Mahatma Education Society's

Pillai College of Engineering

(Autonomous)

Affiliated to University of Mumbai

Dr. K. M. Vasudevan Pillai's Campus , Sector 16, New Panvel – 410 206.

PCE
PILLAI COLLEGE OF ENGINEERING
AUTONOMOUS

Department of Computer Engineering

Syllabus
of
M.Tech. in Computer Engineering

for
The Admission Batch of AY 2022-23

First Year - Effective from Academic Year **2022-23**

Second Year - Effective from Academic Year **2023-24**

as per

Choice Based Credit and Grading System

Mahatma Education Society's

Pillai College of Engineering

Vision

Pillai College of Engineering (PCE) will admit, educate and train a diverse population of students who are academically prepared to benefit from the Institute's infrastructure and faculty experience, to become responsible professionals or entrepreneurs in a technical arena. It will further attract, develop and retain, dedicated, excellent teachers, scholars and professionals from diverse backgrounds whose work gives them knowledge beyond the classroom and who are committed to making a significant difference in the lives of their students and the community.

Mission

To develop professional engineers with respect for the environment and make them responsible citizens in technological development both from an Indian and global perspective. This objective is fulfilled through quality education, practical training and interaction with industries and social organizations.

Dr. K. M. Vasudevan Pillai's Campus , Sector - 16, New Panvel – 410 206

Department of Computer Engineering

Vision

To evolve as a centre of academic excellence and to adapt itself to the rapid advancements in the Computer Engineering field.

Mission

To produce highly qualified, well rounded and motivated graduates who can meet new technical challenges, contribute effectively as team members and be innovators in computer hardware, software, design and application. To pursue creative research and new technologies in computer engineering and across disciplines in order to serve the needs of industry, government, society and the scientific community. To inculcate strong ethical values and responsibility towards society.

Program Educational Objectives (PEOs):

I. Our graduates will have knowledge, skills and attitude that will allow them to contribute significantly to the research and the discovery of new knowledge and methods in computing and enable them to communicate effectively and work in a team.

II. Our graduates will function ethically and responsibly, and will remain informed and involved as full participants in our profession and our society. Our graduates will successfully function in multi-disciplinary teams.

III. Our graduates will apply the basic principles and practices of engineering in the computing domain to the benefit of society and to pursue lifelong learning and professional developments.

IV. Our graduates will use theoretical and technical computer science knowledge to specify requirements, develop a design, and implement and verify a solution for computing systems of different levels of complexity.

Program Outcomes:

Engineering Graduates will be able to:

1. Engineering knowledge:
   Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. 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.
3. 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.
4. 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.
5. 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.
6. The engineer and society:
   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.
7. Environment and sustainability:
   Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics:
   Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work:
   Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. 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.
11. 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.
12. 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):

1. To analyze, design and develop computer programs using appropriate hardware, software and mathematical models in the areas related to algorithms, system software, multimedia, mobile and web technology, data storage and computing, and networking for efficient and secure systems.
2. To use professional engineering practices, logic and strategies for creating innovative career paths to be an entrepreneur, and an urge to pursue higher studies.
3. To Formulate and solve real life engineering problems for the public health and safety with social and environmental awareness along with ethical responsibility.

The Autonomous status of the institute has given an opportunity to design and frame the curriculum in such a way that it incorporates all the needs and requirements of recent developments in all fields within the scope of the technical education. This curriculum will help postgraduates to attain excellence in their respective field. The curriculum has a blend of basic and advanced courses along with provision of imparting practical knowledge to students through minor and major projects. The syllabus has been approved and passed by the Board of Studies.

Outcome based education is implemented in the academics and every necessary step is undertaken to attain the requirements. Every course has its objectives and outcomes defined in the syllabus which are met through continuous assessment and end semester examinations. Evaluation is done on the basis of Choice Based Credit and Grading System (CBCGS). Optional courses are offered at department level.

Every learner/student will be assessed for each course through (i) an Internal/Continuous assessment during the semester in the form of either Practical Performance, Presentation, Demonstration or written examination and (ii) End Semester Examination (ESE), in the form of either theory or viva voce or practical, as prescribed by the respective Board Studies and mentioned in the assessment scheme of the course content/syllabus. This system involves the Continuous Evaluation of students' progress Semester wise. The number of credits assigned with a course is based on the number of contact hours of instruction per week for the course. The credit allocation is available in the syllabus scheme of each semester.

The performance of a learner in a semester is indicated by a number called Semester Grade Performance Index (SGPI). The SGPI is the weighted average of the grade points obtained in all the courses by the learner during the semester. For example, if a learner passes five courses (Theory/labs./Projects/ Seminar etc.) in a semester with credits C1, C2, C3, C4 and C5 and learners grade points in these courses are G1, G2, G3, G4 and G5 respectively, then learners SGPI is equal to:

$$SGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The learner's up to date assessment of the overall performance from the time s/he entered for the programme is obtained by calculating a number called the Cumulative Grade Performance Index (CGPI), in a manner similar to the calculation of SGPI. The CGPI therefore considers all the courses mentioned in the scheme of instructions and examinations, towards the minimum requirement of the degree learners have enrolled for. The CGPI at the end of this semester is calculated as,

$$CGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + \ldots + C_i * G_i + \ldots + C_nG_n}{C_1 + C_2 + C_3 + \cdots + C_i + \ldots + C_n}$$

The Department of Computer Engineering offers a M. Tech. programme in Computer Engineering. This is a four semester course. The complete course is a **64 credit** course which comprises core courses and department level elective courses. There are 3 department level optional course choices for semester I and II separately. The students have to select one course from each DLOC course list.

Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present the **M.Tech Computer Engineering** syllabus effective from the Academic Year 2022-23 . We are sure you will find this syllabus interesting, challenging, and fulfill certain needs and expectations.

Computer Engineering is one of the most sought-after courses amongst engineering students. The syllabus needs revision in terms of preparing the student for the professional scenario relevant and suitable to cater the needs of industry in the present-day context. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully become acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date knowledge to analysis design, implementation, validation, and documentation of computer software and systems.

This syllabus is finalized through a brainstorming session attended by Heads of Department and senior faculty members of Department of Computer Engineering. The syllabus falls in line with the vision and mission of the Computer Engineering Department and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

We would like to place on record our gratitude to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Board of Studies in Computer Engineering

1. Dr. Sharvari S. Govilkar	Coordinator (Chairman)
2. Dr. Prashant P Nitnaware	Member
3. Prof. Varunakshi Bhojane	Member
4. Prof. Payel Thakur	Member
5. Dr. Neeta Deshpande	Member
6. Dr.Jyoti Malhotra	Member
7. Dr.Kavita Sonawane	Member
8. Prof.Pranita Mahajan	Member
9. Mr. Samir Mahindre	Member
10. Prof. Deepti Lawand	Member

Program Structure for
Master of Technology in Computer Engineering
Semester I

W.e.f. A.Y 2022-23

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Practical	Total
CE500T	Computer Programming Paradigms	03	--	03	--	03
CE501T	Business Communication and Intellectual property	03	--	03	--	03
CE50xT	Department Level Optional Course-I	03	--	03	--	03
CE50xT	Department Level Optional Course-II	03	--	03	--	03
CE50xT	Department Level Optional Course-III	03	--	03	--	03
CE515L	DLOC Lab-I	--	02	--	01	01
CE516L	Dissertation-I	--	02	--	01	01
TOTAL		**15**	**04**	**15**	**02**	**17**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Oral /Practs	Total
		Test 1	Test 2	Avg					
CE500T	Computer programming Paradigms	40	40	40	60	2	-	-	100
CE501T	Business Communication and Intellectual property	40	40	40	60	2	-	-	100
CE50xT	Department Level Optional Course-I	40	40	40	60	2	-	-	100
CE50xT	Department Level Optional Course-II	40	40	40	60	2	-	-	100
CE50xT	Department Level Optional Course-III	40	40	40	60	2	-	-	100
CE515L	DLOC Lab-I	--	--	--	--	--	25	25	50
CE516L	Dissertation-I	--	--	--	--	--	25	25	50
TOTAL		**200**	**200**	**200**	**300**	**15**	**50**	**50**	**600**

Department Level Optional Courses :

Every student is required to take 3 Department Elective Courses for Semester I. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

Sr. No	Department Level Optional Course-I	Department Level Optional Course-II	Department Level Optional Course-III
1	**Ethical Hacking and Digital Forensics**	**Data Science**	**Natural Language Processing**
2	IOT Systems and Applications	Information and Cloud Security	Cryptography & System Security
3	Deep Learning	Advanced Operating System	Human Computer Interaction

Program Structure for

Master of Technology in Computer Engineering
Semester II

W.e.f. A.Y 2022-23

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
CE517T	Algorithm and Complexity	03	--	03	--	03
CE518T	User experience Design	03	--	03	--	03
CE5xxT	Department Level Optional Course-IV	03	--	03	--	03
CE5xxT	Department Level Optional Course-V	03	--	03	--	03
CE5xxT	Department Level Optional Course-VI	03	--	03	--	03
CE532L	DLOC Lab-II	--	02	--	01	01
CE533L	Dissertation-II	--	02	--	01	01
TOTAL		**15**	**04**	**15**	**02**	**17**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
CE517T	Algorithm and Complexity -	40	40	40	60	2	--	--	100
CE518T	User experience Design -	40	40	40	60	2	--	--	100
CE5xxT	Department Level Optional Course-IV	40	40	40	60	2	--	--	100
CE5xxT	Department Level Optional Course-V	40	40	40	60	2	--	--	100
CE5xxT	Department Level Optional Course-VI	40	40	40	60	2	--	--	100
CE532L	DLOC Lab-II	--	--	--	--	--	25	25	50
CE533L	Dissertation-II	--	--	--	--	--	25	25	50
TOTAL		**200**	**200**	**200**	**300**	**15**	**50**	**50**	**600**

Department Level Optional Course :

Every student is required to take 3 Department Elective Courses for Semester II. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

Sr. No	**Department Level Optional Course-IV**	**Department Level Optional Course-V**	**Department Level Optional Course-VI**
1	**Big Data Analytics**	**Blockchain Technology-**	**Social Media analytics**
2	ACN and SDN	Cyber security and Laws	High performance computing
3	Internet of Everything	Robotics and its Applications	Computer Vision

Program Structure for
Master of Technology in Computer Engineering

Semester III

W.e.f. A.Y 2023-24

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
CE600LC	Internship / Relevant Certification	-	-	-	03	03
CE601LC	Dissertation-III	-	-	-	12	12
TOTAL		-	-	-	15	**15**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
CE600LC	Internship / Relevant Certification	-	-	-	-	-	50	50	100
CE601LC	Dissertation-III	-	-	-	-	-	100	-	100
TOTAL		-	-	-	-	-	150	50	200

Program Structure for

Master of Technology in Computer Engineering
Semester IV

W.e.f. A.Y 2023-24

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
CE603LC	Dissertation-IV	-	30	-	15	15
		-	30	-	15	**15**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
CE603LC	Dissertation-IV	-	-	-	-	-	100	100	200
TOTAL		-	-	-	-	-	100	100	200

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE500T	Computer programming Paradigms	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE500T	Computer Programming Paradigms	40	40	40	60	-	-	-	100

1. Course Objectives:

1. To Introduce students to functional, logic and concurrent programming paradigms.
2. To Enable students to formulate newer abstractions in the above paradigms.
3. To Familiarize students with writing functional and Object oriented programs.
4. To Prepare students to solve real-world problems using appropriate programming paradigms.

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. Understand and apply the concepts that form the basis of functional, logic and object oriented programming paradigms.
2. Formulate abstractions with procedures and data in different programming paradigms.
3. Write programs in different programming paradigms especially functional, logic and object oriented paradigms.
4. Formulate, implement and solve a given problem scenario using appropriate programming paradigm

3. Detailed Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours
1	**Introduction**	**Overview of different programming paradigms** – Imperative,logical, functional and object-oriented Programming.	**2**

2	**Java Programming**	**Introduction:** Principles of OOP, Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism, Message passing Features of Java Language , Data Types, Operators. **Control Statements:** If-Statement, If-else, Nested-if, Switch Statement, break, continue. **Iteration Statements:** for-loop, while-loop, and do-while-loop.	**8**
3	**Python Programming**	**Introduction:** Features, Identifiers, Keywords, Indention, Variables and Comments, Basic data types: Numeric, Boolean, Compound. **Operators:** Arithmetic, comparison, relational, assignment, logical, bitwise, membership, identity operators, operator precedence. **Control flow statements:** Conditional statements (if, if…else, nested if. Looping in Python: while-loop, for-loop, nested-loops, Loop manipulation using continue, pass, break. **Functions:** Introduction to Functions, Decorators, Iterators and Generators.	**8**
4	**R Programming**	**Introduction:** Basic functionalities of R , data types and operations: numbers, characters and composites, Numeric variables, strings and factors,R packages. **Data structures:** vectors, matrices, lists and data frames.Grouping, loops and conditional execution, Functions. **Exploratory data analysis:** Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot,Graphics and tables , Visualizations and interpretation of results.	**8**
5	**Matlab programming**	**Introduction:** Features, Interface, File Types, Array, Matrix Operation. Arithmetic Operator Logical, Relational. **Branch and Loop:** If-statement, If-else statement, Else-if statement Pause, Break, Continue, Switch-case, try-catch, Return Statement, For Loop,While Loop. Types of Function, Return Types. **Interface and Graphics:** Plotting, Multiple Plot, 2-D Plot, Introduction to Graphical User Interface, GUI Function, Property, GUI Component Design.	**8**
6	**Metaverse Technology**	History, Features, Metaverse value chain, Technologies Involved in the Metaverse. Blockchain Adoption in Metaverse, AR, VR, MR in Metaverse, NFT (non-fungible token) for Metaverse. Financial and Economics of Metaverse, Benefits of Metaverse, Use-cases.	**5**

4. Theory Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/Assignments /Quiz/Case studies/Seminar presentation of 40 Marks.

End Semester Examination: 60 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum

5. Books and References:

A. Books:

1. Scott M L, Programming Language Pragmatics, 4th Edn., Morgan Kaufmann Publishers, 2015
2. E. Balaguruswamy, “Programming with Java A primer”, Fifth edition, Tata McGraw Hill Publication
3. Dr. R. Nageswara Rao, ”Core Python Programming” , Dreamtech Press, Wiley Publication
4. Metaverse: Introduction to The Virtual Reality, Augmented Reality,ISBN-13 : 978-1806030484
5. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
6. Peter I. Kattan, MATLAB for Beginners: A Gentle Approach, 2008. ISBN: 9781438203096

B. References:

1. Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia, 1996.
2. Herbert Schildt, “Java-The Complete Reference”, Tenth Edition, Oracle Press, Tata McGraw Hill Education.
3. Navigating the Metaverse by Cathy Hackl, Dirk Lueth, Tommaso Di Bartolo, John Arkontaky, Yat Siu Released May 2022 Publisher(s): Wiley ISBN: 9781119898993
4. Hands-On Programming with R by Grolemund, O Reilly Publications
5. Stormy Attaway, "MATLAB: A Practical Introduction to Programming and Problem Solving," 2018, Butterworth-Heinemann, ISBN: 978-0128154793

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE501T	Business Communication and Intellectual Property Rights	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE501T	Business Communication and Intellectual Property Rights	40	40	40	60	-	-	-	100

Course Objectives:

1. To provide an outline to effective organisational communication.
2. To enable learners to formulate professional documents in a structured manner that meets the corporate requirements.
3. To foster a comprehensive understanding of marketing strategies for establishing the brand of the business using digital technologies and aim at better customer experience
4. To develop creative and impactful presentation skills
5. To acquaint learners with the procedure of obtaining Patents, Copyrights, Trademarks and Industrial designs
6. To inculcate the ethical code of conduct and corporate etiquettes.

Course Outcomes:

1. Apply business communication strategies and principles to prepare effective communication for developing and presenting business messages.
2. Acquire the writing skills necessary for professional documents to meet the corporate requirement.
3. Understand existing and emerging social media tools to execute a comprehensive communication plan.
4. Able to illustrate effective presentation, research, organisational and creative skills necessary for lifelong learning.
5. Recognize the crucial role of IP in organisations of different industrial sectors for the purposes of product and technology development.

6. Able to determine the importance of ethics and etiquettes in social and professional situations

Prerequisite: Basic language skills

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	BUSINESS COMMUNICATION	1.1 Role of communication in business organisation 1.2 Relevance of communication 1.3 Types- Verbal Non-verbal 1.4 Channels- Vertical, Horizontal and Lateral	2	CO1
II	BUSINESS WRITING	2.1 Business Proposals (SWOT analysis) 2.2 Grant / Research Proposals 2.3 1.2 Memos 2.4 1.3 Press Releases 2.5 1.4 Business Plans	8	CO2
III	DIGITAL SOCIAL MEDIA	3.1 Communicating via Social Media 3.2 Social Media and Public Relations, Social Media strategy and Planning 3.3. Content Strategy. Web Content, Organisation and Distribution 3.4 Social Networking Sites (LinkedIn, Twitter), Photo sharing Sites (Instagram, Snapchat, Pinterest 3.5 News Writing and Community Management 3.6. Facebook and business 3.7. YouTube and Live Streaming	6	CO3
IV	SPEAKING SKILLS	4.1 Speaking on Panels, Moderating Panels, Speaking as keynote or Individual Talk 4.2 Introducing speakers, Summarising speeches and Meeting conference content 4.3 Presentation Skills- Visually present relationship between two or more data sets Data Presentation Methods- Line graph, Column chart, Vertical bar, scatter plot Presentation style- Audience analysis, Care and concern for the audience, effective use of transitions and animations, slide design and content.	7	CO4
V	INTELLECTUAL PROPERTY FOR BUSINESS	5.1. Meaning, Relevance, Business Impact, Protection of Intellectual Property 5.2. Types of Intellectual Property **Copyrights** – Introduction, Nature of copyright, Indian copyright law, copyright works, Author and	8	CO5

		ownership of copyright, Licensing of copyrights, Infringement of copyrights, Remedies and actions, Copyright for digital media, Software/ Internet **Patents-** Concept of patent, Product/Process Patents, Patent Law, Patentable subject matter, Patentability criteria, Duration of patent, Procedure for filing Patent Application, Types of Applications, Procedure of Opposition, Revocation of Patents, Ownership and Maintenance of Patents, Compulsory licensing, Qualification and registration Procedure **Trademarks-** Introduction, Rationale of protection of trademark as (a) an aspect of commercial and (b) of consumer rights, Kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks), Indian Trademarks Law, Procedure for Registration of Trademarks, Non Registrable Trademarks, Infringement of Trademarks and Right of Goodwill, Offences and Penalties **Trade secrets** **Designs-** Need for Protection of Industrial designs, Procedure and Infringement **Geographical Indications –** Concept, Procedure of Registration, duration of protection, Infringement, Penalties and Remedies		
VI	ETHICS AND ETHICAL CODE OF CONDUCT	6.1 Writing Resume and statement of purpose 6.2 Business and corporate activities(special emphasis on business meetings, emails, blogs and web pages) 6.3 Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions.	4	CO6

Text Books:

References:

1.Raman Meenakshi & Singh Prakash, *Business Communication Second edition,* Oxford University Press, Paperback, 2012.
2. Jeremy Harris Lipschultz, *Social Media Communication: Concepts, Practices, Data, Law and Ethics Third edition,* Paperback, 2020
3. V. K. Ahuja, *Intellectual Property Rights In India,* Hardcover, 2015

Sr. No.	Details of Assignments	Details of Activities	Hours	CO Mapping
I	Written assignment on summarising a research proposal 4 page grant proposal (to be included as part of term work)	Example of summarising techniques to be demonstrated.	4	CO1, CO2
II	Written assignment on blog posts, web content	NA	4	CO1, CO3, CO4
III	Presentation skills	Mock Presentation	6	CO1, CO4
IV	Written Assignment on Resume writing/Statement of Purpose.	NA	2	CO2, CO6
V	Written Assignment on Intellectual Property	NA	4	CO5

Term work will consist of-

1. Assignments-10 marks
2. Grant Proposal- 10 marks
3. Attendance -5 marks
4. Presentation- 15 marks

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Ethical Hacking and Digital Forensics	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Ethical Hacking and Digital Forensics	40	40	40	60	-	-	-	150

1. Course Objectives:The course is aimed to:

1. To understand underlying principles of Ethical hacking and digital forensic practices.
2. To learn gathering information from various cyber spaces.
3. Perform security scan to test the applications and systems for vulnerability.
4. Understand and deal with the hacking environment and strategies for covering attack tracks.
5. To learn the importance of incident response and evidence handling in digital forensics
6. To apply digital forensic knowledge to use various digital forensic tools for live data collection

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. Describe principles of Ethical hacking and digital forensic
2. Gather the information required for Digital forensics and Ethical hacking from various cyber spaces
3. Evaluate testing plan for applications and systems for vulnerability
4. Understand hacking environments and learn hacker hiding techniques
5. Explain the methodology of incident response and various security issues
6. Install and Examine various Digital forensics tools for data collection.

3. Detailed Theory Syllabus:

Prerequisite: Cryptography and Security, Computer Networks, Basics of various operating systems.

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Ethical Hacking and Digital Forensics	Introduction to Ethical hacking: definition, difference between hacking and ethical hacking. Vulnerability, Attack Vector. Five stages of hacking: Reconnaissance, Probing, Actual attack, maintaining presence, Covering attack tracks, Digital Forensic, Rules for Digital Forensic, The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Digital Evidences: Types and characteristics and challenges for Evidence Handling.	4
2	Information Gathering	**Information gathering:** from social media accounts, extraction of photographs, exit data, phone number, vehicle registration number, dumpster dumping, google street view and google history. Social Engineering techniques, Google Dork query, Browser extension to collect information. Principles of Ethical hacking (Legality & Ethics) Introduction to OWAPS, types of OWAPS	6
3	Enumeration and System Hacking	**Scanning & Enumeration**: Port Scanning, Network Scanning, Vulnerability Scanning, NMAP Scanning tool, OS Fingerprinting, Enumeration. **System Hacking**: Password cracking techniques, Keyloggers, Escalating privileges, URL Hiding Files, Sniffers & SQL Injection: Active and passive sniffing, ARP Poisoning, Session Hijacking, DNS Spoofing, Conduct SQL Injection attack, Countermeasures. Study of open-source scanning tools.	7
4	Hacking Environment by Hiding hacker details	Installation and configuration of DVWA environment. Virtual box installation, Installation of Kali Linux within virtual box. Kali Linux penetration testing and ethical hacking tools. What is TOR? How can you use it to protect your anonymity online? Proxy chain for using proxy servers, hiding your IP and obtaining access. What is VPN and how you can stay anonymous with VPN. Mac-changer, use of mac-changer to change your MAC address. Incident Response and Forensic Analysis.	8
5	Incident Response Methodology	Incident Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, IR Process – Initial Response, Investigation, Remediation, Tracking of Significant, Investigative Information, Reporting Pre-Incident Preparation, Incident Detection	6

6	Digital Forensic Tools	Live Data Collection: Live Data Collection on Microsoft Windows Systems: Live Data Collection on Unix-Based Systems Forensic Duplication Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools Disk and File System Analysis: Media Analysis Concepts, File System Abstraction Model The Sleuth Kit : Installing the Sleuth Kit , Sleuth Kit Tools Partitioning and Disk Layouts : Partition Identification and Recovery, Redundant Array of Inexpensive Disks Special Containers : Virtual Machine Disk Images, Forensic Containers Hashing, Carving : Foremost , Forensic Imaging : Deleted Data , File Slack , dd , dcfldd , dc3dd Data Analysis Analysis Methodology Investigating Windows systems , Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis, Writing a Report, sample for writing a forensic report	8

4. Theory Assessment:

A. **Internal Assessment:** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Mark Rhodes-Ousley, “Information Security: The Complete Reference”, Second Edition, McGraw-Hill, 2013
2. Dafydd Stuttard, Marcus Pinto, “Web Application Hacker's Handbook”, Wiley
3. Skoudis E. Perlman R. “Counter hack: A step by step Guide to Computer Attacks and Effective Defense”, Prentice Hall Professional technical Reference, 2001.
4. Jason Luttgens, Matthew Pepe, Kevin Mandia, “Incident Response and computer forensics”,3rd Edition Tata McGraw Hill, 2014.
5. Nilakshi Jain, Dhananjay Kalbande,”Digital Forensic: The fascinating world of Digital Evidences” Wiley India Pvt Ltd 2017.
6. Cory Altheide, Harlan Carvey”Digital forensics with open-source tools “Syngress Publishing, Inc. 2011.

B. References:

1. James S. Tiller, “The Ethical Hack: A Framework for Business Value Penetration Testing”, Auerbach Publications, CRC Press
2. EC-Council, “Ethical Hacking and Countermeasures Attack Phases”, Cengage Learning
3. Michael Simpson, Kent Backman, James Corley, “Hands-On Ethical Hacking and Network

Defense", Cengage Learning
4. The Hacker Playbook: Practical Guide to Penetration Testing", by Peter Kim, January 1, 2014
5. Clint P Garrison "Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data, Syngress Publishing, Inc. 2010
6. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations" . Cengage Learning, 2014
7. Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.
8. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	IoT Systems and Applications	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	IoT Systems and Applications	40	40	40	60	-	-	-	100

1. Course Objectives:

The course is aimed to:

1. To understand the basic concepts of IoT.
2. To learn the architecture and levels in IoT
3. To identify the different technologies for implementing IoT
4. To study different types of sensors and its applications
5. To learn different applications in IoT.

2. Course Outcomes:On successful completion of course learner/student will be able to:

1. Describe the basic concepts of IoT
2. Design architecture for an IoT application
3. Apply IoT technologies and communication to design an application
4. Identify the requirements for the real world problems.
5. Develop solutions for different real time IoT applications
6. Design and implement different IoT applications in IoT.

3. Detailed Theory Syllabus:

Prerequisite: Computer Networking, Microprocessors and Interfacing

Module	Module	Detailed Contents of Module	Hrs.

No			
1	Introduction to IoT	Basics of Internet of Things, Smart Objects, Smart Environments, Machine to Machine Communications, Industrial Internet of Things, Who Works on the Internet of Things?, Internet of Things Framework	3
2	Architecture of IoT	Convergence of IT and OT, IoT Challenges, M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack – Design considerations and Data related problems, Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud	7
3	Technologies in IoT	WSN: ZigBee, BLE, WiFi, LTE, IEEE 802.15.4,Cloud Computing, Big Data Analytics. Middleware Technologies Service Discovery, Data Exchange, Computation, Application Layer Technologies, Identity-Related Services, Information Aggregation Services, Collaborative Aware Services, Ubiquitous Services, Business Layer Technologies, Semantics IoT Platforms and Operating Systems	10
4	Things in IoT	Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications Actuators -– Definition, Principles, Classifications, Types, Characteristics and Specifications Smart Object – Definition, Characteristics and Trends Sensor Networks – Architecture of Wireless Sensor Network, Network Topologies	6
5	IoT Design and Prototype	IoT Hardware - Arduino, Raspberry Pi, ESP32, Cloudbit/Littlebits, Particle Photon, Beaglebone Black, IoT Software - languages for programming IoT hardware, A comparison of IoT boards and platforms in terms of computing, development environments and communication standards and connectivity, Software platform	5
6	IoT Applications	Introduction, Internet of Things -Based Precision Agriculture, IoT Application in Agriculture Irrigation, IoT Application in Agriculture Fertilization, IoT Application in Crop Disease and Pest Management. The Internet of Things and People in HealthCare- The Smart Health Care Ecosystem, The Patient at the Center, HealthCare Providers, Devices and Sensors, Applications and Interfaces	5

4. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted

when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Hassan, Q. F, "Internet of things A to Z: technologies and applications"Wiley; IEEE Press, 2018.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.
3. Arsheep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", University Press, FIRST Edition, 2015

B. References:

1. Serpanos, Dimitrios, and Marilyn Wolf. Internet-of-things (IoT) systems: architectures, algorithms, methodologies. Springer, 2017
2. Donal Norris. " The Internet of Things", Mc Graw Hill 2015
3. Rajkumar Buyya, Amir Vahid Dastjerdi, " Internet of Things Principles and Paradigms", Morgan Kaufmann Elsevier

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Deep Learning	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Deep Learning	40	40	40	60	-	-	-	100

1. Course Objectives:

The course is aimed to:

1. To present the mathematical, statistical and computational challenges of building neural networks
2. To apply Deep Learning models to real world problems in an efficient and optimized way.
3. To understand Convolution Neural Networks for solving various computer vision problems.
4. To understand Recurrent Neural Networks basic concepts.
5. To apply RNN for solving various sequence modelling problems.
6. To learn to apply pre-trained models for solving various deep learning problems.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Understand basics of neural networks
2. Improve Neural Network using various hyperparameter tuning.
3. Design Convolutional Neural Network for various applications
4. Apply Recurrent Neural Network to real life problems
5. Understand and use sequence models
6. Understand transfer learning models

3. Detailed Theory Syllabus:

Prerequisite: Machine Learning, Applied Mathematics

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Deep Learning and Neural Networks basics	What is a neural network? Supervised Learning with Neural Networks, Binary Classification and Logistic Regression, Gradient Descent, Shallow neural networks, Deep Neural Networks	4
2	Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization	Practical Aspects of Deep Learning- Bias / Variance, Regularization, Normalizing inputs, Weight Initialization for Deep Networks, Optimization algorithms- Mini-batch gradient descent, Gradient descent with momentum, RMSprop, Adam optimization algorithm, Hyperparameter tuning- Using an appropriate scale to pick hyperparameters, Normalizing activations in a network, Fitting Batch Norm into a neural network, SoftMax Regression, Batch Normalization and Programming Frameworks	8
3	Convolutional Neural Networks	Edge Detection, Padding, Strided Convolutions, One Layer of a Convolutional Network, Pooling Layers Deep convolutional models- ResNets, Networks in Networks and 1x1 Convolutions, Inception Network, Object Detection-Object Localization, Landmark Detection, Object Detection, Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Intersection Over Union, Non-max Suppression, Anchor Boxes	8
4	Recurrent Neural Networks	Recurrent Neural Network Model, Backpropagation through time, Different types of RNNs, Language model and sequence, generation, Vanishing gradients with RNNs, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), Bidirectional RNN, Deep RNNs	8
5	Sequence models & Attention mechanism	Basic Models, Picking the most likely sentence, Beam Search, Refinements to Beam Search, Error analysis in beam search, Attention Model, Speech recognition, Trigger Word Detection	5
6	Transfer Learning	What is transfer learning? What is a Pre-trained Model? use of pre-trained models, Customize a pretrained model: Feature Extraction, Fine-Tuning, Transfer Learning Implementation using VGG16 Model/ MobileNetV2/YOLO/GloVe/ ResNet50	4

4. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer
2. A Guide to Convolutional Neural Networks for Computer Vision, Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, Morgan & Claypool Publishers
3. Recurrent Neural Networks: Design and Applications, Larry Medsker, CRC-Press
4. Natural Language Processing in Action: Understanding, analyzing, and generating text with Python, Hobson Lane, Cole Howard, Hannes Hapke, Manning Publications
5. Transfer Learning, Qiang Yang, Yu Zhang, Wenyuan Dai, SinnoJialin Pan, Cambridge University Press

B. References:

1. Grokking Deep Reinforcement Learning by Miguel Morales, Manning Publications,2020
2. Deep Learning by Josh Patterson, Adam Gibson Released August 2017, O'Reilly Media, Inc.
3. Deep Learning with Python by François Chollet, Manning Publications,2017
4. Practical Deep Learning for Cloud, Mobile and Edge: Real-World AI and Computer Vision Projects Using Python, Keras and TensorFlow by Koul, A. and Ganju, S. and Kasam, M.,O'Reilly Media, Inc.,2019

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Data Science	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Data Science	40	40	40	60	-	-	-	100

1. Course Objectives:The course is aimed to:

1. To understand the foundations of the Data Science process, methods and techniques.
2. To understand management of data and make predictions over the data.
3. To understand the principles of text analytics.
4. To understand why visualization is an important part of data analysis.
5. To understand the ethical responsibilities of data scientists and organizations.
6. To work on various applications of data science.

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. Learn the fundamentals of data science to enable, reproduce and scalable data from a variety of sources.
2. Generate and process dataset and develop models for prediction
3. Analyze text for common theme and trends
4. Design visualizations and narrate stores based on data
5. Develop data science project ethically
6. Analyze importance and impact of data science in varied applications

3. Detailed Theory Syllabus:

Prerequisite: BDA, ML, DBMS, Python, NLP

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to data science	Definition, working, defining goal, benefits and uses of Data Science, Data science vs BI, The data science process, Role of a Data Scientist.	5
2	Data management and Predictive modeling	Data management - Understanding how to create the data set, Data collection methods, Data preparation - importance of data 'cleaning', validity and quality. Data analysis - how format and volume of data limits methods of analysis available Predictive Modeling - Probability and Statistics Basics, Common machine learning models, Feature engineering, Model selection, Performance metrics and hyperparameter optimization, Model Deployment	8
3	Text Analytics	Introduction to text Analytics, Need of Text Analytics, Understanding Text, Cleaning Text Data Sets, Text Classification, Text Clustering, Text mining techniques	5
4	Data visualization and communication	Identifying audience requirements, Data scientist as 'storyteller', Building a narrative, Explaining the technical - how to communicate the role played by ML and/or AI techniques resulting in an informed audience, Introduction to Data Visualization, Visualization Tools(Area Plots, Histograms ,Bar Charts, Pie Charts, Box Plots, Scatter Plots, Waffle Charts, Word Clouds), Visualizing Geospatial Data, visualizing time series data, Importance of data visualization Dashboards	8
5	Ethics of data science	Responsibilities of actuaries around data science and AI, Data Science Ethics, Doing good data science, Owners of the data, Valuing different aspects of privacy, Getting informed consent, The Five Cs, Developing ethical and professional safeguards	5
6	Applications	Healthcare, Banking, Finance, Sports, Advertisement, Transport, Tourism	5

4. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.

2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

1. Davy Cielen, Meysman, Mohamed Ali, “Introducing Data Science”, Dreamtech Press
2. Kevin P. Murphy, “Machine Learning a Probabilistic Perspective”, The MIT Press
3. Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O’ Reilly, 1st edition, 2018
4. Noel Cressie, Christopher K. Wikle , “Statistics for Spatio-Temporal Data, Wiley
5. Rachel Schutt and Cathy O’Neil, “Doing Data Science”, O’Reilly Media
6. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media
7. EMC Education Services,”Data Science and Big Data Analytics”,Wiley

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Information and Cloud Security	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Information and Cloud Security	40	40	40	60	-	-	-	100

1. Course Objectives:The course is aimed to:

1. To introduce the concepts of Information Security, Vulnerabilities, Threat and Risk Assessment.
2. To explore the concepts of Unintentional (Non Malicious) Programming, Malicious Code and Malwares.
3. To explore the concepts of Linux/Windows Operating System vulnerabilities and security.
4. To explore the concepts of Database Security.
5. To understand IT Security Management and Risk Assessment and web application security.
6. To explore cloud privacy and Security.

2. Course Outcomes:On successful completion of course learner/student will be able to:

1. To understand the concepts of Information Security, Vulnerabilities, Threat and Risk Assessment.
2. To understand the concepts of Unintentional (Non Malicious) Programming, Malicious Code and Malwares.
3. To be able to apply the concepts of security in Linux/Windows Operating System to protect against vulnerability.
4. To be able to apply the knowledge of Database Security to protect the Information.
5. Able to understand IT Security Management and apply the knowledge of security principles to protect web applications.
6. To be able to apply the knowledge of security for cloud data storage and secure server - client configuration.

3. Detailed Theory Syllabus:

Prerequisite: Computer Networks, Operating Systems, Cryptography and Network Security.

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Information Security	Security Goals, Computer Security Concepts (CIA), Attacks and Assets, Vulnerabilities, Threat and Risk Assessment, Types of assessments for Information Security, Authentication, Authorization and Access Control Policies, FIM	6
2	Program and Programming Security	Software Flaws - Unintentional (Non Malicious), Programming - Buffer Overflow, Incomplete Mediation, Race Conditions, Malicious Code—Malware -Malware—Viruses, Trojan Horses, and Worms, Miscellaneous Software Based Attacks - Salami Attacks, Linearization Attacks, Covert Channel, Control Against Program Threats, Countermeasures for Users and Developers	7
3	Operating Systems and Security	OS Security Functions, Security in the Design of Operating, Systems, Memory and address Protection , File Protection, User Authentication Linux and Windows Vulnerabilities, File System Security	7
4	Database Security and Network Security	Introduction to Databases, Security Requirements of Databases, Reliability and Integrity of Databases, Database Disclosure, Threats in Network, Firewall, IDS, Secure E-Mail, Security Information and Event Management (SIEM)	6
5	IT Security Management Web application security	IT Security Management and Risk Assessment, IT Security Controls, Plans, and Procedures , Top 10 OWASP, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks	5
6	Cloud privacy and security Issue	Cloud Security Issues and Threats, Data security and Storage, Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth	8

4. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Information Security The Complete Reference 2nd Edition Mark Rhodes-Ousley McGraw Hill Education
2. Information Security Principles and Practice 2nd edition by Mark Stamp, Wiley Publications
3. Security in Computing FIFTH EDITION Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Prentice Hall Publications
4. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O'Riely

B. References:

1. Computer Security Principles and Practice Third Edition William Stallings, Lawrie Brown Pearson Publications.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. Cloud Computing Principles and Paradigms, Rajkumar Buyya Wiley
4. Cloud security, Ronald L. Wiley Publication

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Advanced Operating System	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Advanced Operating System	40	40	40	60	-	-	-	100

1. Course Objectives: The course is aimed to:

1. To learn the architectural differences and issues related to the Advanced Operating System.
2. To learn the Parallel system.
3. To get a comprehensive knowledge of the distributed systems.
4. To get a comprehensive knowledge of Real time operating systems.
5. To get a thorough knowledge of database operating systems
6. To get a thorough knowledge of various operating systems.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Apply the principles and concepts in analyzing and designing Advance Operating Systems.
2. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating systems.
3. Analyze the performance and reliability of different Advanced Operating Systems.
4. Demonstrate the various Scheduling Algorithms.
5. To be able to understand the database Operating system.
6. To be able to understand the various Operating Systems.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Operating Systems,	Introduction to Operating Systems, Design Principles & Concepts, Operating System History and Evolution, Processes, Processes scheduling, Memory Management, Virtual Memory	5
2	Parallel Systems	Shared memory machines, Synchronization Communication, Lightweight RPC, Scheduling, Shared memory multiprocessor OS	6
3	Distributed Operating System	Issues in Distributed Operating System, Architecture, Communication Primitives, Lamport's Logical clocks, Causal Ordering of Messages, Distributed Mutual Exclusion Algorithms, Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols. Distributed File Systems Design Issues Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Checkpointing and Recovery Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.	8
4	Real Time and Mobile Operating System	Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Microkernel Design, Resource Access, Processes and Threads : Scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals- Memory Management - File system.	8
5	Database Operating systems	Concurrency control : Database systems, Concurrency control model of database systems, Problem of Concurrency Control, serializability theory, Distributed Database Systems Concurrency Control Algorithms : Basic synchronization Algorithms, Lock based, Timestamp based and Optimistic Algorithms, Concurrency Control Algorithms : Data Replication	6
6	Case Study	DOS: Mach, .RTOS : UNIX as RTOS , Windows as RTOS, Linux OS, Mobile OS.	5

4. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems" .MC Graw Hill education.
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson education.

B. References:

1. Andrew S.Tanenbaum, "Modern Systems Principles and Paradigms". PHI.
2. Pradeep K.Sinha, "Distributed Operating System-Concepts and design", PHI.
3. Andrew S.Tanenbaum, "Distributed Operating System", Pearson Education.
4. Jane W. S. Liu, “Real Time Systems”, Pearson education.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Natural Language Processing	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Natural Language Processing	40	40	40	60	-	-	-	100

1. Course Objectives: The course is aimed to:

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To understand the basic text processing techniques and significance of morphology.
3. To get acquainted with the basic concepts and algorithmic description of the main language levels: syntax, semantics.
4. To understand language models generation and applications.
5. To recognize the significance of pragmatics and discourse for natural language understanding.
6. To design and implement applications based on natural language processing

2. Course Outcomes: On successful completion of course learner student:

1. Have a broad understanding of the field of natural language processing.
2. Be able to apply text processing techniques and analysis of morphology of text
3. Be able to model linguistic phenomena with formal grammars and design semantic structure
4. Be able to create language model and apply it for NLP applications
5. Understand the mathematical and linguistic foundations underlying approaches to analyse pragmatic and resolve coreference
6. Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction...etc.

3. Detailed Theory Syllabus:

Prerequisite: Data structure & Algorithms, Theory of computer science, Probability Theory.

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction	Introduction to Natural Language Processing, History of NLP, Natural Language Generation, Natural Language Understanding, Generic NLP system, Ambiguity in Natural language, Stages in NLP, Challenges of NLP	3
2	Morphology analysis and Language modeling	Text Processing Challenges, Pre-processing of text (tokenization, text filtration, script validation, stop words), Survey of English and Indian Language Morphology, Inflectional morphology & Derivational morphology, Stemming (Porter stemmer), Lemmatization, Regular expression, Morphological parsing with FST, The role of language models, Simple N-gram models, N-gram for spelling correction.	8
3	Syntax analysis	Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank), Rule based POS tagging, Stochastic POS tagging, Introduction to CFG, Parsing with CFG,Sequence labelling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).	8
4	Semantic Analysis	Lexical Semantics, Attachment for fragment of English-sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses (Homonymy, Polysemy, Synonymy, Hyponymy) WordNet, Vector Space Models of Semantics, Word Sense Disambiguation (WSD), Semantic Role Labelling, Semantic Parsing	6
5	Discourse Context and World Knowledge	Pragmatic analysis and understanding, Discourse: reference resolution, Reference Phenomena, Preferences in Pronoun Interpretation and resolution, Syntactic and Semantic Constraints on Coreference, Coreference Resolution: Coreference, Distinctions in Coreference, Coreference vs. Anaphora, Application,Challenges of Coreference Resolution	6
6	Applications of NLP	Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition,Plagiarism Detection	8

4. Theory Assessment:

A. **Internal Assessment (IA):**
Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed.Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. Books:

1. Sharvari Govilkar, Sagar Kulkarni, Dhiraj Amin — Natural Language Processing, 2018, StartEDU solutions.
2. Daniel Jurafsky, James H. Martin —Speech and Language Processing‖ Second Edition, Prentice Hall, 2008.
3. Christopher D.Manning and Hinrich Schutze, — Foundations of Statistical Natural Language Processing —, MIT Press, 1999.

B. References:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. Daniel M Bikel and ImedZitouni — Multilingual natural language processing applications Pearson, 2013.
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) — The Handbook of Computational Linguistics and Natural Language Processing
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
5. Brian Neil Levine, An Introduction to R Programming
6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial: An introduction into R application and programming.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE50xT	Cryptography and System Security	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE50xT	Cryptography and System Security	40	40	40	60	-	-	-	100

1. Course Objectives:The course is aimed to:

1. To introduce the concepts of modular arithmetic and number theory and their application in Classical Encryption techniques.
2. To explore the working principles and utilities of various cryptographic algorithms including Secret Key Cryptography and Public Key Cryptography.
3. To explore various hashing and Message Digest Algorithms to achieve Confidentiality and Integrity.
4. To explore the design issues and working principles of various authentication protocols, PKI standards and different digital signature algorithms to achieve authentication.
5. To explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
6. To develop the ability to use existing cryptographic utilities to build programs for secure communication.

2. Course Outcomes:On successful completion of course learner/student will be able to:

1. Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
4. Apply different digital signature algorithms to achieve authentication and design secure applications
5. Understand network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Analyze and apply system security concepts to recognize malicious code.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Content	Hrs.
1	Introduction and Number Theory	Security Goals, Services, Security Mechanisms and attacks, The OSI security architecture, Network Security Model, Classical Encryption Techniques, Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography. Modular Arithmetic and Number Theory:- Euclid‘s algorithm, Prime numbers, Fermat‘s & Euler‘s theorem - Testing for primality, The Chinese remainder theorem and its application, Discrete logarithms.	9
2	Symmetric and Asymmetric key Cryptography and key Management	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC5 algorithm Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, ElGamal Algorithm. Key management techniques: using symmetric and asymmetric algorithms. Diffie Hellman Key exchange algorithm.	8
3	Hashes, Message Digests and Digital Certificates	Cryptographic hash functions, Hash function requirements, Hash function uses, MD5, SHA-1, MAC, HMAC, CMAC Digital Certificate: X.509 format, PKI	4
4	Authentication Protocols & Digital signature schemes	Authentication Requirement and Functions, Types of Authentication, User Authentication and Entity Authentication, One-way and mutual authentication schemes, Needham Schroeder Authentication protocol, Kerberos Authentication protocol. Importance of Digital Signature, Digital Signature Schemes – RSA, EIGamal signature schemes	6
5	Network Security and Applications	Network Security Basics,TCP/IP Vulnerabilities (Layer-wise): Application layer: HTTP, DHCP Transport layer: TCP syn flood, Port Scanning, Network layer: IP Spoofing, Packet sniffing, Data link layer: ARP Spoofing, ARP cache poisoning DOS: Classic DOS attacks: Ping flood, ICNP flood, UDP flood, Distributed DOS, Defenses against DOS attacks, Internet Security Protocols: SSL, IPSEC, Secure Email: PGP, Firewall, Honey Pots, IDS	8

6	System Security	Software Vulnerabilities: Buffer Overflow, Format string, SQL injection, Malwares: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits	4

4. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

A. **Books:**

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, ―Cryptography & Network Security‖, Tata Mc Graw Hill
3. Bernard Menezes, ―Cryptography & Network Security‖, Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley.

B. **References:**

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.
3. Build your own Security Lab, Michael Gregg, Wiley India
4. CCNA Security, Study Guide, TIm Boyles, Sybex.
5. Network Security Bible, Eric Cole, Wiley India.
6. Web Application Hacker‘s Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE403TL	Human Computer Interaction	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE403TL	Human Computer Interaction	40	40	40	60	--	--	--	100

1. Course Objectives:

The course is aimed to:

1. Understand the history of screen designing.
2. Understand the importance of human characteristics, design goals and business functions in interface design.
3. Understand functions of Menus, Windows and importance of graphical user interface.
4. Understand characteristics and selection of device based controls.
5. Understand different types of software tools to design interfaces.
6. Understand various design technologies to meet user requirements..

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Describe and apply core theories, models and methodologies from the field of HCI
2. Identify User Interface (UI) design principles.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Evaluate interactive software using guidelines from human factor theories.
5. Conduct user and task analysis
6. Implement graphical user interfaces with modern software tools

3. Detailed Theory Syllabus:

Prerequisite: GUI Basics

Module No	Module	Detailed Contents of Module	Hrs.
1	Overview of HCI	Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user	5
2	Design process	Design process: Human interaction with computers, importance of human characteristics, human consideration, and Human interaction speeds, understanding business functions. Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design	8
3	System Menus	System Menus – Structures of Menus, Functions of Menus, Content of Menus, Kinds of Graphical menus. Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Graphics: Icons, Multimedia, colors, uses problems, choosing colors.	5
4	Controls	CONTROLS: Characteristics of device based controls, Selecting the proper device based controls, Operable controls, Text Entry/Read-only controls, Selection controls, Combination Entry/selection controls, Selecting the proper controls.	5
5	HCI in the software process,	HCI in the software process, The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction	8
6	Software Tools	SOFTWARE TOOLS: Specification methods, Interface, Building tools, Interaction devices, Keyboard and function keys, Pointing devices, Speech recognition digitization and generation, Image and video displays, Drivers.	5

4. Suggested Experiments:

1. To understand the trouble of interacting with machines – Redesign interfaces of home appliances.
2. Design a system based on a user-centered approach.
3. Understand the principles of good screen design.
4. Redesign existing Graphical User Interface with screen complexity
5. Design Web User Interface
6. Implementation of Different Kinds of Menus
7. Implementation of Different Kinds of Windows
8. Design a system with proper guidelines for icons
9. Design website using interface design rules

10. Design mobile app using interface design rules

5. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Practical Assessment: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. Books:

1. The essential guide to user interface design, Wilbert O Galitz, Wiley DreamTech.
2. Designing the user interface. 3rd Edition Ben Shneidermann , Pearson Education Asia.
3. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004.

B. References:

1. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech,
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Donald A. Norman, “The design of everyday things”, Basic book

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE515L	DLOC Lab-I	Contact Hours	-	2	-	2
		Credits	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE515L	DLOC Lab-I	-	-	-	-	25	--	25	50

Detailed Contents :

1 Minimum 4 Laboratory Practical's to be conducted for each of the DLOC subjects as suggested in the subject syllabus.

Modality and Assessment:

1. Each Laboratory assignment will be done by each individual student. The Faculty teaching each DLOC subject will be required to propose and evaluate the respective Laboratory assignments. These will be essentially hands-on practical and not theory / research review types of assignments.

2. End Semester Examination: An oral examination is to be conducted by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE516L	Dissertation -I	Contact Hours	-	2	-	2
		Credits	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE516L	Dissertation -I	-	-	-	-	25	-	25	50

Guidelines for Dissertation-I

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with the Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt to solve the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope
- Quality of Written and Oral Presentation

Dissertation I should be assessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Semester II

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE517T	Algorithm and Complexity	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE517T	Algorithm and Complexity	40	40	40	60	-	-	-	100

Course Objectives:

1. To analyze the algorithms using space and time complexity.
2. To teach problem formulation and problem solving skills.
3. To acquire knowledge of various applied algorithms.
4. To understand selected topics in algorithms that have found applications in areas such as geometric modelling, graphics, robotics, vision, computer animation, etc.
5. To demonstrate the algorithms and optimize them
6. To apply the algorithms on real life problem

Course Outcomes: At the end of the course student should be

1. Able to analyze the complexity of algorithms
2. Able to compare the algorithms
3. Able to select correct algorithms for applications in areas such as geometric modelling, graphics, robotics, vision, computer animation
4. Able to apply the algorithms and design techniques to solve problems.
5. Able to Optimize the algorithms
6. Able to deploy the algorithms

Prerequisite: Data structure, Analysis of Algorithms, Set Theory

Sr.No.	Module	Detailed Content	Hours	CO Mapping
1	Foundations	• Algorithms, Analysing algorithms, Growth of Functions-Asymptotic notation, Mathematical Background for algorithm analysis • Recurrences, The substitution method, The recursion-tree method, The master method, Randomized algorithms	**4**	**CO1, CO2**
2	Advanced Design and Analysis Techniques	• Dynamic Programming-Elements of dynamic programming, Matrix-chain multiplication • Greedy Algorithms-Elements of the greedy strategy, Huffman codes • Amortized Analysis-Aggregate analysis, The accounting method, The potential method, Dynamic tables	**6**	**CO1, CO2**
3	Graph Algorithms	• Single-Source Shortest Paths-The Bellman-Ford algorithm, Dijkstra's algorithm, Difference constraints and shortest paths • All-Pairs Shortest Paths-The Floyd-Warshall algorithm • Maximum Flow-Flow networks, The Ford-Fulkerson method, Maximum bipartite matching	**8**	**CO3, CO4, CO5**
4	Computational Geometry	• Line-segment properties, Determining whether any pair of segments intersects, • Finding the convex hull, Finding the closest pair of points	**8**	**CO3, CO4, CO5**
5	NPC and Approximation Algorithms	• NP-Completeness: NP-completeness and reducibility, NP-completeness proofs, NP-complete problems, • Approximation algorithms: The vertex-cover problem, The traveling-salesman problem, The set-covering problem, The subset-sum problem	**10**	**CO3, CO4, CO5**
6	Applied Algorithms	• Number-Theoretic : Number Theoretic notion, Greatest common divisor, The Chinese remainder theorem, RSA • String Matching Algorithms: The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm, Longest common subsequence • Facebook Graph Search algorithm • Probabilistic Algorithm: Game Theoretic Techniques • Randomized Algorithms: Monte Corlo and Las Vegas algorithms	**12**	**CO3, CO4, CO5**

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI, India Second Edition
2. Horowitz, Sahani and Rajsekaran, Fundamentals of Computer Algorithms", Galgotia
3. Rajeev Motwani, PrabhakarRaghavan, " Randomized Algorithm", Cambridge University Press

Reference Books:

1. Aho, Hopcroft, Ullman: The Design and analysis of algorithms", Pearson Education
2. Vijay V. Vajirani, "Approximation Algorithms",Springer.
3. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI
4. SanjoyDasgupta, Christos Papadimitriou, UmeshVazirani, "Algorithms", Tata McGraw- Hill Edition

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE407TL	User Experience Design	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE407TL	User Experience Design	40	40	40	60	-	-	--	100

1. Course Objectives:

The course is aimed to:

1. To study and understand importance of user experience design principles
2. To understand elements of user experience design
3. To encourage students to participate in designing futuristic applications
4. To understand data visualization interaction design.
5. To understand prototype design.
6. To understand usability testing.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. To Apply principles of user experience
2. To apply emerging and established technologies to enhance User Experience design
3. To create an interface for international standards with ethics.
4. To design prototypes.
5. To apply usability tests.
6. To evaluate user experience

3. Detailed Theory Syllabus:

Prerequisite: Web Technologies, Software Engineering, Human Computer Interaction

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction	Introduction to interface design, Understanding and conceptualizing Interface, Understanding User's conceptual cognition.	4
2	Elements of UX Design	Core Elements of User Experience, Working of UX elements	4
3	The UX Design Process – Understanding Users	Defining the UX, Design Process and Methodology, Understanding user requirements and goals, Understanding the Business Requirements/Goals, User research, mental models, wireframes, prototyping, usability testing.	8
4	The UX Design Process- The Structure: Information Architecture and Interaction Design	Visual Design Principles, Information Design and Data Visualization Interaction Design, Information Architecture, Wire framing & Storyboarding, UI Elements and Widgets, Screen Design and Layouts	8

5	UX Design Process: Prototype and Test	Testing your Design, Usability Testing, Types of Usability Testing, Usability Testing Process, Preparing and planning for the Usability Tests, Prototype your Design to Test, Introduction of prototyping tools, conducting Usability Test, communicating Usability Test Results	8
6	UX Design Process: Case study and application Design Activity	Select any problem statement Apply UX design steps and concepts to provide low fidelity and high fidelity design , Prototype.	4

4. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5**. Books and References:**

A. Books:

1. Interaction Design, Beyond Human Computer Interaction, Rogers, Sharp, Preece Wiley India Pvt Ltd.
2. The essentials of Interaction Design, Alan Cooper, Robert Reimann, David Cronin.
3. Designing The user Interface by Shneiderman, Plaisant,Cohen,Jacobs Pearson.

B. References:

1. The Elements of User Experience by Jesse James Garrett.
2. Don’t make me think, by Steve Krug.
3. Observing the User Experience: A Practitioner's Guide to User Research by Mike Kuniavsky.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	Big Data Analytics	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	Big Data Analytics	40	40	40	60	-	-	-	100

1. Course Objectives:

The course is aimed to:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
3. To introduce programming skills to build simple solutions using big data technologies such as NoSql, Map-Reduce and write the parallel algorithm for multi process execution.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To enable students to have skills that will help them to solve complex real-world problems in decision support.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2. Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Content	Hrs.
1	Overview Of big data analytics	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	3

2	Data analytics using MapReduce/ Hadoop	Introduction to Big Data Frameworks: Hadoop, Core Hadoop Components; Hadoop Ecosystem-Overview, Hadoop Limitations. MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce	10
3	No SQL	Introduction to NoSQL, NoSQL Business Drivers, NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study, NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	6
4	Mining Data Streams	The Stream Data Model: A Data- Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm.	12
5	Finding Similar Items and Clustering	Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance. CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets, Answering Queries.	10
6	Real-Time Big Data Models	PageRank Overview, Efficient computation of PageRank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. Introduction to Recommendation System: content based Recommendation System, collaborative Recommendation System, hybrid Recommendation System. Issues and challenges Recommendation System Big Data Case Studies – How big companies use Big Data : Walmart, Netflix, eBay etc….	4

		Demonstration of Graph Database : NEO4J Example: Social Network Circle ,	

4. Suggested Experiments:

Software Requirements if any: Windows / Linux Desktop OS / Kali Linux, Hadoop, R studio, Mongodb

1. HDFS Basics, Hadoop Ecosystem Tools Overview.
Installing Hadoop.
2. Copying File to Hadoop.
3. Copy from Hadoop File system and delete file.
4. Moving and displaying files in HDFS.
5. Programming exercises on Hadoop.
6. To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
7. Experiment on Hadoop Map-Reduce / PySpark:
8. Write a program to implement a word count program using MapReduce.
9. Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.
10. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language
11. Implementing any one Clustering algorithm (K-Means/CURE) using Map-Reduce
12. Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web)

5. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Term Work Assessment: The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practical's based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance).

7. Books and References:

A. **Books:**

1. CreAnand Rajaraman and Jeff Ullman Mining of Massive Datasets, Cambridge University Press,
2. Alex Holmes Hadoop in Practice, Manning Press, Dreamtech Press.
3Dan Mcary and Ann Kelly Making Sense of NoSQL – A guide for managers and the rest of us Manning Press

B. **References:**

1. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press
2. Alex Holmes “Hadoop in Practice”, Manning Press, DreamTech Press. [3] Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.
3. Bill Franks , “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley
4. Chuck Lam, “Hadoop in Action”, Dreamtech Press
5. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”,
6. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publication

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE 314	Advanced Computer Network with S/w Defined Network	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE 314	Advanced Computer Network with S/w Defined Network	40	40	40	60	-	-	--	100

1. Course Objectives:

The course is aimed to:

1. To make learners aware about advances in Optical Network technologies.
2. To give an overview of IPv6 Protocol
3. To understand the ICMPv6 protocol
4. To give an overview of advanced internet protocols.
5. To learn how an SDN enabled network makes a difference w.r.t. traditional network and the key benefits of SDN by the separation of data and control planes
6. To understand open flow protocols and learn how to use SDN in various fields.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Demonstrate the understanding of WAN Technology typically ATM .
2. Explore the issues of advanced internet routing protocols.
3. Explore the IPv6 and ICMPv6 protocol
4. Demonstrate the understanding of protocol used for management of networks.
5. Able to implement the operation of SDN control plane with different controllers
6. Able to apply the knowledge of Openflow in various SDN applications.

3. Detailed Theory Syllabus:

Prerequisite: Data Communication Networks, Computer Networks

Module No	Module	Detailed Contents of Module	Hrs.
1	Optical Networks:	SONET/SDH standard, Architecture, Format, Hardware, Configuration, advantages, WAN Technology Introducing ATM Technology, Need and Benefit, Concept, Faces of ATM	6
2	Understanding IPV6	Introduction to IPv6,Features of IPv6,IPv6 Terminology, The Case for IPv6 Deployment,IPv6 Protocol for Windows,IPv6 Addressing, The IPv6 Header,IPv6 Extension Headers,IPv6 and Name Resolution	8
3	ICMPv6	ICMPv6 Overview, Types of ICMPv6 Messages,ICMPv6 Header,ICMPv6 Error Messages, Comparing ICMPv4 and ICMPv6 Messages, Neighbour Discovery, Duplicate Address Detection	6

4	Advance Routing Protocols	Multicast Routing: Reverse Path Broadcasting, Internet Group Management Protocol, Reverse Path Multicasting, Discrete (Distance) Vector Multicasting protocol, IP forwarding Architectures, Overlay Model: Classical IP over ATM and LANE (LAN -emulator), Multiprotocol Label Switching MPLS : Fundamentals of Labels, Label Stack, VC Merging, Label ,Integrated services, RSVP, Differentiated Services Multimedia Over Internet: RTP, Session Control Protocol H.323	8
5	Introduction to SDN	Basics of SDN, Traditional Switch Architecture, SDN Architecture and Characteristics, Need of SDN, Centralized and Distributed Control and Data Planes, The Working principle of SDN - SDN Controllers, SDN Operations, SDN Devices, SDN Applications and Alternate SDN Methods	6
6	Open Flow Specifications and SDN Use cases	Openflow Architecture, OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases	5

4. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Term Work Assessment: The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

6. Books and References:

A. Books:

1. M. A. Gallo and W. M. Hancock, Computer Communications and Networking Technologies, Cengage Learning, (1e).
2. Understanding IPv6 Third Edition, Joseph Davies
3. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014
4. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

B. References:

1. Andrew Tanenbaum― Computer Networks‖, Prentice Hall, (5e).
2. Cisco Certified Network Analyst study guide, Wiley Publishing House.(7e).
3. Douglas E. Comer, Internetworking with TCP/IP Volume One, (6e).
4. James F. Kurose, Keith W. Ross, ―Computer Networking, A Top-Down Approach Featuring the Internet‖, Addison Wesley, (5e).
5. Software Defined Networking with OpenFlow By Siamak Azodolmolky, Packt Publishing, 2013

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	Internet of Everything	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	Internet of Everything	40	40	40	60	-	-	-	100

1. Course Objectives:

The course is aimed to:

1. To learn the concepts of IOT.
2. To identify the different technologies.
3. To learn different applications in IOT.
4. To learn different protocols used in IOT.
5. To learn the concepts of smart city development in IOT.
6. To learn how to analyze the data in IOT.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Apply the concepts of IOT.
2. Identify the different technologies.
3. Apply IOT to different applications.
4. Analysis and evaluate protocols used in IOT.
5. Design and develop smart cities in IOT.
6. Analysis and evaluate the data received through sensors in IOT.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Content	Hrs.
1	Introduction	Definition of Internet of Everything (IoE), Pillars of IoE, Relationship between M2M, IoT and IoE, Objects and Identifier.	3
2	RFID Technology	Introduction, Principle, Components and Architecture of RFID, RFID middleware, Issues in RFID, IPv6 Addressing Schemes and Electronic Product Code, RFID Applications and case studies, Hardware issues.	8

3	RFID Protocols	Types of Protocols : Pure, Slotted, Frame slotted ALOHA, Tree protocols, Tree splitting algorithms, Binary search algorithms, Bitwise arbitration protocols, Main query tree protocols. Basic Differences between protocols.	8
4	Communication Protocols and Localization	Introduction to Wireless Sensor Network, Protocols: MQTT, CoAP, REST Transferring data, Basic Difference between Protocols, Security IoT Protocols and Technology: CoAP and DTLS, Localization, mobility management	8
5	Industrial Internet of Things	Introduction ,Industry 4.0 , Industrial Internet of Things (IIoT) , IIoT Architecture , Basic Technologies Applications and Challenges	8
6	Data Analytics for IoE	Big Data Analytics, Cloud and Fog Computing in the Internet of Things: IoT System Requirements, Cloud Computing in IoT ,Advantages of Using the Cloud for IoT, Examples of Cloud - Based IoT	4

4. Suggested Experiments:

Software Requirements if any: Arduino IDE, Tinkercad, Proteus

1. Create a Problem statement based on Survey, identify the Hardware and software requirement for their mini project problem statement.
2. Study of IoT architecture with respect to your mini project.
3. Identify and design the required hardware and sensors for your circuit board configuration.
4. Use suitable software and an emulator for coding the input devices and sensors.
5. Interface hardware with Web to publish or remotely access the data on the Internet.
6. Analyze the readings obtained in the project and identify its future scope
7. Documentation (PPT + Report) of mini-project and technical paper writing.

5. Theory Assessment:

A. **Internal Assessment (IA):**

Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Term Work Assessment: The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. **Books:**

1. Hassan, Q. F, "Internet of things A to Z: technologies and applications",Wiley; IEEE Press, 2018
2. Internet of Things connecting objects to the web, by Hakima Chaouchi, Wiley.
3. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
5. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

B. **References:**

1. The Internet of Things (MIT Press) by Samuel Greengard.
2. The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
3. RFID and the Internet of Things, by Herve chabanne, Wiley
4. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1
5. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess River Publishers, 2013, ISBN: 978-87-92982-96-4 (E-Book), ISBN: 978-87-92982-73-5 (Print)
6. "The Internet of Things Connecting Objects to the Web" Hakima Chaouchi, ISBN: 978-184821-140-7, Willy Publications
7. Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Manoel Carlos Ramon Apress, 2014.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	BlockChain Technology	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	BlockChain Technology	40	40	40	60	25	-	-	125

1. Course Objectives: The course is aimed to:

1. Understand how blockchain systems work
2. Understand the use of cryptography required for blockchain
3. Integrate ideas from blockchain technology into their own projects.
4. Understandthe concept of public blockchain
5. Understandthe concept of private blockchain
6. Design, build, and deploy smart contracts and distributed applications using cryptocurrency

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. Explain blockchain concepts.
2. Apply cryptographic hash required for blockchain.
3. Apply the concepts of smart contracts for an application.
4. Design a public blockchain using Ethereum.
5. Design a private blockchain using Hyperledger.
6. Design a blockchain application

3. Detailed Theory Syllabus:

Module No	Module	Detailed Content	Hrs.
1	Introduction to Blockchain Technology	What is a blockchain, Origin of blockchain (cryptographically secure hash functions), Foundation of blockchain: Merkle trees, Components of blockchain, Block in blockchain, Types: Public, Private, and Consortium, Consensus Protocol, Limitations and Challenges of blockchain	5

2	Cryptocurrency	Cryptocurrency: Bitcoin, Altcoin, and Tokens (Utility and Security), Cryptocurrency wallets: Hot and cold wallets, Cryptocurrency usage, Transactions in Blockchain, UTXO and double spending problem, Bitcoin blockchain: Consensus in Bitcoin, Proof-of-Work (PoW), Proof-of-Burn (PoB), Proof-of-Stake (PoS), and Proof-of-Elapsed Time (PoET), Life of a miner, Mining difficulty, Mining pool and its methods	6
3	Programming for Blockchain	Introduction to Smart Contracts,Types of Smart Contracts, Structure of a Smart Contract, Smart Contract Approaches, Limitations of Smart Contracts Introduction to Programming: Solidity Programming –Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struct, Mapping, Inheritance, Error handling Case Study –Voting Contract App, Preparing for smart contract development	6
4	Public Blockchain	Introduction to Public Blockchain, Ethereum and its Components, Mining in Ethereum, Ethereum Virtual Machine (EVM), Transaction, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum Types of test-networks used in Ethereum, Transferring Ethers using Metamask, Mist Wallet, Ethereum frameworks, Case study of Ganache for Ethereum blockchain. Exploring etherscan.io and ether block structure.	7
5	Private Blockchain	Introduction, Key characteristics, Need of Private Blockchain, Smart Contract in a Private Environment, State Machine Replication, Consensus Algorithms for Private Blockchain -PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT Introduction to Hyperledger, Tools and Frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes, Transaction Flow, Working of Hyperledger Fabric, Creating Hyperledger Network, Case Study of Supply Chain Management using Hyperledger	8
6	Blockchain in Action: Use Cases	Use case in Financial Services, Insurance, Government, Supply Chain Management, Healthcare, Healthcare payments pre-authorization, The Internet of Things (IoT), Agriculture	6

4. Suggested Experiments:

Software Requirements if any: Python, Java Scripts, Geth

1. Implementation of any symmetric and asymmetric cryptosystem.
2. Simple blockchain implementation in any suitable programming language
3. Block chain implementation with database
4. Smart contract with token/coin.
5. Smart Contract to solve/optimize a problem using Ethereum
6. Use Geth to Implement Private Ethereum BlockChain
7. Create a DApp, with Ethereum
8. Create wallet in Metamask and connect it to Ganache Test Network
9. Create a Case study of BlockChain being used in the real world.

5. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Term Work Assessment: The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. **Books:**

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhillash K. A and Meena Karthikeyen, Universities Press.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum,and more, 3rd Edition, Packt Publishing

B. **References:**

1. Blockchain Basics A Non-Technical Introduction In 25 Steps
2. Introduction to Blockchain Technology Author: Tiana Laurence
3. Mastering Ethereum, Andreas M. Antonopoulos, O'relly
4. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
5. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
6. Blockchain with Hyperledger Fabric,Luc Desrosiers, Nitin Gaur, SalmanA. Baset, Venkatraman Ramakrishna, Packt Publishing
7. https://solidity.readthedocs.io/en/v0.6.2/

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	Cyber Security and Laws	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	Cyber Security and Laws	40	40	40	60	25	-	25	150

1. Course Objectives: The course is aimed to:

1. To understand and identify different types of cybercrime and cyber law.
2. To recognize Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.

2. Course Outcomes: On successful completion of course learner/student will be able to.

1. Able to understand the concept of cybercrime and its effect on the outside world.
2. Able to Interpret and apply IT law in various legal issues.
3. Able to distinguish different aspects of cyber law.
4. Able to develop the various cyber security algorithms.
5. Able to Apply Information Security Standards compliance during software design and development.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Contents of Module	Hrs.
1	Introduction to Cybercrime	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes	04

2	Cyber offenses & Cybercrime	How criminal plan the attacks, Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	09
3	Tools and Methods Used in Cyberline	Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer OverFlow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	06
4	The Concept of Cyberspace	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	08
5	Indian IT Act. and Information Security Standard compliances	Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments, The Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021.SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI	06
6	.Case Studies	● Study google dork query useful for ethical hacking. ● Find all available open source scanning tools and prepare a comparative table on these parameters, operating system support, ability to search, scanning time, ability to detect vulnerabilities and ease of use. ● Prepare cheat sheet for all OWASP top 10 attacks ● Analysis of SQL Injection Using DVWA Tool ● List and compare all available free to use proxy and VPN services.	06

4. Suggested Experiments:

1. To study the steps to protect your personal computer system by creating User Accounts with Passwords and types of User Accounts for safety and security.
2. Study the steps to protect a Microsoft Word Document of different versions with different operating systems.
3. Study various methods of protecting and securing databases.
4. Study “How to make strong passwords” and “passwords cracking techniques” using ERD Commander, Cain & able.
5. Web browser Security- Browser Security IE(Mozilla Firefox, Google Chrome) Add-ons.(Firebug, WOT).
6. Cryptography using PGP and Truecrypt.

7. Steganography using S-Tools and Snow.
8. Email Security (Header Analysis. Email Tracker pro., Read notify).
9. Mobile Security Apps- Smartphone encryption.
10. Ethical Hacking Information Gathering Tool – Samspade (Nslookup , Whois, Tracert,) Scanning Tool(Angry IP Scanner, Nmap).
11. Protection of Information Assets using Recuva.

5. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% of the syllabus is completed. Duration of each test shall be one and a half hours.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Practical Assessment: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

A. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. **Books:**

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi.
2. The Indian Cyber Law by Suresh T. Vishwanathan, Bharat Law House New Delhi.
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai.
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi.

A. **References:**

1. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
2. William Stallings, Cryptography and Network Security, Pearson Publication.
3. Websites for more information are available on: The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in.
4. Website for more information, A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals33538

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	Robotics and its Applications	Contact Hours	3	2	-	5
		Credits	3	1	-	4

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	Robotics and its Applications	40	40	40	60	25	-	-	125

1. Course Objectives: The course is aimed to:

1. Learn the basics of Robots.
2. Learn the concepts of Direct and Inverse Kinematics of Robotics.
3. Learn the concepts of Motions, velocities and dynamic analysis of force.
4. Learn the concepts of Trajectory planning.
5. Learn the concepts of Motion Planning
6. Learn the concepts of Potential Functions and Visibility Graphs

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. Apply the basic concepts of Robots.
2. Apply and evaluate the concepts of Direct and Inverse Kinematics of Robotics.
3. Apply and evaluate the Motions, velocities and dynamic analysis of force.
4. Apply and evaluate Trajectory Planning for rigid robots and mobile robots.
5. Apply the concepts of Motion planning.
6. Apply the concepts of Potential Functions and Visibility Graphs

3. Detailed Theory Syllabus:

Module No	Module	Detailed Content	Hrs.

1	Introduction to Robotics	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications, Soft and Hard automation	3
2	Direct and Inverse Kinematics	Homogeneous transformation ,matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit- Hatenberg representation of forward kinematics, Inverse kinematic solutions, 4-axis Scara Robot	8
3	Motions, velocities and dynamic analysis of force	Differential relationship, Jacobian, Lagrangian mechanics, Moments of Inertia, Transformation of forces and moment between coordinate frames	6
4	Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	7
5	Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	5
6	Potential Functions and Visibility Graphs	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs	8

4. Suggested Experiments:

1. Forward Kinematics of Cylindrical Robot Coordinates
2. Forward Kinematics of 3 DOF Robot using D-H algorithm
3. Inverse Kinematics of 2 DOF Robots.
4. Inverse Kinematics of 3 DOF Robot
5. Inverse Kinematics of 3 DOF Robot Arm
6. Trajectory using Third Order Polynomial.
7. Simulation of BUG 2 Algorithm
8. Simulation of Tangent BUG
9. Simulation of Potential Field
10. Simulation of Visibility Graphs.

5. Theory Assessment:

A. **Internal Assessment (IA):** Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and a half hours.

B. **End Semester Theory Examination:** In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Term Work Assessment: The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practical's based on the above list. Also Term work

Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. **Books:**

1. Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition, 2011
2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, "Principles of Robot Motion – Theory, Algorithms and Implementations", Prentice-Hall of India, 2005.

B. **References:**

1. Mark W. Spong & M. Vidyasagar, "Robot Dynamics & Control", Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, "Learning ROS for Robotics Programming", Shroff Publishers, First Edition, 2013.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE410TL	Social Media Analytics	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE410TL	Social Media Analytics	40	40	40	60	-	--	-	100

1. Course Objectives: The course is aimed to:
1 Familiarize the learners with the concept of social media.
2 Familiarize the learners with the concept of social media analytics and understand its significance.
3 Enable the learners to develop skills required for analyzing the effectiveness of social media.
4 Familiarize the learners with different tools of social media analytics.
5 Familiarize the learner with different visualization techniques for Social media analytics.
6 Examine the ethical and legal implications of leveraging social media data.

2. Course Outcomes:
On successful completion of course learner/student will be able to:
1 Understand the concept of Social media
2 Understand the concept of social media Analytics and its significance.
3 Learners will be able to analyze the effectiveness of social media
4 Learners will be able to use different Social media analytics tools effectively and efficiently.
5 Learners will be able to use different effective Visualization techniques to represent social media analytics.
6 Acquire the fundamental perspectives and hands-on skills needed to work with social media data.

3. Detailed Theory Syllabus:

Prerequisite: Graph Theory, Data Mining, Python/R programming

Module No	Module	Detailed Contents of Module	Hrs.
1	Social Media Analytics: An Overview	Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. Purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social	6

		Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools	
2	Social Network Structure, Measures & Visualization	Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools	6
3	Social Media Text, Action & Hyperlink Analytics	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools	8
4	Social Media Location & Search Engine Analytics	Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools	6
5	Social Information Filtering	Social Information Filtering - Social Sharing and filtering , Automated Recommendation systems, Traditional Vs social Recommendation Systems Understanding Social Media and Business Alignment, Social Media KPI, Formulating a Social Media Strategy, Managing Social Media Risks	6
6	Social Media Analytics : Case studies	Text Analytics with Semantria, Analyzing Social Media Networks with NodeXL,Analyzing Social Media Actions with Hootsuite,Apps Analytics with Countly,location analytics using Google Fusion Tables, Hyperlinks Analytics with VOSON,Search Engine Analytics with Google Trends,	7

4. Suggested Experiments:

1 Study various -

i)Social Media platforms (Facebook, twitter, YouTube etc)

ii)Social Media analytics tools (Facebook insights, google analytics net lytic etc)

iii) Social Media Analytics techniques and engagement metrics (page level, post level, member level)

iv) Applications of Social media analytics for business.

e.g. Google Analytics

https://marketingplatform.google.com/about/analytics/

https://netlytic.org/

2.Data Collection-Select the social media platforms of your choice (Twitter, Facebook, LinkedIn, YouTube, Web blogs etc) ,connect to and capture social media data for business (scraping, crawling, parsing).
3.Data Cleaning and Storage- Preprocess, filter and store social media data for business (Using Python, MongoDB, R, etc).
4.Exploratory Data Analysis and visualization of Social Media Data for business.
5.Develop Content (text, emoticons, image, audio, video) based social media analytics model for business.
(e.g. Content Based Analysis :Topic , Issue ,Trend, sentiment/opinion analysis, audio, video, image analytics)
6.Develop Structure based social media analytics model for any business.
(e.g. Structure Based Models -community detection, influence analysis)
7.Develop a dashboard and reporting tool based on real time social media data.
8.Design the creative content for promotion of your business on social media platform.
9 .Analyze competitor activities using social media data.
10. Develop social media text analytics models for improving existing product/ service by analyzing customer's reviews/comments.

5. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Practical Assessment: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. Term Work: Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

A. Books:

1.Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan,(ISBN-10: 1507823207).

2.Analyzing the Social Web 1st Edition by Jennifer Golbeck

3.Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, Matthew A Russell, O'Reilly

4Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

B. References:

1.Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, Avinash Kohirkar, IBM Press

2.Social Media Analytics Strategy_ Using Data to Optimize Business Performance, Alex Gonçalves, APress Business Team

3.Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulus (2019), Wiley, ISBN 978-1-118-82485-6

4.Python Social Media Analytics: Analyze and visualize data from Twitter, YouTube, GitHub, and more Kindle Edition by Siddhartha Chatterjee , Michal Krystyanczuk

5.Learning Social Media Analytics with R,by Raghav Bali, Dipanjan Sarkar, Tushar Sharma.

6. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann, 2013

7. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media, 2013.

7. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE413TL	High Performance Computing	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE413TL	High Performance Computing	40	40	40	60	-	--	-	100

1. Course Objectives:

The course is aimed to:

1. To learn fundamental concepts of parallel processing.
2. To learn utilization of high performance computing resources using programming frameworks.
3. To learn usage of modern processor technology as a high performance computing platform.
4. To learn and appreciate core design issues in parallel computing.
5. To study application of high performance computing to practical problems.
6. To understand factors limiting performance of high performance computing systems.

2. Course Outcomes:

On successful completion of course learner/student will be able to:

1. Memorize and Understand classes of parallel computer architectures.
2. Understand standardized, multi-platform communication methods for parallel programming.
3. Understand usage of graphical processing unit hardware as high performance computing unit.
4. Analyze fundamental issues in parallel computing.
5. Understand parallel computing implementation for a computationally intensive problem.
6. Understand practical limitations of technology for high performance computing.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Contents of Module	Hrs.
1	Parallel Processing Concepts	Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc), Architectures: N-wide superscalar architectures, multi-core, multi-threaded	6
2	Parallel Programming with MPI, OpenMP	Processor Architecture, Interconnect, Communication, Memory Organization, and Programming, building blocks of MPI, Overlapping communication and computation, collective communication operations, OpenMP Threading Building blocks; An Overview of Memory Allocators, Parallel programming model, combining MPI and OpenMP, Shared memory programing	12
3	Parallel Programming using GPU	Models in high performance computing architectures: (Examples: Nvidia Tesla GPU), Memory hierarchy and transaction specific memory design, Thread Organization, An Overview of CUDA, Programming with CUDA	8

4	Fundamental Design Issues in Parallel Computing	Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms to Parallel Architectures, Performance Analysis of Parallel Algorithms	8
5	Fundamental Limitations Facing Parallel Computing	Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their limitations	3
6	Application of HPC	CASE study in HPC	2

4. Suggested Experiments:

1. Study and Write case study on your College network.
2. Write a program for matrix multiplication using MPI.
3. Write a program for matrix addition using OpenMP.
4. Write a program for matrix addition using CUDA.
5. Write a program for parallel quicksort algorithms.
6. Write a program to Send messages to parallel computers connected through the network and find latency.
7. Write a case study on application of HPC.

5. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one and half hour.

A. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

6. Practical Assessment: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. Term Work: Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

A. Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

7. Books and References:

1. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 1993
2. "Parallel Programming in C with MPI and OpenMP", Michael J. Quinn, McGraw-Hill International Editions, Computer Science Series, 2008.
3. "CUDA by Example – An Introduction to General Purpose GPU Programming",Edward Kandrot and Jason Sanders, Addison-Wesley Professional ©, 2010.
4. NVIDIA TESLA V100 GPU ARCHITECTURE
5. "Introduction to Parallel Computing",AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , Pearson Education, Second Edition, 2007.

6. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.

B. .References:

1. "Case for Energy Proportional Computing", L. Barraso and Holzl, IEEE Computer Dec 2007.
2. "High Performance Computing: Paradigm and Infrastructure", Lawrence Yang, Minyi Guo, Wiley, 2006

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE5xxT	Computer Vision	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE5xxT	Computer Vision	40	40	40	60	-	-	-	100

1. Prerequisite: Basic coordinate geometry, matrix algebra, linear algebra

2. Course Objectives: The course aims to:

1. To introduce fundamentals of computer vision and its relationship with Artificial Intelligence.
2. To learn the process of image formation, transformation and geometric primitives using a digital camera.
3. To learn various algorithms in computer vision.
4. To study various algorithms for Image Descriptors and Features.
5. To explore pattern recognition and classification techniques using ANN and CNN.
6. To know computer vision applications such as motion estimation, segmentation and object recognition.

2. Course Outcomes: On successful completion of course learner/student will be able to:

1. To describe fundamentals of Computer Vision and distinguish between Image Processing and Computer Vision and also explain its relationship with other domains like AI,ML etc.
2. To describe the process of image formation and storage using digital devices.
3. To remember and apply image pre-processing techniques required for computer vision.
4. To extract color, texture and shape features from images to describe and perform analysis.
5. To implement classification techniques to identify and recognize objects.
6. To identify and apply computer vision techniques in real life situations.

3. Detailed Theory Syllabus:

Module No	Module	Detailed Contents of Module	Hrs.	COs
I	Introduction	What is Computer Vision (CV), Challenge of CV, Tasks in CV, Difference between Image Processing and CV, Relationship of Artificial Intelligence and CV.	3	CO1
II	Image Formation	**Transformations:** Camera, Sampling and aliasing, Geometric primitives. 2D and 3D transformation, 3D rotations, 3D to 2D projections, Lens distortions. **Photometric image formation:** Lighting, Reflectance and shading, Optics.	6	CO2
III	Image Preprocessing	**Image Enhancement:** Point Processing, Mask Processing, Spatial and Frequency Domain Filtering. **Image Transforms:** Haar, Curvelet, Ridgelet, Shearlet, Contourlet Transform **Image Morphology**: Binary Morphological operations, Dilation, Erosion, Opening and Closing. Grayscale Morphological operations.	8	CO3
IV	Image Feature Representation	**Image Features:** Color, Texture, Shape. Histogram of Oriented Gradients, Scale Invariant Feature Transform. **Image Representation and Description**: Chain Code, Shape Number, Fourier Descriptors, Image Moments. **Texture Descriptors:** Texture representation methods,Gabor filter, MPEG-7 homogeneous texture descriptor **Edge Detection:** Gradient-based methods, Laplacian of Gaussian operator, Difference of Gaussian Operator, Canny Edge Detector, Hough Transform.	8	CO4
V	Pattern Recognition and Classification	**Introduction to Pattern Recognition:** Linear Regression, Decision Functions, Statistical Decision Theory, Gaussian Classifier, Parameter Estimation, Dimension Reduction, Template Matching. **Image Classification:** Artificial Neural Network (ANN), Convolutional Neural Networks (CNNs), Autoencoder.	8	CO5
VI	Applications of Computer Vision	Motion Estimation and Object Tracking, Gesture Recognition, Face and Facial Expression Recognition, Image Fusion, Medical Image Segmentation.	4	CO6

5. Suggested Experiments for DLOC Lab:

Software Requirements if any: Python.

1. Install OpenCV for Python on Windows & Manipulate with the images Images.
2. Image Processing:
    a. Image Processing:OpenCV Resize Image ,OpenCV Image Rotation
    b. OpenCV Drawing Functions,Eroding an Image,Blurring an Image,Create Border around Images, Grayscaling of Images,Scaling, Rotating, Erosion and Dilation of images
    c. Convert an image from one color space to another ,Filter Color with OpenCV Denoising of colored images,Visualizing image in different color spaces

3.Feature Detection:

a. OpenCV Blob Detection,Canny Edge Detection
b. OpenCV Image Smoothing
c. Shifting and Edge Detection
d. Line detection using Hough Line method
e. Circle Detection
f. Detect corner of an image

4.Histogram:

a. Analyze an image using Histogram,Histograms Equalization, Simple Thresholding Adaptive Thresholding
b. OpenCV Image Threshold OpenCV Contours,OpenCV Mouse Event

5.Pattern Recognition and Classification

a. OpenCV Video Capture
b. Face Detection with OpenCV
c. Car detection with OpenCV

6. Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

7. Practical Assessment under DLOC Lab: An Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

A. **Term Work:** Term Work shall consist of practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the topics mentioned in the syllabus.

B. **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

8. Books and References:

A. Text Books:

1. Bhuyan, Manas Kamal. Computer vision and image processing: Fundamentals and applications. CRC Press, 2019.
2. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
3. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010

B. References:

1. Milan Sonka,Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning
2. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
3. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
4. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE532L	DLOC Lab-II	Contact Hours	-	2	-	2
		Credits	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE532L	DLOC Lab-II	-	-	-	-	25	25	-	50

DETAILED SYLLABUS:

Detailed Contents :

1 Minimum 4 Laboratory Practical's to be conducted for each of the DLOC subjects as suggested in the subject syllabus.

Modality and Assessment:

1. Each Laboratory assignment will be done by each individual student. The Faculty teaching each DLOC subject will be required to propose and evaluate the respective Laboratory assignments. These will be essentially hands-on practical and not theory / research review types of assignments.

2. End Semester Examination: An oral examination is to be conducted by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
CE516L	Dissertation -II	Contact Hours	-	2	-	2
		Credits	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
CE516L	Dissertation -II	-	-	-	-	25	-	25	50

Guidelines for Assessment of Dissertation II

Dissertation II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution
- Validation of results
- Quality of Written and Oral Presentation

o Students should publish at least one or two paper based on the work in reputed International / National Conference/Journal (desirably in Referred Journal should be ISI/Scopus/SCI indexing) (desirably in Refereed Journal)

o **Dissertation II** should be accessed through a presentation jointly by Internal and External Examiners appointed by the Head of the department .