches, Alternative Approaches to Meaning;**Semantic Analysis:** Syntax-Driven Semantic Analysis, Attachments for a Fragment of English; Lexical Semantics: Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Lab Component / Practical Topics: Perform semantic analysis using WordNet, lexical relations, and simple semantic representations with NLTK.
- Link: https://nptel.ac.in/courses/106105158

Unit V

Discourse: Reference Resolution, Text Coherence, Discourse Structure; **Generation**: Introduction to Language Generation, An Architecture for Generation; **Machine Translation**: Language Similarities and Differences, The Transfer Metaphor.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation
- Lab Component / Practical Topics: Build simple applications for machine translation, text generation, and discourse analysis using NLP libraries.
- Link: https://nptel.ac.in/courses/106105158

Text Books:

1. Daniel Jurafsky and James H Martin - Speech and Language, Prentice Hall, 2nd Edition, 2008.

Reference Books:

1. Tanveer Siddiqui, U.S. Tiwary- Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Interpret how speech and language technology relies on formal models to capture knowledge, and language processing deals with subparts of words (morphology). (PO- 1,5,11, PSO-2)
2. Illustrate the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories. (PO-2,3,11, PSO-2)
3. Describe feature structures and unification operation which is used to combine them, and probabilistic parsing to capture more syntactic information. (PO-2,11, PSO-2)
4. Demonstrate the gap from language to common sense Knowledge (semantic processing), and meanings associated with lexical items. (PO- 1,3,5,11, PSO-2)
5. Illustrate natural language outputs construction from non-linguistic inputs and machine translation framework approaches. (PO-1,11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2 & CO3
Case Study	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Case Study		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

ADVANCED DBMS	
Course Code: CSE644	**Credits: 3:0:0**
Prerequisite: DBMS Concepts	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

Unit I

Overview of Database Models: Database models: Flat data model, Entity relationship model, Relation model, Record base model, Network model, Hierarchical model, Object oriented data model, Object relation model, Semi structured model, Associative model, Context data model, graph data model.

The Enhanced Entity-Relationship (EER) Model: Subclasses, Super classes, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization Hierarchies, Modeling of UNION Types Using Categories, A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Design an EER schema for a database application

Unit II

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Multiple-Key access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement Operations on B/B+ Tree using Java or Python Programming

Unit III

Query Processing and Optimization: Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions Query Optimization: Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Techniques used for Evaluation of Expressions and Join / Sort Operations.

Unit IV

Parallel Databases: I/O Parallelism, Inter-query Parallelism, Intra-query Parallelism, Intra-operation Parallelism, Interoperation Parallelism, Query Optimization, Design of Parallel Systems, Parallelism on Multi-Core Processors

Distributed Databases: Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases,

Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of I/O Parallelism in parallel databases using Partitioning Techniques and Commit Protocol for distributed Transactions.

Unit V

Enhanced Data Models for Advanced Applications: Active Database Concepts and Triggers: Generalized Model for Active Databases and Oracle Triggers, Design and Implementation Issues for Active Databases. Temporal Database Concepts: Time representation, Calendars and Time Dimensions, Incorporating Time in Relational Databases using Tuple Versioning. Spatial Database Concepts: Introduction, Spatial Data Types and Models. Multimedia Database Concepts

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement of Triggers in active databases and Time in Relational databases.

Text Books:

1. "Database System Concepts" by Abraham Silberschatz , Henry F. Korth, sixth Edition McGraw Hill Education.
2. "Fundamentals of Database Systems" by Ramez Elmasri, Shamkant B. Navathe, Fifth Edition, Pearson Publications.

References:

1. "Database Management Systems" by Raghu Ramakrishnan, Johanners Gehrke, Second Edition. McGraw-Hill Education

Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=aZjYr87r1b8

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Describe different Database Models and Apply EER Model to Design Databases (PO-1,2,3 PSO-1,2)
2. Discuss the concepts of Indexing and Hashing as applied to Data Storage and Query Processing (PO- 1,2,3, PSO- 1, 2)
3. Explain how Queries are Processed and Optimized (PO- 1,2, 3, PSO- 1, 2)
4. Describe the Processing of the Queries in Distributed and Parallel Databases. (PO- 1, 2,3 PSO- 1)
5. Understand Enhanced Data models for advanced Applications like Active Databases, Temporal Databases, Spatial Databases and Multimedia Databases. (PO- 1,2,3, PSO- 1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 & CO3
Quiz –II/Project Implementation	10	CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 and CO5

Edge AI and Automation	
Course Code: CSE645	**Credits: 2:0:1**
Prerequisite: Basics of Machine Learning, IoT, and Python Programming	**Contact Hours: 30L+30P+30S**
Course Coordinator: Veena GS	

Course Contents

Unit I

Introduction to Edge AI and TinyML: What is Edge AI? Why Edge and not Cloud? Introduction to TinyML: Definition and scope. Benefits: Latency, privacy, bandwidth, energy efficiency, Applications: Smart homes, healthcare, wearables, agriculture, industrial IoT, Architecture of edge intelligence systems.

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- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Collecting data using Arduino/ESP32 sensors
- Link: https://www.tinyml.org

Unit II

Hardware and Tools for TinyML Overview of low-power edge devices: Arduino Nano 33 BLE Sense, ESP32, Raspberry Pi, Coral Edge TPU, NVIDIA Jetson Nano. Sensors: microphones, IMUs, temperature, camera modules.ML frameworks and tools: TensorFlow Lite, Edge Impulse, TinyML Kit.On-device deployment workflow. Introduction to n8n for IoT automation.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Training and deploying ML models using Edge Impulse
- Link: https://docs.edgeimpulse.com

Unit III

ML Model Compression and Deployment: Challenges of ML on resource-constrained devices. Model optimization techniques: Quantization, pruning, knowledge distillation. Energy-efficient inference and memory constraints. Compiling and converting models for deployment, TFLite conversion, Micro interpreter. Flashing and testing models on devices

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Running inference on microcontrollers.
- Link : https://www.tensorflow.org/lite/microcontrollers

Unit IV

Workflow Automation with n8n: Introduction to workflow automation tools: n8n and Node-RED.n8n interface, triggers, and nodes. Connecting edge devices to n8n using:
MQTT, HTTP Webhooks, Serial-to-API. Building ML inference pipelines. Automating tasks: email/SMS alerts, dashboards, serverless functions.Case studies: anomaly detection alert system, auto-logging IoT data

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Building a simple n8n workflow to trigger based on sensor input.
- Link: https://docs.arduino.cc/tutorials/

Unit V

Security, Power Management, and Trends: Security and privacy in Edge AI:Local inference, data isolation. Federated learning basics (optional intro). Power management strategies. Real-world deployment considerations: OTA updates, model versioning. Trends: Edge + LLMs, Neuromorphic chips, TinyML-as-a-Service

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Mini-project: End-to-end IoT-ML-Workflow application
- Link : https://docs.espressif.com

Text Books:

1. Pete Warden and Daniel Situnayake, TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, O'Reilly Media, 2019. ISBN: 978-1492052043.
2. Vijay Janapa Reddi (Ed.), TinyML Cookbook, Packt Publishing, 2022. ISBN: 978-1803237305.

Reference Books:

1. John H. Davies, TinyML Cookbook: AI and IoT on Ultra-Low-Power Devices, Packt Publishing, 2022.
2. A. C. S. N. Kumar, Edge AI: Convergence of Edge Computing and Artificial Intelligence, CRC Press, 2024.
3. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, Wiley, 2018.

Course Outcomes (COs):

At the end of the course the student will be able to:

1. Demonstrate the DevOps culture by illustrating applications cloud infrastructure and configuration management with Ansible. (PO-2, 3, 5, 9, PSO-3)
2. Apply the DevOps pipeline process starting with continuous integration and continuous deployment principles. (PO-2, 3, 5, 9, PSO-3)
3. Demonstrate how to create and run a container from a Docker file and deploy a complex application on Kubernetes. (PO-2, 3, 5, 9, PSO-3)
4. Illustrate the different ways to test APIs with Postman, static code analysis with SonarQube and perform security and performance tests. (PO-2, 3, 5, 9, PSO-3)
5. Apply security in the DevOps process with DevSecOps and related best practices. (PO-2, 3, 5, 9, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
CI/CD Pipeline Implementation using DevOps tools for build automation, testing, deployment, and monitoring.	20	CO1, CO2, CO3 CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Demonstration		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 ,CO4 & CO5

BLOCKCHAIN ESSENTIALS & DAPPS	
Course Code: CSE646	**Credits: 2:0:1**
Prerequisite: Networking	**Contact Hours: 30L+15P+30S**
Course Coordinator: Dr. Parkavi A	

Course Contents

Unit I

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Simulate a distributed key-value store using Python/Java, demonstrate partition tolerance by turning off one server.
- Link: https://nptel.ac.in/courses/106105184

Unit II

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization.

Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA**)**.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Implement AES (symmetric) encryption/decryption in Python, Implement RSA (asymmetric) key generation, encryption, decryption.
- Link: https://nptel.ac.in/courses/106105184

Unit III

Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block , The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Create and sign a test Bitcoin transaction using Python, Demonstrate multisig transactions
- Link: https://nptel.ac.in/courses/106105184

Unit IV

Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, the consensus mechanism, the world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network Hands-on: Clients and wallets –Geth

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Compare **Bitcoin vs Ethereum**, Explore Ethereum block explorers (Etherscan, Blockchair), Observe real-time transactions and contracts.
- Link: https://nptel.ac.in/courses/106105184

Unit V

Hyperledger: Reference architecture Requirements Fabric: Hyperledger Fabric, Fabric architecture, Membership services, Blockchain services, Components of the Fabric, Sawtooth Lake: PoET, Transaction families, Consensus in Sawtooth, Development environment, Corda: Architecture, State objects, Transactions Consensus, Flows, Components, Nodes, Permissioning service, Network map service, Notary service, Oracle service Transactions, Vaults, CorDapp

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Explore Hyperledger ecosystem (Fabric, Sawtooth, Indy, etc.), Map Fabric's reference architecture: Membership, Consensus, Chaincode, Ledger.
- Link: https://nptel.ac.in/courses/106105184

Text Book:

1. Imran Bashir, Mastering Blockchain: A Technical Reference Guide to the Inner Workings of Blockchain, Cryptography, Ethereum, Hyperledger, and Smart Contracts, 4th Edition, Packt Publishing, 2023. ISBN: 978-1803235769.

Reference Books:

1. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Blockchain, 2nd Edition, O'Reilly Media, 2017. ISBN: 978-1491954386.
2. Andreas M. Antonopoulos and Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2019. ISBN: 978-1491971949.

3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015. ISBN: 978-1491920497

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Illustrate the Blockchain terminologies with its applications. (PO-1,2,3, PSO-1,2)
2. Analyse the working principles of Blockchain. (PO-1,2,3,6, PSO-1,2,3)
3. Comprehend the principles & methodologies used in Bitcoin and able to deploy smart contract. (PO-1,2,3, PSO-1,2)
4. Create Ethereum Network, Wallets, Nodes, Smart contract & Dapps (PO-1,2,3,4,5,6, PSO-1,2)
5. Develop Blockchain Based Application Architecture using Hyperledger (PO-1,2,3,4,5,6, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO3,CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
NPTEL Certification	20	CO1, CO2, CO3 ,CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ NPTEL Certification		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 & CO5

MOBILE APPLICATION DEVELOPMENT	
Course Code: CSOE02	**Credits: 3:0:0**
Prerequisite: Basic C Programming	**Contact Hours: 45L+45S**
Course Coordinator: Uzma Sulthana	

Course Contents

Unit I

Features of Flutter, Advantages of Flutter -, Disadvantages of Flutter., Flutter Installation in Windows, Flutter Installation in Mac OS, Architecture of Flutter Applications, Creating Simple Application in Android Studio- Architecture of Flutter Applications

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Experiential learning on Flutter development lifecycle and sample app implementation.

Unit II

Flutter Basics and Dart Programming: Widgets- Gestures- Concept of State- Layers- Introduction to Dart Programming, Variables and Data types, Decision Making and Loops., Functions, Object Oriented Programming, Introduction to Widgets- Widget Build Visualization.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Practical sessions on Dart programming and Flutter widget implementation

Unit III

Introduction to Layouts: Type of Layout Widgets- Single Child Widgets- Multiple Child Widgets- Advanced Layout Application-Introduction to Gestures- Statement Management in Flutter. Ephemeral State Management-Application State - scoped model- Navigation and Routing.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Hands-on exercises with layout widgets, state management, and navigation in Flutter

Unit IV

Animation on Flutter: Introduction to Animation Based Classes-Work flow of the Flutter Animation- Working Application- Android Specific Code on Flutter- Introduction to Package- Types of Packages- Using a Dart Package- Develop a Flutter Plugin Package- Accessing Rest API- Basic Concepts- Accessing Product service API

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Hands-on exercises with Flutter animation classes, packages, and REST API integration

Unit V

Database Concepts and API: SQLite- Cloud Fire store- Internalization on Flutter- Using intl Package-Testing on Flutter- Types of Testing- Widget Testing- Steps Involved- Working Example-

Deployment- Android Application- IOS Application- Development Tools- Widget Sets- Flutter Development with Visual Studio Code- Dart DevTools- Flutter SDK

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Practical sessions on Flutter databases, testing, and deployment

Text Books:

1. Alberto Miola by Flutter Complete Reference
2. Thomas Bailey and Alessandro Biessek by Flutter for Beginners
3. franke zenmate by Practical flutter

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Demonstrate Flutter installation and its key features. (PO1,2,3 4,5)
2. Apply Dart programming concepts such as variables, loops, functions, and object-oriented programming. (PO1,2,3,4 5)
3. Develop interactive animations using Flutter. (PO-1,2, 3,4,5)
4. Develop Flutter application using Dart packages (PO-1,2, 3, 4, 5)
5. Build Flutter applications with database integration (PO-1, 2, 3,4,
6. 5)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study	10	CO1, CO2, CO3, CO4 & CO5
Report	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Reports		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

FULL STACK DEVELOPMENT	
Course Code: CSOE04	**Credits: 3:0:0**
Prerequisite: Basics of Programming	**Contact Hours: 45L+45S**
Course Coordinator: Akshatha Kamath	

Course Contents

Unit I

Fundamentals: A Brief Introduction to the Internet, The World Wide Web Web, Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol, Security, The Web Programmers Toolbox. **Introduction to XHTML:** Origins and Purposes of HTML and XHTML, Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Exercise on Xhtml

Unit II

Introduction to XHTML: Tables, Forms, Frames, Syntactic Differences between HTML and XHTML Cascading **Style Sheets:** Introduction, Levels of Style Sheets, Style Specification Formats, Selector Formats, Property Value Forms, Font Properties, List Properties, Color, Alignment of Text, The Box Model, Background Images, The span and div Tags

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Exercises on CSS

Unit III

The Basics of JavaScript: Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics, Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, Constructors, Pattern Matching Using Regular Expressions, Errors in Scripts, JavaScript and HTML Documents, The JavaScript Execution Environment, The Document Object Model, Element Access in JavaScript, Events and Event Handling, The DOM 2 Event Model, The navigator Object, DOM Tree Traversal and Modification.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Exercise on JavaScript

Unit IV

Dynamic Documents with JavaScript: Introduction, Positioning Elements, Moving Elements, Element Visibility, Changing Colors and Fonts, Dynamic Content, Stacking Elements, Locating the Mouse Cursor, Reacting to a Mouse Click, Slow Movement of Elements, Dragging and Dropping Elements **Introduction to PHP:** Origins and Uses of PHP, Overview of PHP, General Syntactic Characteristics, Primitives, Operations, and Expressions, Output, Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Files, Cookies, Session Tracking.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Exercise on PHP

Unit V

Database Access through the Web:

Relational Databases: An Introduction to the Structured Query Language, Architectures for Database Access, The MySQL Database System, Database Access with PHP and MySQL, **NoSQL Databases:** An Introduction, Basics of MongoDB, CRUD Operations, Database Access with PHP and MongoDB.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Exercise on Database

Text Books:

1. Robert W Sebesta: Programming The World Wide Web, 4th Edition, Pearson Education 2008
2. Steve Perry: Learn to Build Web Applications with PHP, MySQL and JavaScript, O'Reilly Publications, 2017
3. Brad Dayley: NoSQL with MongoDB in 24 Hours, Sams Teach Yourself, Pearson Education; First edition, 2015

Reference Books/websites:

1. M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to program, 4th Edition, Pearson education, 2011.
2. Chris Bates: Web Programming Building Internet Applications, 3rd Edition, Wiley India, 2011.
3. Web Link for PHP: https://www.php.net/
4. Web Link for MySQL: https://www.mysql.com/
5. Web link for MongoDB: https://www.mongodb.com/

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Explain different components and technologies of World Wide Web as a platform.
2. Apply the concepts of HTML and CSS in designing web pages.
3. Apply the JavaScript concepts in designing dynamic web pages.
4. Demonstrate the uses of PHP as a server side scripting language.
5. Demonstrate the concepts of Database connectivity in web applications for both Structured and NoSQL databases

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3, CO4 & CO5
Programming assignment	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Programming Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

OBJECT ORIENTED PROGRAMMING WITH C++	
Course Code: CSOE05	**Credits: 3:0:0**
Prerequisite: C Programming	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Dayananda R B	

Course Contents

Unit I

Beginning with C++ and its features: What is C++?, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, operator overloading and control structures in C++ .

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Basic programs

Unit II

Functions, classes and Objects: Functions, Inline function, function overloading, friend and virtual functions, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, members, pointers to members and member functions

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Programs on classes and objects

Unit III

Constructors, Destructors and Operator overloading: Constructors, Multiple constructors in a class, copy constructor, Dynamic constructor, Destructors, defining operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Programs on constructors and operator Overloading

Unit IV

Inheritance, Pointers, Virtual Functions, Polymorphism: Derived Classes, Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Programs on Inheritance

Unit V

Streams and Working with files:C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations, opening and closing a file, EOF .

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Programs on Streams

Text Book:

1. Object Oriented Programming with C++, E. Balaguruswamy, TMH, 6th Edition, 2013.

Reference Book:

1. Object Oriented Programming using C++, Robert Lafore, Galgotia publication 2010

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Explain the basics of Object Oriented Programming concepts.
2. Apply the object initialization and destroy concept using constructors and destructors.
3. Apply the concept of polymorphism to implement compile time polymorphism in programs by using overloading methods and operators.
4. Use the concept of inheritance to reduce the length of code and evaluate the usefulness. Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs.
5. Use I/O operations and file streams in programs.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3, CO4 & CO5
Programming Assignment	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Qui +Marks scored in Programming Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	
Course Code: CSOE09	**Credits: 3:0:0**
Prerequisite: Knowledge of any advanced programming language, Algorithms and Data structures, Elementary Discrete Mathematics or similar.	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction: What is AI? Foundation and History of Artificial Intelligence. **Intelligent Agents**: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving by search**: Problem Solving Agents, Example Problems, Searching for Solution, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions. (Chapter 1, 2, 3 of Text Book 1)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit II

Introduction to Machine Learning: What is Machine Learning, Key Terminology, Key tasks of machine learning, Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. **Decision Tree** - Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning. (Chapter 1and 3 of Text Book 2)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit III

Artificial Neural Networks - Introduction, Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and the Backpropagation algorithm. **Bayesian Learning** - Introduction, Bayes theorem, Naive Bayes Classifier, The EM Algorithm. (Chapter 4 and 6 of Text Book 2)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit IV

Instance Based Learning - Introduction, k-nearest neighbor learning, Locally Weighted Regression, radial basis function, Case-based reasoning **Genetic Algorithms** – Representing hypotheses, Genetic Operators, Fitness Function and Selection, An Illustrative Example. **Reinforcement Learning** – Introduction, The Learning Task (Chapter 8, 9 and 13 of Text Book 2)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit V

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction. **Natural Language Communication:** Phrase, Structure Grammars, Syntactic Analysis, Augmented Grammars and Semantic Interpretation, Machine translation, Speech recognition. (Chapter 22, 23 of Text Book 1)

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Text Books:

1. Stuart J Russel and Peter Norvig: "Artificial Intelligence - A Modern Approach", 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: "Artificial Intelligence", 3rd Edition, Tata McGraw hill, 2011.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
3. Peter Harrington. "Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2016.

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Identify the modern view of artificial intelligence and its applications based on agent Philosophy. (PO-1,2,3,4,5)
2. Demonstrate the fundamental understanding of machine learning techniques, Concept learning and Decision tree. (PO-1,2,3,5,7,8,9,10,12)
3. Analyse neural networks and Bayes classifier for problem solving (PO-1,2,3,5,7,8,9,10,12)
4. Illustrate and implement Instance based learning, Reinforcement learning and Genetic Algorithm for optimization of engineering problems (PO-1,2,3,4,5)
5. Apply the concept of Natural Language Processing in building intelligent systems through machine translation and speech recognition. (PO-1,2,3,4,5)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Case Study	10	CO1, CO2, CO3, CO4 & CO5
Report	10	
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Reports		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 & CO5

INTRODUCTION TO BIG DATA ANALYTICS	
Course Code: CSOE10	**Credits: 3:0:0**
Prerequisite: Programming Knowledge	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Ganeshayya I Shidaganti	

Course Contents

Unit I

UNDERSTANDING BIG DATA: What is big data – why big data –.Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit II

NOSQL DATA MANAGEMENT: Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schema less databases – materialized views – distribution models – shading — version – map reduce – partitioning and combining – composing map-reduce calculations.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit III

BASICS OF HADOOP: Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit IV

MAPREDUCE APPLICATIONS: MapReduce workflows – unit tests with MRUnit – test data and local tests– anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Unit V

HADOOP RELATED TOOLS: Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Cassandra – Cassandra data model – Cassandra examples – Cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Nil

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

Reference Books:

1. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4. Alan Gates, "Programming Pig", O'Reilley, 2011

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Describe the Role and Importance of Big Data in various Business Context
2. Describe the Aggregate Data Models and Distribution Models in managing the Big Data Storage.
3. Discuss the Architecture and Features of Hadoop Distributed File System (HDFS) for handling Big Data.
4. Discuss the Map Reduce Fundamentals and Workflows for handling Big Data.
5. Interpret on various Hadoop related Tools and explore the Operations for Analyzing Big data Applications.

Course Assessment and Evaluation:

<table>
<tr><td colspan="3">Continuous Internal Evaluation (CIE) : 50 Marks</td></tr>
<tr><td>Assessment Tools</td><td>Marks</td><td>Course Outcomes addressed</td></tr>
<tr><td>Internal Test-I (CIE-I)</td><td>30</td><td>CO1, CO2 & CO3</td></tr>
<tr><td>Internal Test-II CIE-II)</td><td>30</td><td>CO4 & CO5</td></tr>
<tr><td colspan="3">Average of the two CIE will be taken for 30 marks</td></tr>
<tr><td>Other Components</td><td></td><td></td></tr>
<tr><td>Case Study</td><td>10</td><td rowspan="2">CO1, CO2, CO3, CO4 & CO5</td></tr>
<tr><td>Report</td><td>10</td></tr>
<tr><td colspan="3">The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Case Study +Marks scored in Reports</td></tr>
<tr><td colspan="3">Semester End Examination (SEE)</td></tr>
<tr><td>Course End Examination (Answer One full question from each Unit-Internal Choice)</td><td>100</td><td>CO1, CO2, CO3, CO4 & CO5</td></tr>
</table>

Project Management with Git	
Course Code: CSOE12	**Credits: 3:0:0**
Pre-requisites: Agile Methodologies, Scrum	**Contact Hours: 42**
Course Coordinator: Brunda G	

Course Content

Unit I

Introduction to Project Management: Introduction: What is a Project, What is Project Management, Project Characteristics, Project Objectives, Project Scope and Stakeholders, Project Management Software: Jira, Trello, Asana, Task Management and Issue Tracking, Software Development Life Cycle: SDLC Phases, Waterfall, Iterative, Incremental, Agile and DevOps, Agile Frameworks: Agile Manifesto, Scrum, Kanban, Crystal and Dynamic Systems Development Method, Industry Practices: User Stories, Product Backlog, Sprint Planning, Daily Stand-up, Sprint Review, Retrospective, Bug Tracking and Risk Management.

Unit II

Git: Version Control with Git: **Understanding version control concepts — why we need it, centralized vs distributed VCS.** Installing Git and First-Time Setup: **Configuring username and email.** Getting a Repository: **Init and clone.** Recording Changes to the Repository: **Add, commit, status, diff.** Viewing the Commit History: **Log.** Undoing Things: **Checkout, revert, basic reset.** Working with Remotes: **Push, pull, fetch.** Tagging: **Basic tags, semantic versioning.** Git Branching: **Branches in a nutshell, basic branching and merging, branch management.**

Unit III

GitHub: Account Setup and Configuration: Setting up a GitHub account and configuring it for use. **Contributing to a Project:** Forking, cloning, opening a pull request. **Maintaining a Project:** Managing releases, reviewing and merging contributions. **Branching Workflows:** GitHub Flow, trunk-based development, Gitflow. **Remote Branches:** Understanding and working with remote-tracking branches. **Rebasing:** Rebasing a feature branch instead of merging.

Unit IV

Distributed Workflows: **Understanding distributed Git workflows, contributing to and maintaining a project in a distributed setup.**
Git Tools: **Revision Selection, Interactive Staging, Stashing and Cleaning, Searching, Rewriting History, Reset Demystified, Advanced Merging, Debugging with Git and Submodules.**

Unit V

The GitHub EcoSystem: Exploring the GitHub Marketplace - Introducing the GitHub Marketplace, Listing Your App on the Marketplace. Attending Events- Exploring Types of Events, Knowing What to Expect at Events, Becoming Familiar with GitHub Events, Speaking at Events .The Parts of TENS : Ten Ways to Level Up on GitHub - GitHub Help Docs, GitHub Learning Labs, GitHub In-Person Training, Project-Specific Documentation, External Community Places, Online Coding Tutorials, Online Courses and Tutorials, Blogs and Twitter, Community Forum. Ten Ways to Improve Your Development Workflow - Drafting Pull Requests, Git Aliases, Run Tests Automatically, Take Breaks, Prototype User Interfaces, Scaffold Apps with Yeoman, Chrome Web Developer Tools, StackOverflow, Code Analysis Tools, Project Boards.

Textbooks:

1. Pro Git: Scott Chacon and Ben Straub, 2nd Edition, 2014, Apress, ISBN: 978-1-4842-0076-6 (available free online at git-scm.com/book under Creative Commons Attribution Non-Commercial Share Alike 3.0 license)
2. GitHub® For Dummies® Published by: John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030-5774, www.wiley.com
3. Ken Schwaber and Jeff Sutherland, The Scrum Guide: The Definitive Guide to Scrum: The Rules of the Game.
4.

Reference Book:

1. Directing the Agile Organization-By Evan Leybourn
2. https://www.geeksforgeeks.org/software-engineering/what-are-agile-frameworks/

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Demonstrate software project management practices and Agile methodologies. (PO-1, PO-2, PO-3, PO-4, PO-5)
2. Apply Git commands and version control techniques for software development. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6)
3. Demonstrate GitHub-based collaboration using branches, pull requests, and distributed workflows. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6)
4. Apply advanced Git techniques for merging, conflict resolution, debugging, and repository management. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6)
5. Utilize GitHub ecosystem tools and best practices to improve development workflows. (PO-1, PO-2, PO-3, PO-4, PO-5)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
20 Marks Components		
GitHub Project Demonstration	20	CO1, CO2, CO3, CO4 & CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Demonstration		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 and CO5

Mini Project	
Course Code: CSP67	**Credits: 0:0:3**
Prerequisite: Nil	**Contact Hours: 2 hours/week**
Course Coordinator: Dr. Chandrika Prasad /Mamatha A	

Guidelines:

As a part of Mini Project, students must carry out the following activities:

1. Students should form a group to carry out their project. The minimum group size is 3 and maximum group size is 4.
2. The groups will be attached to one Internal Guide by the Department.
3. Students can carry out their project in-house once guide approves the topic.
4. Identify the problem statement based on the current state of Art and trends in the area of interest.
5. Based on the survey, identify the project requirements and do feasibility study.
6. Identify and draw a system level architecture by showing subsystems and their input/output need.
7. Implement the programs using step by step for each module.
8. Integrate and examine the implementation and test the project scope and the requirements.
9. Prepare the demonstration of the Project documents and the presentation.
10. The evaluation is based on presentation and report.

Assessment:

- CIE - Minimum 2 reviews of the project + any other relevant components (for 50 Marks)
- SEE - Project Demonstration + any other component as decided by Internal Examination (for 50 Marks)
- The evaluation will be done by the internal guide and a co-examiner twice during the semester.
  - Mid-semester evaluation: Students must do a group presentation and produce documents of system requirements, and system design (during 6th week).
  - Final Evaluation: At the End of the semester students must do a group presentation, demonstrate the project work and submit the complete report. (During 13th week).

Course Outcomes (COs):

At the end of the course, student should be able to

1. Formulate a real-world problem and its requirements. (PO-1,2,3,4,6,11,12, PSO-1,2,3)
2. Develop a design document for a set of requirements. (PO-1,2,3,4,5,11,12, PSO-1,2,3)
3. Test and validate the conformance of the developed prototype against the original requirements of the problem. (PO-1,2,3,4,5,11,12, PSO-1,2,3)
4. Appraise the Contribution of an individual or in a team in development of the project. (PO-8,9,11,12, PSO-1,2,3)
5. Develop effective communication skills for presentation of project related activities (PO-8,9, 10, 11,12, PSO-1,2,3)

Technical Skill Enhancement Course	
Course Code: CS68	**Credits: 0:1:0**
Prerequisite: Programming Knowledge	**Contact Hours: 15**
Course Coordinator: Dr. J Geetha	

Course Contents

Week		Topic	Description	Tools/Platforms
1		Resume Building & LinkedIn Optimization	Professional resume writing, ATS-friendly formats, optimizing LinkedIn for visibility.	Canva, LinkedIn
2		Git & GitHub for Developers	Version control basics, GitHub portfolio creation, hosting projects.	Git, GitHub
3		Coding Practice: Arrays & Strings	Common DSA problems from interviews, live coding.	LeetCode, HackerRank
4		Coding Practice: Linked Lists, Stacks & Queues	Practice and discussion of patterns.	GeeksforGeeks
5		Coding Practice: Trees, Graphs & Hashing	Problem-solving with medium-level problems.	Codeforces, InterviewBit
6		Object-Oriented Programming (OOP)	Real-life OOP examples, interview-level questions.	Java/C++/Python
7		DBMS & SQL for Interviews	Writing SQL queries, Normalization, Joins, Case-based queries.	MySQL, SQLite
8		Operating System & CN Concepts	Focus on process/thread, memory mgmt, TCP/IP, DNS, Routing.	Visualization tools
9		Aptitude & Logical Reasoning	Time-bound practice for Quant, LR, and Verbal.	IndiaBix, PrepInsta
10		System Design Basics	Real-world design: URL shortener, load balancer, scalable systems.	Draw.io, Excalidraw
11		Frontend Basics: HTML, CSS, JS	Mini webpage creation & deployment.	CodePen, Netlify
12		Backend Basics: REST APIs & JSON	CRUD operations with Postman or Express.js examples.	Postman, Node.js
13		Mock Interview & Coding Test	Technical + HR mock interview, coding challenge.	InterviewBuddy, HackerRank
14		Feedback, Portfolio Review & Next Steps	Personalized feedback, GitHub review, roadmap for 7th sem.	Resume & GitHub

Evaluation criteria for the course:

The 14-week industry-led Saturday program will be evaluated entirely through Continuous Internal Evaluation (CIE) with no external examination. The assessment will focus on weekly participation and engagement, completion of hands-on assignments, coding practice, and application of concepts through mini-projects. Students will be evaluated on resume building, LinkedIn optimization, GitHub portfolio creation, coding tasks across data structures, OOP, SQL, and system design exercises, along with frontend and backend mini-projects. A mock interview and coding test will assess technical and communication skills, while the final review will focus on the quality of the GitHub portfolio, resume, and LinkedIn

profile, reflecting overall growth. Marks will be awarded cumulatively based on consistency, practical application, and industry readiness, ensuring that students build a strong professional portfolio and are better prepared for placements.