

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 30 Years Successfully

B. Tech - COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM AND SYLLABUS

REGULATION 2022

(Based on Choice Based Credit System (CBCS) and

Outcome Based Education (OBE))

Effective from the Academic year 2023-2024

DEPARTMENT OF

COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

To develop a knowledge hub for Computer Science Engineers and Technocrats in application of their competence for the betterment of the Individual, Industry and Society.

MISSION

- To nurture the students to be industry ready by providing a strong conceptual foundation and by enhancing their employability and entrepreneurial skills.
- To provide holistic growth by conducting relevant enrichment programs, which includes curricular, co-curricular, extra-curricular and extension activities.
- To inculcate innovation and creativity through practically viable Internships and Project works.
- To create a Research oriented mindset and focus in fulfilling growing demands of the society through mentoring and lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: Graduates will be engineering practitioners and leaders who will contribute to the solution of industry's technological problems.

PEO2: Graduates will be engineering professionals, innovators, or entrepreneurs working in industry on technology development, deployment, or engineering system implementation.

PEO3: Graduates will perform their jobs with social awareness and responsibility.

PEO4: Graduates will interact with their peers in other disciplines in industry and society, contributing to the country's economic growth.

PROGRAM OUTCOMES (PO)

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 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.

PO 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.

PO 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.

PO 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.

PO 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.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 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.

PO 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.

PO 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.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Apply database design principles and techniques to improve decision-support systems for business analytics.

PSO 2: Design and apply appropriate data analytics models for data profiling and to enrich software standards.

Competencies and Performance Indicators			
PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.			
1.1	Demonstrate competence in mathematical modelling	1.1.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
		1.1.2	Apply the concepts of probability, statistics and queuing theory in modeling of computer-based system, data and network protocols.
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply engineering fundamentals
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.			
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	Evaluate problem statements and identifies objectives
		2.1.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
		2.1.3	Identify mathematical algorithmic knowledge that applies to a given problem

2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	Reframe the computer-based system into interconnected subsystems
		2.2.2	Identify functionalities and computing resources.
		2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
		2.2.4	Compare and contrast alternative solution/methods to select the best methods
		2.2.5	Compare and contrast alternative solution processes to select the best process.
2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
		2.3.2	Identify design constraints for required performance criteria.
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1	Applies engineering mathematics to implement the solution.
		2.4.2	Analyze and interpret the results using contemporary tools.
		2.4.3	Identify the limitations of the solution and sources/causes.
		2.4.1	Arrive at conclusions with respect to the objectives.
PO 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 public health and safety, and cultural, societal and environmental considerations.			
3.1	Demonstrate an ability to define a complex/ open-	3.5.1	Able to define a precise problem statement with objectives and scope

	ended problem in engineering terms	3.1.2	Able to identify and document system requirements from stake- holders
		3.1.3	Able to review state-of-the-art literature to synthesize system requirements.
		3.1.4	Able to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard
		3.1.5	Explore and synthesize system requirements from larger social and professional.
		3.1.6	Able to develop software requirement specifications (SRS).
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Able to explore design alternatives.
		3.2.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
		3.2.3	Identify suitable non-functional requirements for evaluation of alternate design solutions.
3.3	Demonstrate an ability to select optimal design scheme for further development	3.3.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
		3.3.2	Consult with domain experts and stakeholders to select candidate engineering
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Able to refine architecture design into a detailed design within the existing constraints.
		3.4.2	Able to implement and integrate the modules.
		3.4.3	Able to verify the functionalities and validate the design.
PO 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.			
4.1	Demonstrate an ability to conduct investigations of	4.1.1	Define a problem for purposes of investigation, its scope and importance

	technical issues consistent with their level of knowledge and understanding	4.1.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
		4.1.3	Able to choose appropriate hardware/ software tools to conduct the experiment.
4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
		4.3.2	Critically analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.			
5.1	Demonstrate an ability to identify/create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
		5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline specific tools, techniques and	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and

	resources		(iv) creating engineering designs.
		5.2.2	Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
PO 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.			
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public
PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.			

7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	Understand the relationship between the technical, socio- economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
		7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.			
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1	Identify tenets of the ASME professional code of ethics
		8.2.2	Examine and apply moral & ethical principles to known case studies
PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.			
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations Communication,	9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership

	problem solving,conflict resolution and leadership skills		skills
		9.2.2	Treat other team members respectfully
		9.2.3	Listen to other members
		9.2.4	Maintain composure in difficult situations
9.6	Demonstrate success in a team-based project	9.6.1	Present results as a team, with smooth integration of contributions from all individual efforts
PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the 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			
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1	Read, understand and interpret technical and non-technical information
		10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
		10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
		10.2.2	Deliver effective oral presentations to technical and non- technical audiences
10.3	Demonstrate the ability to integrate different modes of	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
	communication	10.3.2	Use a variety of media effectively to convey a message in a document or a presentation
PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments. Competency			

11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1	Describe various economic and financial costs/benefits of an engineering activity
		11.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1	Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
		11.3.2	Use project management tools to schedule an engineering project, so it is completed on time and on budget.
PO 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.			
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	Describe the rationale for the requirement for continuing professional development
		12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
		12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3	Demonstrate an ability to identify and access sources for	12.3.1	Source and comprehend technical literature and other credible sources of

	new information		information
		12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.
PSO 1: Apply database design principles and techniques to improve decision-support systems for business analytics.			
13.1	Ability to investigate complex problems	13.1.1	Identify problem statements and develop smart solutions for real time applications
		13.1.2	Investigate all the probable solutions towards the identified problem
13.2	Design and Develop solutions systematically	13.2.1	Apply database design principles and techniques to propose solutions for business analytics
		13.2.2	Analyze and suggest the testing strategies to develop an optimal solution
		13.2.3	Implement a customized solution using appropriate data analytic techniques
PSO 2: Design and apply appropriate data analytics models for data profiling and to enrich software standards.			
14.1	Develop cost benefit solutions using engineering principles and practices	14.1.1	Describe the rationale for choosing solutions based on engineering principles
		14.1.2	Conduct feasibility and cost-benefit analysis for implementing the solution
14.2	Ability to visualize data through augmented, virtual and mixed reality	14.2.1	Identify the problem and develop an hybrid vision system
		14.2.2	Develop an innovative solution with ethics in multi-disciplinary areas

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES(VISTAS)

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

The Panel members for Board of studies meeting are listed below

S. No	Name of the Board Member	Designation	Institute / Industry
Internal Members			
1	**Dr. R. Anandan**	Professor & Head Department of Computer Science and Engineering Vel's Institute of Science, Technology & Advanced Studies (VISTAS)	Chairman
2	**Dr. S. Arun**	Director, IQAC Vel's Institute of Science, Technology & Advanced Studies (VISTAS)	Internal Member
3	**Dr. R. A. Karthika**	Associate Professor, Department of Computer Science and Engineering Vel's Institute of Science, Technology & Advanced Studies (VISTAS)	Internal Member
4	**Dr. A. Rajesh**	Associate Professor Department of Computer Science and Engineering Vel's Institute of Science, Technology & Advanced Studies (VISTAS)	Internal Member
5	**Dr. K. Kalaivani**	Assistant Professor Department of Computer Science and Engineering Vel's Institute of Science, Technology & Advanced Studies (VISTAS)	Internal Member
External Expert Members			
1	**Dr. Asnath Victy Phamila Y**	Associate Professor School of Computer Science and Engineering Vellore Institute of Technology - VIT Chennai	Academic Expert
2	**Mr. Santhosh Gopynadhan**	Senior Director Optum Global Solutions (India) Private Limited, Chennai	Industrial Expert
Student Member			
1	**Mr. Pavan Srivatsav**	Project Associate Cognizant Technology Solutions, Chennai	Alumni

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING CREDIT DISTRIBUTION

B.TECH CSE ARTIFICIAL INTELLIGENCE AND DATA SCIENCE										
Credits Per Semester										
S. No	**Course Category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total Credits**
1	HSC	-	3	2	2	2	2	-	-	11
2	BSC	10	10	4	7	-	-	-	-	31
3	ESC	8	8	3	-	-	-	-	-	19
4	PCC	-	-	13	15	14	10	4	-	56
5	PEC	-	-	-	-	3	7	7	3	20
6	OEC	-	-	-	-	3	3	6	6	18
7	Project	-	-	-	-	-	-	5	10	15
8	MC	-	-	-	-	-	-	-	-	0
	TOTAL	**18**	**21**	**22**	**24**	**22**	**22**	**22**	**19**	**170**

HSC	Humanities and Social Science Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
EEC	Employability Enhancement Courses
MC	Mandatory Courses

B. TECH CSE ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (Regulation 2022)								
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
SEMESTER 1								
BSC	Chemistry	3	1	-	4	40	60	100
BSC	Mathematics -I (Calculus and Linear Algebra)	3	1	-	4	40	60	100
ESC	Programming for Problem Solving	3	-	-	3	40	60	100
BSC	Chemistry Laboratory	-	-	4	2	40	60	100
ESC	Programming for Problem Solving Laboratory	-	-	4	2	40	60	100
ESC	Workshop and Manufacturing Practices	1	-	4	3	40	60	100
MC	Universal Human Values	2	-	-	0			100
		12	**2**	**12**	**18**			
SEMESTER II								
HSC	English	2	-	-	2	40	60	100
BSC	Physics (Semiconductor Physics)	3	1	-	4	40	60	100
BSC	Mathematics II (Probability and Statistics)	3	1	-	4	40	60	100
ESC	Basic Electrical and Electronics Engineering	3	1	-	4	40	60	100
ESC	Engineering Graphics and Design	1	-	4	3	40	60	100
HSC	English Laboratory	-	-	2	1	40	60	100
BSC	Physics Laboratory (Semiconductor Physics)	-	-	4	2	40	60	100
ESC	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1	40	60	100
MC	Constitution of India	2	-	-	0			100

		14	**3**	**12**	**21**			
SEMESTER III								
BSC	Mathematics III (Fourier Series and Transforms)	3	1	-	4	40	60	100
ESC	Digital Electronics	3	-	-	3	40	60	100
PCC	Operating Systems	3	-	-	3	40	60	100
PCC	Data Structures and Algorithms	3	1	-	4	40	60	100
PCC	Introduction to AI and ML	3	-	2	4	40	60	100
PCC	Operating Systems Lab	-	-	2	1	40	60	100
PCC	Data Structures and Algorithms Lab	-	-	2	1	40	60	100
HSC	Personality Development I	2	-	-	2	40	60	100
MC	Basic Life Skills	2	-	-	0			100
		19	**2**	**6**	**22**			
SEMESTER IV								
BSC	Mathematics IV (Random Process and Queuing Theory)	3	1	-	4	40	60	100
PCC	Computer Organization and Architecture	3	-	-	3	40	60	100
PCC	Database Management Systems	3	-	-	3	40	60	100
PCC	Computer Networks	3	-	-	3	40	60	100
PCC	Introduction to Data Science	3	-	2	4	40	60	100
PCC	Database Management Systems Lab	-	-	2	1	40	60	100
PCC	Computer Networks Lab	-	-	2	1	40	60	100
HSC	Personality Development II	2	-	-	2	40	60	100
BSC	Environmental Science and Engineering	3	-	-	3	40	60	100
		20	**1**	**6**	**24**			

SEMESTER V								
PCC	Java and Web Programming	3	-	-	3	40	60	100
PCC	Mobile Application Development	3	-	-	3	40	60	100
PEC	Professional Elective Course - I	3	-	-	3	40	60	100
OEC	Open Elective Course - I	3	-	-	3	40	60	100
PCC	Deep Learning and Predictive Modeling	3	-	2	4	40	60	100
PCC	Java and Web Programming Lab	-	-	2	1	40	60	100
PCC	Mobile Application Development Lab	-	-	2	1	40	60	100
HSC	Personality Development III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL /SWAYAM/Coursera/Math works) - Minimum 4 weeks	-	-	4	2			100
		17	-	**10**	**22**			

SEMESTER VI								
PCC	.Net Programming	3	-	-	3	40	60	100
PCC	Computational Data Analytics	3	-	-	3	40	60	100
PEC	Professional Elective Course - II	3	-	-	3	40	60	100
PEC	Professional Elective Course - III	3	-	2	4	40	60	100
OEC	Open Elective Course - II	3	-	-	3	40	60	100
PCC	.Net Programming Lab	-	-	2	1	40	60	100
PCC	Computational Data Analytics Lab	-	-	2	1	40	60	100
HSC	Personality Development - IV	2	-	-	2	40	60	100
PCC	Summer Internship (4 weeks)	-	-	4	2			100
		17	-	**10**	**22**			

SEMESTER VII								
PCC	Full Stack Web Development	3	-	-	3	40	60	100
OEC	Open Elective Course - III	3	-	-	3	40	60	100
OEC	Open Elective Course - IV	3	-	-	3	40	60	100
PEC	Professional Elective Course - IV	3	-	-	3	40	60	100
PEC	Professional Elective Course - V	3	-	2	4	40	60	100
PCC	Full Stack Web Development Lab	-	-	2	1	40	60	100
Project	Project Phase I	-	-	10	5	40	60	100
		15	**-**	**14**	**22**			
SEMESTER VIII								
PEC	Professional Elective Course - VI	3	-	-	3	40	60	100
OEC	Open Elective Course - V	3	-	-	3	40	60	100
OEC	Open Elective Course - VI	3	-	-	3	40	60	100
Project	Project Phase II	-	-	20	10	40	60	100
		9	**-**	**20**	**19**			

LIST OF ALL BASIC SCIENCE COURSES

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
BSC - 01	Physics (Semiconductor Physics)	3	1	-	4
BSC - 02	Mathematics I (Calculus and Linear Algebra)	3	1	-	4
BSC - 03	Physics Laboratory (Semiconductor Physics)	-	-	4	2
BSC - 04	Chemistry	3	1	-	4
BSC - 05	Mathematics II (Probability and Statistics)	3	1	-	4

BSC - 06	Chemistry Laboratory	-	-	4	2
BSC - 07	Mathematics III (Fourier Series and Transforms)	3	1	-	4
BSC - 08	Environmental Science and Engineering	3	-	-	3
BSC - 09	Mathematics IV (Random Process and Queuing Theory)	3	1	-	4

LIST OF ALL HUMANITIES AND SOCIAL SCIENCES COURSES

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
HSC-01	English	2	-	-	2
HSC-02	English Laboratory	-	-	2	1
HSC-03	Personality Development I	2	-	-	2
HSC-04	Personality Development II	2	-	-	2
HSC-05	Personality Development III	2	-	-	2
HSC-06	Personality Development IV	2	-	-	2

LIST OF ALL ENGINEERING SCIENCE COURSES

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
ESC-01	Basic Electrical and Electronics Engineering	3	1	-	4
ESC-02	Engineering Graphics and Design	1	-	4	3
ESC-03	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1
ESC-04	Programming for Problem Solving	3	-	-	3
ESC-05	Workshop and Manufacturing Practices	1	-	4	3
ESC-06	Programming for Problem Solving Laboratory	-	-	4	2

LIST OF ALL PROFESSIONAL ELECTIVE COURSES

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PEC-01	Applied Cryptography	3	-	-	3
PEC-02	Big Data Programming	3	-	-	3
PEC-03	Cloud Computing	3	-	-	3
PEC-04	Cryptography and Network Security	3	-	-	3
PEC-05	Cyber Forensics	3	-	-	3
PEC-06	Data Warehousing and Data Mining	3	-	-	3
PEC-07	E- Commerce	3	-	-	3
PEC-08	Ethical Hacking	3	-	-	3
PEC-09	Information Retrieval	3	-	-	3
PEC-10	Object Oriented Analysis and Design	3	-	-	3
PEC-11	Soft Computing	3	-	-	3
PEC-12	Software Engineering	3	-	-	3
PEC-13	Software Project Management	3	-	-	3
PEC-14	Software Quality Assurance	3	-	-	3
PEC-15	Software Testing	3	-	-	3
PEC-16	System Software	3	-	-	3
PEC-17	User Interface Design	3	-	-	3
PEC-18	Virtual Reality	3	-	-	3
PEC-19	Agile Methodologies	3	-	-	3
PEC-20	Information Security	3	-	-	3
PEC-21	Software Defined Networks	3	-	-	3
PEC-22	Block Chain Technologies	3	-	-	3
PEC-23	Natural Language	3	-	-	3

	Processing				
PEC-24	Applications of AI	3	-	-	3
PEC-25	Information Security Analysis and Audit	3	-	-	3
PEC-26	Intelligent Database System	3	-	-	3
PEC-27	Recommender Systems	3	-	-	3
PEC-28	Text and Speech Analysis	3	-	-	3
PEC-29	Business Analytics	3	-	-	3
PEC-30	Image and Video Analytics	3	-	-	3
PEC-31	Computer Vision	3	-	-	3
PEC-32	Cognitive Science and Analytics	3	-	-	3

S.NO	**COURSE TITLE**	**Hours / Week**			**Credits**
		Lecture	**Tutorial**	**Practical**	
PEC-33	Data Exploration and Visualization	3	-	2	4
PEC-34	Big Data Analytics	3	-	2	4
PEC-35	Python for Data Science	3	-	2	4
PEC-36	NOSQL Database	3	-	2	4
PEC-37	Game Programming	3	-	2	4
PEC-38	Robotics and its applications	3	-	2	4
PEC-39	Concepts of Virtual and Augmented Reality	3	-	2	4
PEC -40	Embedded System for Internet of Things	3	-	2	4
PEC -41	Knowledge Engineering	3	-	2	4
PEC -42	Stream Processing	3	-	2	4
PEC -43	Robotic Process Automation	3	-	2	4
PEC -44	Security and Privacy in Cloud	3	-	2	4

LIST OF ALL MANDATORY COURSES

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
MC	Universal Human Values	2	-	-	-
MC	Constitution of India	2	-	-	-
MC	Basic Life Skills	2	-	-	-

LIST OF OPEN ELECTIVE COURSES OFFERED TO OTHER PROGRAMS

S.NO	COURSE TITLE	Hours / Week			Credits
		Lecture	Tutorial	Practical	
OEC-01	Internet of Things	3	-	-	3
OEC-02	Artificial Intelligence	3	-	-	3
OEC-03	Introduction to Data Analytics	3	-	-	3
OEC-04	Fundamentals of AI and ML	3	-	-	3
OEC-05	UI and UX Design	3	-	-	3
OEC-06	Devops	3	-	-	3
OEC-07	Multimedia and Animation	3	-	-	3
OEC-08	Video Creation and Editing	3	-	-	3

BSC	CHEMISTRY	3	1	0	4

Course Objectives

- To learn about the molecular orbitals, ionic interactions and periodic properties.
- Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

UNIT I Atomic and molecular structure, Intermolecular forces and potential energy surfaces 12

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene, benzene and aromaticity. Valence Bond Theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions, potential energy surfaces of H3, H2F and HCN.

UNIT II Spectroscopic techniques and applications 12

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational, rotational spectroscopy of diatomic molecules, Morse equations and Mossbauer spectroscopy . Applications. Diffraction and scattering

UNIT III Use of free energy in chemical equilibria 12

Thermodynamic functions: energy, entropy , free energy and fugacity. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV Periodic properties 12

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, diagonal relationship, anomalous behaviour of Lithium, carbon and Nitrogen, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V Organic reactions and synthesis of a drug molecule **12**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, Coupling reaction and ring openings. Synthesis of a commonly used drug molecule.

Total Hours: 60

Text Books

1: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
2: Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
3: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

Reference Books

1: Physical Chemistry, by P. W. Atkins.
2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp. 3: University chemistry, by B. H. Mahan.

Web Links:

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
2. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
3. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermodynamics / Chemical_Energetics/Free_Energy and_Equilibrium
4. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Periodic. Trends_of_Elemental_Properties/Periodic_Properties_ of_the_Elements
5. https://www.bcebhagalpur.ac.in/wp-content/uploads/2020/03/Organic-Reactions-Synthesis-of-Drug- Molecule.pdf

COURSE OUTCOMES

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

CO1	Analyze microscopic chemistry in terms of atomic and molecula orbitals and intermolecular forces	**K3**
CO2	Distinguish the ranges of the electromagnetic spectrum used fo exciting different molecular energy levels in various spectroscopi techniques.	**K2**
CO3	Analyze bulk properties and processes using thermodynami considerations	**K3**
CO4	Classify the properties and reactivity of different types of elemen based on the periodic table	**K3**
CO5	Apply the basic terms involved in an Organic reactions and synthes of a drug molecule.	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	3	3	2	1	3	1	3	1	-	-	1	-	3	1
CO 2	3	3	2	2	3	2	3	2	-	-	2	-	3	2
CO 3	3	3	2	2	2	2	2	2	-	-	2	-	3	2
CO 4	3	3	2	2	2	2	2	2	-	-	2	-	3	2
CO 5	3	3	2	2	3	2	3	2	-	-	2	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
		✓	✓	✓

BSC	MATHEMATICS I (CALCULUS AND LINEAR ALGEBRA)	3	1	0	4

Course Objectives

- To familiarize the prospective engineers with techniques in basic calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines

UNIT-I: Calculus **12**

Rolle’s theorem-Mean value theorems-Taylor’s and Maclaurin theorems - Indeterminate forms and L'Hospital's rule-Curvature-radius of curvature – Evolutes and envelopes.

UNIT-II: Multivariable Calculus **12**

Limits-continuity- partial derivative – total derivative – maxima and minima- saddle points-method of Lagrange multipliers

Unit-III: Sequence and series **12**

Convergence of sequence and series – test for convergence- power series – Comparison test- Root test, D'Alembert's test and Leibnitz's test

Unit-IV: Matrices **12**

Introduction to Matrices- Rank of matrix- Linear systems of equations-symmetric-skew symmetric matrix and orthogonal matrices-Eigen values and Eigen vectors Diagonalization of matrices- Cayley-Hamilton theorem and orthogonal transformation.

Unit-V: Vector spaces **12**

Vector Space- linear Independence and dependence of vectors, basis, dimension-Linear transformations (maps), range and kernel of a linear map, rank and nullity-Inner product spaces-Gram-Schmidt Orthogonalization.

Total Hours: 60

Textbooks:

1. G.B.Thomas and R.L.Finney, Calculus and Analytic geometry, 9thEdition,Pearson,Reprint, 2002.
2. Ramana B.V., Higher Engineering Mathematics,Tata McGraw Hill New Delhi, 11,Reprint,2010
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference books:

1. P. Sivaramakrishna Das and C. Vijayakumari, Mathematics-I, First Edition, Pearson India Educationservices Pvt. Ltd.
2. Erwinkreyszig, Advanced Engineering Mathematics, 9 Edition, John Wiley&Sons, 2006.
3. VeerarajanT.,Engineering Mathematics for firstyear,TataMcGraw-Hill,NewDelhi,2008.
4. D.Poole, LinearAlgebra: A ModernIntroduction,2nd Edition, Brooks/Cole,2005.
5. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition,2010.

Web Links:

1. https: / / online courses.n ptel a c . i n / n o c 2 0 _m a 3 7/ preview

Course Outcome

CO1	Apply the concept of differential calculus and to evaluate the curvature, radius of curvature and envelope	**K3**
CO2	Understand the concept of limits, continuity and to evaluate derivatives	**K2**
CO3	Analyze the convergence of the series using root test, D'Alembert's test, Leibnitz's test	**K3**
CO4	Determine the rank of a matrix, linear system of Equation and Eigen values and Eigenvectors	**K3**
CO5	Evaluate the linear independence and dependence of vectors, linear transformations and inner product space.	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	2	1	3	-	-	-	-	-	-	-	3	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	-

Assessment Methods:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
			✓	✓

ESC	PROGRAMMING FOR PROBLEM SOLVING	3	0	0	3

Course Objectives

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

UNIT I Introduction To Programming 9

Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types),

Input / Output - Arithmetic expressions and precedence, Conditional Branching and Loops -Writing and evaluation of conditionals and consequent branching - Iteration and loops

UNIT II Arrays And Basic Algorithms 9

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

UNIT III FUNCTIONS AND POINTERS 9

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers- Defining pointers, Use of Pointers in self-referential structures

UNIT IV STRUCTURES AND UNIONS 9

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

UNIT V STRING FUNCTIONS AND FILES 9

Strings - library string functions, pointers in strings, pointers and function arguments, Files – file Operations, processing a file, Preprocessor directives, use of typedef,

Command line arguments, Enumerated data types.

Total Hours: 45

Text Books:

1: E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill

2 : Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill

Reference Books:

1: Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, PrenticeHall of India

2: YashavantKanetkar, “Let Us C”, BPB Publications

3: Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)

Web Links:

1. https://www.edx.org/course/c-programming-getting-started

COURSE OUTCOMES

CO1	Determine a pictorial representation with a stepwise procedure for solving complex problems	**K2**
CO2	Develop a high level programming code using c languages.	**K3**
CO3	Evaluate the various functional operations for solving problem.	**K4**
CO4	Make use of various c operations like array, pointer, strings and searching method	**K3**
CO5	Develop a C module for a given set of instruction.	**K4**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS O1**	**PSO2**
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO5	3	2	3	2	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**

✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

BSC	**CHEMISTRY LABORATORY**	**0**	**0**	**4**	**2**

Course Objectives

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule.

Experiments

1. Determination of the rate constant of a reaction.
2. Determination of the partition coefficient of a substance between two immiscible liquids.
3. Determination of surface tension and viscosity.
4. Thin layer chromatography.
5. Determination of chloride content in water.
6. Determination of cell constant and conductance of solutions.
7. Synthesis of a polymer/drug.
8. Determination of saponification / acid value of an oil.
9. Determination of redox potentials and emf by Potentiometric method.
10. Estimate the adsorption of acetic acid by charcoal.

Total Hours: 30

Text Books

1: S. Sundaram and K. Raghavan "Practical Chemistry", S. Viswanathan. Co. 3rd edition 2011.

2: Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rd edition 2011.

Reference Books

1: Vogel's – "Textbook of qualitative organic Analysis", Longmann, 12th edition, 2011

2: J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6th edition, 2010.

Web Links

1. https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:kinetics/x2eef969c74e0d802:introduction-to-rate-law/v/experimental- determination-of-rate-laws
2. https://www.youtube.com/watch?v=qdmKGskCyh8
3. https://www.youtube.com/watch?v=7_6_dKlo67k

COURSE OUTCOMES

CO1	Estimate the rate constants of reactions and partition coefficient of immiscible liquids.	**K2**
CO2	Find the viscosity and to test the purity of the compound	**K3**
CO3	Estimate the amount of chlorine content present in drinking water and to know the conductance of a solution.	**K4**
CO4	Develop a small drug molecule and to know the saponification of an oil.	**K3**
CO5	Find out the unknown element by Potentiometric method and to remove some of the toxic chemical by charcoal method.	**K4**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO5	3	2	3	2	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
	✓	✓	✓	

ESC	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**	**0**	**0**	**4**	**2**

Course Objective:

- To design and develop C Programs for various applications

LIST OF EXPERIMENTS:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

Total Hours: 30

Text Books:

1: E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill 2: Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill

Reference Books:

1: Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, PrenticeHall of India

2: YashavantKanetkar, “Let Us C”, BPB Publications

3: Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)

Web Links:

1. https://www.edx.org/course/c-programming-getting-started

COURSE OUTCOMES

CO1	Determine the advanced features of the C language	**K5**
CO2	Develop the model data using primitive and structured types.	**K5**

CO3	Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.	**K4**
CO4	Develops the ability to analyze a problem, develop an algorithm to solve it.	**K5**
CO5	Develops the use of the C programming language to implement various algorithms, anddevelops the basic concepts and terminology of programming in general.	**K6**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	3	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	3	-	-	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

ESC	**WORKSHOP AND MANUFACTURING PRACTICES**	**1**	**0**	**4**	**3**

COURSE OBJECTIVS:

1. To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
2. To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

LIST OF EXPERIMENTS:

MECHANICAL ENGINEERING PRACTICE

1. Welding

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

2. Basic Machining

To make Simple Turning and Taper turning in the lathe.

3. Fitting Work

To make square, hexagonal, V joint in bench fitting as per th given dimensions and Tolerances.

4. Sheet Metal Work

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

CIVIL ENGINEERING PRACTICE:

1. Buildings

a. Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

2. Plumbing Works

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers,elbows in household fittings.

b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

Electrical & Electronics

a. To make fluorescent lamp wiring.
b. To make stair case wiring.
c. To make residential wiring.
d. To measure Peak-peak, rms, period, frequency using CRO.
e. To solder components devices and circuits by using general purpose PCB.

Total Hours: 45

COURSE OUTCOMES

CO1	Experiment with facing, Turning and various types of fitting joint	**K 1**
CO2	Develop the half lap joint, TEE Lap joint carpentry and welding.	**K 5**

CO3	Practice casting, moulding, & smithy trades	**K 2**
CO4	Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering	**K 5**
CO5	Make a Basic pipe connections for Mixed pipe material connection and Pipe connectionswith different joining components	**K 1**

TEXT BOOKS:

T1: Jeyachandran K., Natarajan S. & Balasubramanian S., A Primer on Engineering Practices Laboratory, AnuradhaPublications, 2007

T2: Jeyapoovan T., Saravanapandian M. & Pranitha S., Engineering Practices Lab Manual, Vikas Publishing House Pvt.Ltd, 2006.

T3: Bawa H.S., Workshop Practice, Tata McGraw, 2007. 4. Rajendra Prasad A. & Sarma P.M.M.S., Workshop Practice, Sree Sai Publication, 2002

REFERENCE

R1: Rajendra Prasad A. &Sarma P.M.M.S., Workshop Practice, Sree Sai Publication, 2002.

WEB LINKS:

W1: http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3783

W2: https://www.slideshare.net/jeandedieuiyakaremye3/workshop-practice-ii-lecture-notes

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	2	-	2	-	2	-	1	2	1	2
CO2	3	1	3	1	3	-	2	-	2	-	1	2	2	2
CO3	3	1	3	1	2	-	2	-	3	-	1	2	1	1
CO4	3	1	2	1	2	-	2	-	2	-	1	2	1	1
CO5	3	1	3	1	2	-	2	-	1	-	1	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓

Quiz	MCQ	Projects	Seminars	Demonstration / Presentation
			✓	✓

HSC	ENGLISH	2	0	0	2

Course Objective:

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

UNIT I VOCABULARY BUILDING 6

General Vocabulary –Nouns--Compound nouns, Synonyms, Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.-Instructions.

UNIT II BASIC WRITING 6

Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Blending and Clipping, Framing questions- Yes/No types and "Wh" questions, Summarizing, Precise writing, Paragraph Writing.

UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH 6

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund, Checklist.

UNIT IV NATURE AND STYLE OF SENSIBLE WRITING 6

Situational Dialogues, Process description, Definitions, Numerical Expressions, Recommendation, Information Transfer- Flow chart Bar chart and Pie chart, Writing introduction and conclusion.

UNIT V WRITING PRACTICES 6

Active voice and Passive voice, ,Making negative sentences ,Tenses,Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report,

Investigation Report and Survey, Essay writing, Reading Comprehension Passages.

Total Hours : 30

Text Books:

1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
2. Department of Humanities and Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
3. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
4. Department of Humanities and Social Sciences, Anna University, ''English for Engineers and Technologists'' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
5. M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

Reference Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Weblinks:

- https://ehlion.com/magazine/technical-english/
- https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

Course Outcomes

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

CO1	Improve the language proficiency of a technical under-graduate in English with emphasis on Learn, Speak, Read and Write skills.	**K 1**
CO2	Develop listening skills for academic and professional purposes.	**K 5**

CO3	Acquire the ability to speak effectively in English in real life situations	**K 2**
CO4	Provide learning environment to practice listening, speaking, reading and writing skills.	**K 5**
CO5	Variety of self-instructional modes of language learning and develop learner autonomy.	**K 1**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	-	-	-	2	2	-	2	3	3	3	3	2	-
CO 2	-	-	-	-	2	2	-	2	3	3	3	3	2	-
CO 3	-	-	-	-	-	-	2	-	1	1	1	1	2	-
CO 4	-	-	-	-	2	1	3	1	-	-	-	-	2	-
CO 5	-	1	2	2	2	2	-	2	3	3	3	3	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
			✓	✓

BSC	**PHYSICS (SEMICONDUCTOR PHYSICS)**	**3**	**1**	**0**	**4**

Course Objectives

- To learn the basics of electronic materials, semiconducting materials and their interaction with light, new engineered semiconductor devices.
- To apply these fundamental principles to solve practical problems related to materials used for engineering applications.

UNIT I Electronic materials **12**

Energy bands in solids -Types of electronic materials: metals - semiconductors and insulators - Direct and indirect band gaps - Free electron theory - electrical

conductivity and thermal conductivity - Fermi distribution- Effect of temperature on Fermi function – Density of energy states - Kronig-Penny model - E-k diagram.

UNIT II Semiconductors 12

Intrinsic semiconductor - carrier concentration derivation – Variation of Fermi energy level with temperature - extrinsic semiconductors – derivation- carrier concentration in n type and p type semiconductor – Variation of Fermi energy level with temperature and impurity concentration.

UNIT III Light-semiconductor interaction 12

Optical transitions in bulk semiconductors: absorption - spontaneous emission and stimulated emission - Einstein's coefficient- derivation - Photovoltaic effect - Solar cells – principle and working - excitons

UNIT IV Semiconductor devices and Measurements 12

Semiconductor diodes: construction and working – PN diode – Zener diode – Light Emitting Diode (LED) – Measurements: UV-Vis spectroscopy - Hall effect – Determination of Hall coefficient – Applications.

UNIT V Engineered semiconductor materials 12

Shape Memory Alloys (SMA) – Characteristics, Properties of Ni-Ti alloy - Applications - Semiconductor Nanomaterials: Synthesis, properties and applications of nanophase materials – Quantum confinement - Quantum nanostructures: quantum dots - quantum wires - quantum wells.

Total Hours: 60

Text books:

1: Rajendran V, and Marikani A, 'Materials Science' Tata McGraw Hill publications, New Delhi 2011.

2: Vijaya, M. and Rangarajan G, 'Materials Science' Tata McGraw Hill publications, New Delhi 2006.

3: Dr. Mani P , 'A text book of Engineering Physics – II' Shri Dhanam Publilsher, Chennai 2016 4: Murugeshan R, Kiruthiga Sivaprasath, 'Modern Physics' S Chand Publisher 2016

Reference Books:

1: S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).

2: Charles Kittel 'Introduction to Solid State Physics', John Wiley and sons, 7th edition, Singapore 2008. 3: Kasap S.O, "Principles of Electronic Materials", 3rd edition, McGrawHill Higher Education, 2005.

4: Pradeep T, "A text book of Nanoscience and Nano technology, McGrawHill

Higher Education, 2012.

5: Palanisamy P.K, 'Materials Science', Scitech publications, Chennai, 2007.

6: J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995). R7: P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).

Web Links:

1. https://nptel.ac.in/courses/115102026/2
2. https://nptel.ac.in/courses/115102026/15
3. http://textofvideo.nptel.ac.in/115102026/lec18.pdf
4. https://nptel.ac.in/courses/122103010/34
5. http://orbit.dtu.dk/files/4817236/petersen.pdf

COURSE OUTCOMES

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

CO1	Analyze the behavior of free electrons in conducting materials.	**K 1**
CO2	Analyze the type of semiconducting materials and their applications.	**K 5**
CO3	Identify the direct and indirect band gap semiconductors	**K 2**
CO4	Demonstrate the construction and working of various semiconductor devices	**K 5**
CO5	Develop the design and fabrication of quantum nanostructures.	**K 1**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	3	3	-	-	-	-	-	-	3	-	3	3
CO5	-	3	3	3	-	-	-	-	-	-	3	-	-	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**

✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

BSC	**MATHEMATICS II (PROBABILITY AND STATISTICS)**	**3**	**1**	**0**	**4**

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

UNIT I : Basic Probability: 12

Introduction to Probability-Conditional probability – Baye's Theorem- Random Variables-Discrete random variables-Continuous Random Variables –Probability mass function-Probability density function.

UNIT II : Standard Distributions: 12

Introduction to theoretical distribution-Discrete Distributions- Binomial, Poisson, Geometric Distributions- Continuous Distribution-Uniform, Normal, Exponential and Gamma distribution-Properties.

UNIT III: Correlation and Regression Analysis: 12

Correlation: Types of Correlation-Methods of studying correlation- Scatter diagram method, Karl Pearson's Coefficient of correlation, Spearman's Rank Correlation Coefficient. Regression: Regression Lines and Regression equations - simple problems

UNIT IV: Basic Statistics: 12

Introduction-Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Mean deviation- Standard Deviation and coefficient of variation

UNIT V: Sampling : 12

Introduction to small sample – t-test-Single mean, difference of means, and Paired t-test- F-test- Chi- square test for goodness of fit and independence of attributes.

Total Hours: 60

Text Books

1. N.P. Bali and Manish Goyal, A text book of engineering mathematics, laxmi publications, reprint, 2014 (Ninth Edition)

2. S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

Web links

1.https://onlinecourses.nptel.ac.in/noc20_ma17

Course Outcome:

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

CO1	Apply the fundamental concepts of probability	**K 1**
CO2	Understand of standard distributions which can describe real life phenomenon.	**K 5**
CO3	Understand and critically discuss the issues surrounding of correlation and Regression	**K 2**
CO4	Evaluate the underlying assumptions of analysis tools of measures of central tendency and dispersion	**K 5**
CO5	Analyze the uses and limitations of Testing of hypothesis used in engineering	**K 1**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	3	3	-	-	-	-	-	-	3	-	3	3
CO5	-	3	3	3	-	-	-	-	-	-	3	-	-	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

ESC	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	**3**	**1**	**0**	**4**

COURSEOBJECTIVE:

To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.

1. To provide adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices.
2. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.
3. To emphasize the importance of transformers in transmission and distribution of electric power.

UNIT I DC CIRCUITS 12

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Thevenin and Norton Theorems.

UNIT II AC CIRCUITS 12

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power,apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III TRANSFORMERS 12

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers,regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV ELECTRICAL MACHINES & POWER CONVERTERS 12

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction of Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

UNIT V BASICS OF ELECTRONICS 12

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics. Binary Number System — Boolean Algebra theorems– Logic gates- Introduction to sequential Circuits– Flip-Flops.

Total Hours :60

TEXT BOOKS:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.

REFERENCE BOOKS

1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989

Web Links:

1. https://www.electricaltechnology.org/category/basic-electrical-fundamentals
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES

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

CO1	Understand and analyse DC circuits	K2
CO2	Understand and analyse AC circuits	K2
CO3	Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections.	K3
CO4	Understand and Examine the various electrical machines and converter circuits	K2
CO5	Identify the basics of electronics	K3

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	1	-	1	3	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	3	-
CO3	1	1	1	1	1	3	3	2	-	1	1	1	-	-
CO4	1	-	1	1	1	3	1	1	-	1	1	1	-	1
CO5	2	1	1	1	1	1	-	-	-	1	-	1	1	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓			✓	✓

ESC	**ENGINEERING GRAPHICS AND DESIGN**	**1**	**0**	**4**	**3**

COURSE OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of
- Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I INTRODUCTION TO ENGINEERING DRAWING AND PLANE CURVES 9

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Scales – Plain, Diagonal and Vernier Scales.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 9

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes- Auxiliary Planes.

UNIT III PROJECTION OF SOLIDS 9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method - Auxiliary Views.

UNIT IV PROJECTION OF SECTION OF SOLIDS AND DEVELOPMENT OF SURFACE 9

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V PROJECTION OF ORTHOGRAPHIC AND ISOMETRIC 9

Free hand sketching: Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Total Hours: 45

TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46 th Edition, (2003).
2. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).

REFERENCES

1. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
2. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
3. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
4. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
5. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill PublishingCompany Limited (2008).
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing CompanyLimited, New Delhi, (2008).

Weblinks:

https://onlinecourses.nptel.ac.in/noc21_me128/preview **Course Outcomes**

CO1	Understand the theory of projection able to know and understand the conventions and the methods of engineering drawing	K2
CO2	Improve their visualization skills so that they can apply these skills in projections of surfaces	K3
CO3	Improve their visualization skills so that they can apply these skills in projections of solids	K3
CO4	Impart and inculcate a proper understanding of the theory of projection. Improve the visualization skills	K3

CO5	Understand the various concepts like dimensioning, conventioning and standards related to working drawings in order to become professionally efficient. Impart the knowledge for understanding and drawing of simple residential/office buildings	K4

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	3	-	-	-	-	-	-	-	3	-
CO 2	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO 3	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO 4	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO 5	3	3	2	2	3	-	-	-	-	-	-	-	3	-

Assessment Methods:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
✓	✓		✓	✓

HSC	ENGLISH LABORATORY	0	0	2	1

Course Objectives

- To enable the student to explore the knowledge in communication skills.
- To gain knowledge in the process of Placement Interviews, Group Discussions and other recruitment procedures.

List of Experiments

1. Introduction to English sounds

2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarizing
7. Report Writing
8. Information Transfer
9. Presentation Skills
10. Group Discussion
11. Letter Writing
12. Cover letter and Resume

Total Hours: 30

Text Books:

1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
2. M.Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

Reference Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
3. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Weblinks:

- https://onlinemasters.ohio.edu/blog/engineering-communication/
- https://online.rice.edu/courses/communication-skills-for-engineers-specialization

Course Outcome

CO1	Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.	K2

CO2	Use appropriate pronunciation and rhythm of spoken language in oral communication	K3
CO3	Draft and interpret the written communication in official contexts like narrative, descriptive, creative, critical and analytical reports.	K3
CO4	Infer implied meanings of different genres of texts and critically analyze and evaluate them for ideas, as well as for method of oral presentation	K3
CO5	Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions, negotiation and conversations.	K4

Mapping of Program outcomes with course outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	2	-	2	-	-	-	-	-	1	-
CO2	3	2	1	1	3	1	3	3	-	-	-	-	2	-
CO3	3	2	1	1	3	1	3	3	-	-	-	-	2	-
CO4	3	2	1	1	3	1	3	3	-	-	-	-	2	-
CO5	3	2	1	1	3	1	3	3	-	-	-	-	2	-

Assessment Methods:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observations**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**
✓		✓	✓	✓

BSC	**PHYSICS LABORATORY (SEMICONDUCTOR PHYSICS)**	**0**	**0**	**4**	**2**

Course Objectives

- To enable the student to explore the field of Mechanics of Solids and Properties of Matter.

- To gain knowledge in the scientific methods and learn the process of measuring different Physical variables.

Experiments

1. Determination of Rigidity Modulus – Torsional pendulum
2. Determination of wavelength and particle size using laser
3. Ultrasonic Interferometer
4. Determination of band gap of a semiconductor material
5. Hooke's law – Determination of spring constant
6. Determination of Young's Modulus – Uniform Bending
7. Determination of Young's Modulus – Non Uniform Bending
8. Determination of Viscosity of a liquid - Poiseuille's method
9. Spectrometer – Grating
10. Deflection Magnetometer - Tan A position
11. Deflection Magnetometer - Tan B position
12. Potentiometer - Calibration of low range Voltmeter

Total Hours: 30

Text Books:

1: C. C. Ouseph, U. J. Rao, V. Vjiayendran, Practical Physics,1st Edition, 2015.

2: Biswajit Saha, Practical Physics Book, LAP LAMBERT Academic Publishing, 1st Edition, 2020.

Reference Books:

1: G.L. Squires, Practical Physics, 4th Edition, Cambridge University Press, 2001.

2: D. Chattopadhyay, P.C. Rakshit, B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

Web Links:

1. http://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=2
2. https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1509&cnt=4

COURSE OUTCOMES

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

CO1	Measure the wavelength and particle size of semiconductor diode laser.	K2

CO2	Analyze the coefficient of viscosity of a liquid	K3
CO3	Estimate the band gap energy of given semiconductor material.	K3
CO4	Determine the compressibility of the liquid using ultrasonic interferometer	K4
CO5	Measure the Young's modulus of the given solid materials	K4

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	3	-	-	-	3	-	3	-	3	2
CO2	2	2	-	2	2	-	-	-	3	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	3	-	3	-	3	2
CO4	3	3	-	3	3	-	-	-	3	-	3	-	3	3
CO5	3	3	3	3	3	-	-	-	3	-	3	-	3	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

ESC	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**

Course Objectives

- To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.
- To expose the students to learn experimental skills about Transformers, DC Motor, Converters.

LIST OF EXPERIMENTS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage,phase-to-neutral voltage, line and phase currents).
5. Load Characteristics of a DC Motor
6. Torque - Slip Characteristic of an Induction motor
7. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
8. Demonstration of DC-DC Converter.
9. Demonstration of DC-AC converter.
10. Demonstration of AC-DC converter.

TOTAL Hours: 30

Text Books:

1: D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010. 2: D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

Reference Books:

1. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
2. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

Web Links:

1. https://www.electricaltechnology.org/category/basic-electrical-fundamentals
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES

CO1	Understand the basic safety precautions and learn to make use of measuring instruments	K2
CO2	Analyse the steady state response of R-L, R-C circuits	K3
CO3	Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections	K3
CO4	Understand and Experiment with single phase induction motor and three phase induction motor	K2
CO5	Demonstrate DC-DC, DC-AC and AC-DC converters	K4

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

BSC	MATHEMATICS III (FOURIER SERIES AND TRANSFORMS)	3	1	0	4

Course Objective:

This course aims to provide the students to study Fourier Transforms and some concepts of infinite Fourier Sine and Cosine transforms, finite Fourier Sine and Cosine transforms and applications to solve some infinite and boundary value problems using finite and infinite transforms.

UNIT I FOURIER SERIES 12

Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series- Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 12

Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification PDE-Method of separation of variables – One dimensional wave equation and One dimensional heat equation of heat conduction – Steady state solution of two-dimensional heat equation of heat conduction (square plate only) .

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform –Introduction- properties – Inverse Z-transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

Total Hours:60

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi,43rd Edition, 2013.

2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint,2008.

3. Sivaramakrishna Das. P & Vijayakumari. C , A Text book of Engineering Mathematics-III

REFERENCE BOOKS:

1. Bali.N.P. and Manish Goyal 'A Textbook of Engineering Mathematics', Laxmi Publications, 9th edition,2011.

2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.

3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,3rdEdition, 2012.

Weblinks: https://nptel.ac.in/courses/122103012

Course Outcome:

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

CO1	Develop Fourier series for different types of functions.	K4
CO2	Acquaint the student with Fourier Transform techniques used in wide variety of situations	K3
CO3	Introduce the basic concepts of Partial differential equations for solving standard Partial differential equations	K4
CO4	Analyze the student with Fourier series techniques in solving heat flow problems used in various situations	K2
CO5	Understand the z-transforms and its properties	K4

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	1	2	2	-	-	-	-	-	3	3	3
CO 2	3	2	2	1	2	2	1	-	-	-	-	1	2	2
CO 3	3	2	1	1	1	3	-	-	-	-	-	1	2	1
CO 4	3	1	1	2	1	-	-	-	-	-	-	2	1	1
CO 5	2	1	1	1	1	3	-	-	-	-	-	2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments

✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

ESC	**DIGITAL ELECTRONICS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
2. To introduce the methods for simplifying Boolean expressions
3. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4. To introduce the concept of memories and programmable logic devices.

UNIT I: LOGIC GATES, BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES **9**

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De-Morgan's Theorem, Minimum of Boolean Expressions, Minterm, Maxterm, Sum of Products (SOP) & Product of Sums (POS) forms, Canonical forms, Karnaugh maps, Quine McCluskey method of minimization

UNIT II : COMBINATIONAL LOGIC DESIGN **9**

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Adder/ Subtractor, Code Converters, Magnitude Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.

UNIT III : SEQUENTIAL LOGIC DESIGN **9**

Flip Flop design: SR, JK, D and T Flip Flop, Realization of Flip flops, Counters: Modulo N Counter, UP/DOWN Counter, Ripple Counter, Ring Counter, Shift registers- SISO, SIPO, PIPO, PISO, Races, Hazards.

UNIT IV : MEMORIES, PROGRAMMABLE LOGIC DEVICES AND

LOGIC FAMILIES **9**

Memories: ROM, PROM, EPROM, EEPROM, RAM, Static RAM cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM CELL. Programmable logic devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA).

UNIT V VHDL CONCEPTS IN DIGITAL DESIGN **9**

Design entry: Different modeling styles in VHDL, Dataflow, Behavioral and Structural Modeling, VHDL constructs and codes for combinational and sequential circuits.

TOTAL HOURS : 45

COURSE OUTCOME:

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

CO1:	Examine the laws of Boolean algebra and Simplify minterms and maxterms using K map and tabulation methods.	K4
CO2:	Analyze combinational logic circuits like adders, subtractors, multiplexers and Demultiplexers.	K4
CO3:	Distinguish the operations of SR,JK,T and D flip-flops.	K4
CO4:	Criticize the different types of memories and their designs.	K5
CO5:	Compile VHDL codes to design combinational and sequential circuits.	K6

TEXT BOOKS:

T1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.

T2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.

T3. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

WEBLINKS:

1. www.tutorialspoint.com/digital_electronics/index.asp
2. www.coertvonk.com/hw/logic/synchronous-sequential-logic-30712

REFERENCE BOOKS:

R1. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.

R2. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989.

R3. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition2012.

R4. Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

CO/PO MAPPING:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO3	1	3	3	2	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	1	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	1	2	2	2
	2	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**2**	**2**	**2**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PCC	OPERATING SYSTEMS	3	0	0	3

Course Objectives

- To understand the features of operating system and its role in managing various system resources.
- To learn the Structure and functions of OS, Process scheduling, Deadlocks, Device management, Memory management and File systems

UNIT I PROCESSES AND THREADS 9

Introduction to operating systems – review of computer organization – operating system structures – system calls – system programs – system structure – virtual machines. Processes: Process concept – Process scheduling – Operations on processes – Cooperating processes – Inter process communication – Communication in client-server systems. Threads: Multi-threading models – Threading issues.

UNIT II PROCESS SCHEDULING AND SYNCHRONIZATION 9

CPU Scheduling: Scheduling criteria – Scheduling algorithms – Multiple-processor scheduling – Real time scheduling – Algorithm Evaluation. Process Synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – critical regions – Monitors. Deadlock: System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance –Deadlock detection – Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Memory Management: Background – Swapping – Contiguous memory allocation –Paging – Segmentation – Segmentation with paging. Virtual Memory: Background – Demand paging – Process creation – Page replacement – Allocation of frames – Thrashing.

UNIT IV FILE SYSTEMS 9

File-System Interface: File concept – Access methods – Directory structure – File system mounting – Protection. File System Implementation: Directory implementation –Allocation methods – Free-space management – efficiency and performance – recovery– log-structured file systems.

UNIT V I/O SYSTE MS 9

I/O Systems – I/O Hardware – Application I/O interface – kernel I/O subsystem – streams – performance. Mass storage Structure: Disk scheduling – Disk management –Swap-space management – RAID – disk attachment – stable storage – tertiary storage.

TOTAL HOURS: 45

Text Books:

1. Silbers chatz, Galvin, and Gagne, "Operating System Concepts", Sixth Edition, Wiley India Pvt Ltd, 2003
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004
2. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004

Web Links:

1. https://www.tutorialspoint.com/operating_system/index.html
2. https://onlinecourses.nptel.ac.in/noc21_cs44/preview

COURSE OUTCOMES

CO1	Understand the concept of operating system structures, system calls, system programs and build user programs based on it	K2, K6
CO2	Compare the performance of various CPU scheduling algorithms	K4
CO3	Compare and contrast various memory management schemes	K4
CO4	Use allocation methods to allocate disk space to the files	K3
CO5	Evaluate the various file and disk management strategies	K5

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	-	-	-	-	-	-	-	-	2	3
CO2	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO3	3	1	3	2	3	-	-	-	-	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO5	1	3	1	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	DATA STRUCUTRES AND ALGORITHMS	3	1	0	4

Objectives

- To understand the basic concepts of digital and algorithms.
- To differentiate linear and non-linear data structures and the operations upon them.
- To perform sorting and searching in a given set of data items.
- To comprehend the necessity of time complexity in algorithms.

UNIT I : Introduction to Algorithms and Analysis **12**

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation – Recursive Tree Method.

UNIT II : Linear Data Structures **12**

Array- 1D and 2D array, Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi. Queue - Types of Queues: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications -Polynomial Manipulation – Josephus problem(permutation)

UNIT III : Sorting and Search Techniques **12**

Searching - Linear Search and binary search, Applications - Finding square root of ‘n’-Longest Common Prefix- Sorting – Insertion sort - Selection sort – Bubble sort – (Counting Sort) – Quick sort- Merge sort, Analysis, Applications - Finding the ‘n’

closest pair's

UNIT IV : Non-linear Data Structures **12**

Tree - Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Applications - Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm.

UNIT V: Hashing, Heaps and Balanced Binary Search Trees **12**

Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications - Heaps - Heap sort, Applications -Priority Queue using Heaps - AVL trees – Terminology - basic operations (rotation, insertion and deletion) - Recent trends in algorithms and data structures

TOTAL HOURS: 60

TEXT BOOKS:

1. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.
2. Mark A. Weiss, Data Structures & Algorithm Analysis in C++, 3rd edition, 2008, PEARSON.

REFERENCE BOOKS:

1. Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures, The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2 008.
2. Horowitz, Sahni, and S. Anderson-Freed, Fundamentals of Data Structures in C UNIVERSITIES PRESS, Second Edition,2008.

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://archive.nptel.ac.in/courses/106/106/106106127/

COURSE OUTCOMES

CO1	Understand the fundamental analysis and compute time complexity for a given problem	**K3**
CO2	Articulate linear data structures and perform various operations	**K2**

	permitted on them	
CO3	Design and apply a suitable algorithm for searching and sorting Problems	**K6**
CO4	Develop an algorithm using non-linear data structures	**K6**
CO5	Understand and apply appropriate hashing techniques to find solutions for practical problems	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	2	2	2	-	-	-	-	-	-	-	3	3

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	**INTRODUCTION TO AI AND ML**	**3**	**0**	**2**	**4**

Course Objectives

- To understand the basics of Machine Learning (ML)
- Able to program in Python ML Packages
- To understand the methods of Machine Learning

- To visualize a dataset

UNIT I : INTRODUCTION TO ARTIFICAIL INTELLIGENCE 12

Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents- Structure of agents -– Problem solving agents –Uninformed search strategies – Breadth first search – Uniform cost search – Depth first search – Depth limited search – Bidirectional search – Searching with partial Information.

UNIT II : INTRODUCTION TO MACHINE LEARNING 12

Machine learning: Types of Machine Learning - Understanding data – Continuous variable, categorical variable, Independent variable, dependent variable -Regression and classification- linear regression introduction- Over fitting and Underfitting - Bias and Variance -Machine Learning Life cycle -- Data Preprocessing techniques – Feature selection

UNITIII : MACHINE LEARNING ALGORITHMS 12

Classification and Regression- Naïve bayes- Decision trees- support vector machine (SVM) –Random forest- Linear Regression- Multiple Linear Regression-Logistic Regression. -K-nearest neighbor - Unsupervised learning - k-means clustering- Principal component analysis

UNIT IV : MODEL EVALUATION 12

Model Evaluation and Selection methods, Precision-Recall and ROC Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics

UNIT V : MACHINE LEARNING USING PYTHON 12

Scikit- learn Dataset - Understanding Dataframe-slicing a dataframe-managing data – Data Loading with NumPy and pandas- creating training and test sets - Implementation of Machine learning algorithms - predictions - implementation of metrics for validating machine learning algorithms - Scaling and normalization- Data visualization

TOTAL HOURS: 60

Text Books:

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012

2. Sebastain Raschka, "Python Machine Learning", Packt publishing (open source).

Reference Books:

1. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009
2. Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning" (2nd ed)., Springer, 2008

Web Links:

1. https://machinelearningmastery.com/types-of-learning-in-machine-learning/ Online
2. https://www.coursera.org/learn/machine-learning
3. https://nptel.ac.in/courses/106/106/106106139/
4. https://www.timberlake.co.uk/machinelearning

COURSE OUTCOMES

CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	**K3**
CO2	To apply the Basic Concepts of Machine Learning	**K4**
CO3	To build various machine learning algorithms using Linear models	**K5**
CO4	To apply ML techniques to application and evaluate the models	**K4**
CO5	Apply basic principles of AI and ML in solutions that require problem solving, inference, perception, knowledge representation, and learning.	**K4**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	2	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	2	3
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester**	**Assignments**	**Case**

			Exams		**Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book Test**
✓	✓	✓	✓	✓	✓

PCC	**OPERATING SYSTEMS LAB**	**0**	**0**	**2**	**1**

Course Objective:

To practice various system calls and concepts of process management, memory management techniques.

List of Experiments:

1. Study of Linux commands.
2. Writing programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Writing programs using the I/O system calls of UNIX operating system (open, read, write, etc)
4. Writing C programs to simulate UNIX commands like ls, grep, etc.
5. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions).
6. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)
7. Developing Application using Inter Process communication (using shared memory, pipes or message queues)
8. Implementation of Producer – Consumer problem using semaphores (using UNIX system calls).
9. Implementation of Deadlock avoidance using Banker's algorithm.
10. Implementation of some memory management schemes – I

11. Implementation of some memory management schemes – II
12. Implementation of any file allocation technique (Linked, Indexed or Contiguous)

TOTAL HOURS : 30

Text Books:

1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", Sixth Edition, Wiley India Pvt Ltd, 2003
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004
2. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004

Web Links:

1. https://www.tutorialspoint.com/operating_system/index.html
2. https://onlinecourses.nptel.ac.in/noc21_cs44/preview

Course Outcome	Description	Knowledge Level
CO1	Implement the concept of Linux commands in Linux terminal.	K3
CO2	Develop a program using the system calls of UNIX operating system	K6
CO3	Analyze the performance of different CPU Scheduling Algorithms for the given process	K4
CO4	Develop Application using Inter Process communication.	K6
CO5	Solve Deadlock using Banker's algorithm.	K3

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	2

CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	-	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	-	-	-	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

PCC	**DATA STRUCTURES AND ALGORITHMS LAB**	**0**	**0**	**2**	**1**

Course Objectives

- Understand various data representation techniques in the real world.
- Implement linear and non-linear data structures.
- Analyze various algorithms based on their time and space complexity.
- Develop real-time applications using suitable data structure.
- Identify suitable data structure to solve various computing problems

Experiments

1. Implementation of Single Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) traversal
2. Implementation of polynomial expression in memory using single linked list.
3. Implementation of Circular Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) traversal
4. Implementation of Double Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.

5. Design and implement Stack and its operations using List.
6. Implementation of stack operations:
   a. To convert infix expression into postfix expression.
   b. To evaluate the postfix expression.
7. Design and implement Queue and its operations using List.
8. Implementation of binary search tree operations: a. Creation of node. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.
9. Implementation of searching techniques:
   - Linear search b. Binary search c. Fibonacci search
10. Implementation of sorting techniques to arrange a list of integers in ascending order. a. Bubble sort b. Insertion sort c. Selection sort
11. Implementation of sorting techniques to arrange a list of integers in ascending order. a. Quick sort b. Merge sort
12. Implementation of graph traversal algorithms: a. Depth first search. b. Breadth first search.

TOTAL HOURS : 30

Text Books:

1: M. A. Weiss, "Data Structures and Algorithm Analysis in C", third Edition, Pearson Education, 2007

2: A. V. Aho, J. E. Hop croft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.

Reference Books:

1. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2009

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://onlinecourses.nptel.ac.in/noc22_cs26/preview

COURSE OUTCOMES

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

Course	Description	Knowledge

Outcome		Level
CO1	Gain skills to design and analyze simple linear and nonlinear data structures	K3
CO2	Examine insertion, deletion and modification in singly and doubly linked list.	K4
CO3	Construct Stack, Queue in array for which all insertions and deletions are made at both end using various operations	K4
CO4	Apply Insertion, find and deletion operations in Binary Search Tree and Hashing functions.	K4
CO5	Evaluate shortest path in an undirected graph using depth and breadth first algorithms	K3

Mapping Of Course Outcomes To Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	-	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	-	-	-	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

HSC	PERSONALITY DEVELOPMENT I	2	0	0	2

COURSE OBJECTIVES:

- To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders

UNIT I: Soft Skills I **6**

Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality Determinants of Personality–Features and Traits– Components of self concept–Barriers–Self analysis

UNIT II : Soft Skills II **6**

Importance of Soft Skills – First impression–Work Place requirements–Discipline – Cleanliness Hygiene – general Appearance—Building Confidence—Concept of Thinking and Usage –Value of Time–Focus & Commitment.

UNIT III : Soft Skills In Action **6**

Grooming – Attire – Understanding others– Stability & Maturity Development – Strength s – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal settings

UNIT IV : Self Awareness And Self Esteem **6**

Definitions – Components of Self awareness – Developing Self awareness – Self esteem – meaning – Steps to improve self esteem.

UNIT V : Self Motivation **6**

Motivation – Meaning –Techniques of self motivation–Motivation & goal setting – Motivation and emotion – Motivation at work.

TOTAL Hours : 30

COURSE OUTCOME:

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

TEXT BOOKS:

1. Personality Development And Soft Skills Barun K Mitra, Oxford Publication
2. Seven habits of Highly Effective people – Stephen R. covey

REFERENCE BOOKS:

1. Emotion, motivation and Self regulation – Nathan C. Hall, McGill University, Canada Thomas Goetz, University of Konstanz, Germany

http://www.emeraldgrouppublishing.com.

2. Psychology of Self esteem – Nathaniel Branden, Nash (1st edition), Jossey – Bass (32 nd anniversary edition)

Weblinks:

https://nptel.ac.in/courses/109104107

COURSE OUTCOMES

CO1	Discuss the features, dimensions and determinants of personality	**K2**
CO2	Make a good first impression in professional and other situations	**K3**
CO3	Demonstrate confidence, punctuality and commitment as an engineer	**K3**
CO4	Set goals for development using SWOT analysis	**K5**
CO5	Develop self-awareness and improve self esteem	**K3**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	2	-	3	-	2	3	2
CO2	2	2	2	2	2	-	-	2	-	2	-	2	3	3
CO3	3	2	2	2	2	-	-	-	-	3	-	2	2	2
CO4	2	2	3	3	2	-	-	2	-	3	-	2	3	2
CO5	2	3	2	3	3	-	-	3	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

MC	BASIC LIFE SKILLS	2	0	0	0

COURSE OBJECTIVE:

1. To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I : Physical Health 6

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.Yogasanas: Pranamasana – HasthaUttanasana - PadaHasthasana – AswaSanjalana Asana – Thuvipathaasva Sanjalana asana – AstangaNamaskara - Bhujangasana–AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana– HasthaUttanasana - Pranamasana. Pranayama: Naddisuddi - Clearance Practice - Benefits.

UNIT II : Life Force 6

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds).Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III : Mental Health 6

Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation – Benefit.Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV : Values 6

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – Modesty Tolerance - Adjustment - Sacrifice – Forgiveness Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity Social Values:Non-violence– Service Patriotism – Equality Respect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V : Morality (Virtues) 6

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

TOTAL HOURS : 30

TEXT BOOKS/ REFERENCE BOOKS:

1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,
8. K. R. Dhanalakshmi and N. S. Raghunathan, " Personality Enrichment, Margham Publications
9. D.r V. M. Selvaraj, "Personality Development" Bhavani Publications
10. R. S. Agarwal, "Quantitative Aptitude".
11. A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc19_hs32/preview

COURSE OUTCOME:

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

CO1	Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness	**K2**

CO2	Demonstrate foundational standing, sitting, balance postures with proper alignment and Maintain youthfulness through kaya kalpa practice.	**K3**
CO3	Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.	**K3**
CO4	Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values.	**K5**
CO5	Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense of relaxation through meditation to keep up morality in life.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	2	-	3	-	2	3	2
CO2	2	2	2	2	2	-	-	2	-	2	-	2	3	3
CO3	3	2	2	2	2	-	-	-	-	3	-	2	2	2
CO4	2	2	3	3	2	-	-	2	-	3	-	2	3	2
CO5	2	3	2	3	3	-	-	3	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

BSC	**MATHEMATICS-IV (RANDOM PROCESS & QUEUING THEORY)**	**3**	**1**	**0**	**4**

Course Objective:

- To understand and conduct computer systems modeling and performance analysis.
- To introduce the basic probability tools and concepts this is useful in modeling, such as Markov models and queuing theory.
- To provide necessary mathematical support and confidence to tackle real life problems.
- To provide the required mathematical support to develop probabilistic models which can be used in several areas of science and engineering.

UNIT I : CLASSIFICATION OF RANDOM PROCESSES 12

Definition and examples – First order – Second order – Strictly stationary – Wide-sense stationary and ergodic process – Markov process – Poisson and Normal process.

UNIT II: QUEUEING THEORY-I 12

Markovian queues – Birth and Death Queuing models- Steady state results- Single server queuing models- (M/M/1): (∞/FIFO) Model–(M/M/1): (k/FIFO) Model - Characteristics of parameters of models.

UNIT III: QUEUEING THEORY-II 12

Multiple server queuing models- Little's Formula - queues with finite waiting rooms- Finite source models.- (M/M/C): (∞/FIFO) Model –Characteristics of parameters of models, (M/M/C): (k/FIFO) Model –Characteristics of parameters of models.

UNIT IV: NON-MARKOVIAN QUEUES 12

Finite source models - M/G/∞ queues – Pollaczek -Khinchine formula - M/G/1:(∞/GD) model as special cases.

UNIT V: QUEUEING NETWORKS 12

Queueing Networks - Classification and Basic Concepts.Open and Closed Networks of M/M/m Type Queues, Jackson's Theorem.

TOTAL HOURS: 60

TEXT BOOKS:

1: Gross. D. and Harris C.M, “Fundamentals of Queueing Theory”, Wiley Student edition, 2004.

2: Sivaramakrishna Das. P and Vijayakumari. C, “Probability &Queueing Theory”, Pearson Eduaction Asia, 6th Edition ,2013.

3. S.Palaniammal, “Probability &Queueing Theory”, Eastern Economy Edition, 2012.

REFERENCE BOOKS:

1. A.O. Allen, “Probability, “Statistics and Queueing Theory with Computer Applications”, Elsevier, 2nd edition, 2005.

2. G.Balaji, “Probability &Queueing Theory”, Balaji Publishers, 2018.

3. T.Veerarajan , Probability Statistics and Random Process, M c Graw Hill,2018.

Web Links :

1. https://www.youtube.com/watch?v=dSej7AHlim4
2. https://www.youtube.com/watch?v=a3eq_8R8uFY
3. https://www.youtube.com/watch?v=DblXnXxUQc0
4. https://www.youtube.com/watch?v=2aPlzhsEsIw
5. https://www.youtube.com/watch?v=mbYVI-5cPUU

COURSE OUTCOMES

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

CO1	Demonstrate the problems on Ergodic process, Poisson process and Markov chain.	**K2**
CO2	Analyze the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.	**K4**
CO3	Apply M/M/C model with finite and infinite capacity.	**K3**
CO4	Analyze a network of queues with Poisson external arrivals, exponential service requirements and independent routing. (Jackson networks)	**K4**
CO5	Identify various elements of a queuing networks and each of its description	**K3**

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	1	1	2	1
CO2	2	1	1	1	1	-	-	-	-	-	1	-	-	-
CO3	2	2	1	1	1	-	-	-	-	-	1	1	2	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	1	1
CO5	2	2	1	1	1	-	-	-	-	-	1	1	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3

Course Objectives

- To understand the architecture of computers and to analyze the performance using various addressing modes.
- To familiarize with hierarchical memory system including cache memories and virtual memory.
- To impart knowledge about different ways of communicating with I/O devices and standard I/O interfaces.

UNIT I : BASIC STRUCTURE OF COMPUTERS 9

Functional units – Basic operational concepts – Bus structures – Performance and metrics – Instructions and instruction sequencing – Hardware – Software Interface – Instruction set architecture – Addressing modes – RISC – CISC – ALU design – Fixed point and floating point operations : Floating Point Numbers and Operations.

UNIT II : BASIC PROCESSING UNIT 9

Some Fundamental concepts – Execution of a complete instruction: Branch instructions – Multiple bus organization – Hardwired control: A Complete Processor – Micro programmed control: Microinstructions – Micro program Sequencing –

Wide-Branch Addressing – Microinstructions with next address field – Prefetching and emulation – Nano programming.

UNIT III : PIPELINING 9

Basic concepts: Role of Cache Memory – Pipeline Performance – Data Hazards – Instruction Hazards – Influence on Instruction Sets: Addressing modes – Condition Codes – Datapath and Control Considerations – Superscalar Operation: Out-of-Order Execution – Execution Completion – Dispatch Operation – Performance Considerations – Exception Handling.

UNIT IV : MEMORY SYSTEM 9

Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache Memories: Mapping Functions – Replacement Algorithms – Example – Performance Considerations: Interleaving – Hit Rate and Miss Penalty– Caches on the Processor Chip – Virtual Memories – Memory Management Requirements – Associative Memories – Secondary Storage devices.

UNIT V : I/O ORGANIZATION 9

Accessing I/O devices – Interrupts : Interrupt Hardware – Enabling and Disabling Interrupts – Handling Multiple Devices – Controlling Device Requests – Exceptions – Direct Memory Access: Bus Arbitration – Buses: Synchronous Bus – Asynchronous Bus – Interface circuits: Parallel Port – Serial Port – Standard I/O Interfaces (PCI, SCSI, and USB), I/O devices and processors.

TOTAL HOURS : 45

TEXT BOOK:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, sixth Edition, Tata McGraw Hill, 2011

REFERENCE BOOKS

1. William Stallings, “Computer Organization and Architecture – Designing for Performance”, eleventh Edition, Pearson Education, 2019.
2. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”,fifth Edition, Elsevier, 2014
3. John P. Hayes, “and Organization”, Third Edition, Tata McGraw Hill, Computer Architecture 2012
4. M. Morris Mano, “Computer system Architecture”, Third edition, Prentice Hall of India, 2017

Web Links:

1. https://nptel.ac.in/courses/106105163
2. https://nptel.ac.in/courses/106103180
3. https://nptel.ac.in/courses/106106166

Course Outcomes:

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

Course Outcome	Description	Knowledge Level
CO1	Apply the basic features of operational concepts with its functional operations.	K3
CO2	Determine hardware blocks and control lines are used for specific instructions that execute at different operational level.	K5
CO3	Demonstrate the operation like add and multiply integers and floating-point numbers using two's complement and IEEE floating point representation for various models.	K5
CO4	Analyze clock periods, performance, and instruction throughput of single-cycle, multi-cycle, and pipelined implementations of a simple instruction set	K4
CO5	Deduct and describe the pipeline hazards and identify possible solutions to those hazards	K5

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	2	2	3	2
CO2	3	3	3	3	2	2	-	-	-	-	2	2	3	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2	3	2
CO4	3	3	3	3	2	2	-	-	-	-	2	2	3	2
CO5	2	3	3	3	2	2	-	-	-	-	2	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

Course Objectives

- To help the learner to understand the concepts, techniques, security features, how data is stored in the system, Query Languages used and different types of Statements used in the Query Processing in Database Management Systems. **9**

UNIT I : INTRODUCTION 9

Database system application-Purpose of database system-View of data-Database language-Relational database-Data storage and queuing-Transaction management-Database architecture-Database users and administrators-History of database system

UNIT II : INTRODUTION TO SQL 9

SQL Data Definition and its types – Specifying Constraints in SQL – Basic Retrieval Queries in SQL – INSERT,UPDATE ,DELETE Statements in SQL – Aggregate Functions in SQL – GROUPING : The GROUP BY and HAVING Clause – JOIN Expressions - VIEWS - TRANSACTIONS – SUBQUERIES

UNIT III : DATABASE DESIGN& PROGRAMMING TECHNIQUES 9

Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form–Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form– Entity relationship Model –Entity relationship Diagram and Examples

UNIT IV : TRANSACTION MANAGEMENT AND DATABASE SECURITY 9

Transaction - Simple Transaction Model – Serialzability- Lock based protocols-Time stamp-based protocol-Deadlock handling- Two Phase Commit – Introduction to Database Security Issues – Access Control Based on Granting and Revoking Privileges – Challenges of Database Security

UNIT V : DATA STORAGE AND QUERYING 9

Overview of Physical storage Media - Magnetic disks - RAID-Tertiary storage – File organization- Organization of records in files- B+ - tree index files - B-tree Index files- Static Hashing- Dynamic Hashing -Overview of query processing- CASE STUDY-ORACLE

TOTAL Hours : 45

Text Books:

1. Abraham Silberschatz, Henry F.korthS.Sudharshan, ”Database system concepts” sixth edition,tata mcgraw hill 2010.
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, FourthEdition , Pearson / Addision wesley, fifth edition, 2009.

Reference Books:

1. Raghu Ramakrishnan, “Database Management Systems”, Third Edition, McGraw Hill, 2003.
2. S.K.Singh, “Database Systems Concepts, Design and Applications”, Second Edition, Pearson Education, 2011.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview.
2. https://www.w3schools.com/mysql/mysql_rdbms.asp.

COURSE OUTCOMES

CO1	Identify the purpose and need of database management system and compare it with conventional systems	**K3**
CO2	Construct various SQL queries such as DDL & DML statements, Joins, Aggregate functions, Views and sub queries	**K5**
CO3	Compare and distinguish all the five normal forms in Database management system	**K4**
CO4	Apply and assess the transaction management and database security	**K5**

CO5	Examine various data storage and querying techniques such as RAID, B tree and B+ tree index files, static and dynamic hashing and query processing	**K6**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO2	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO4	2	2	2	3	3	-	-	-	-	-	-	-	-	3
CO5	0	2	3	3	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓		✓

PCC	**COMPUTER NETWORKS**	**3**	**0**	**0**	**3**

Course Objectives:

- To understand the concepts of data communications and to study the functions of different layers.
- To introduce IEEE standards employed in computer networking and to familiarize with different protocols and network components.

- To help the leaner to design, calculate, and apply subnet masks and addresses to fulfill networking requirements.
- To analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

UNIT I : PHYSICAL LAYER AND MEDIA 9

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Guided Media - Coaxial Cable – Fiber Optics – Unguided Media – Wireless- Switching- Digital Transmission –Analog Transmission- Line Coding – Dial up Modems

UNIT II : DATA LINK LAYER 9

Error Detection and Correction – Introduction-Parity Checking– LRC – CRC – Check Sum-Hamming code – Framing - Flow Control and Error control - Stop and Wait – go back-N ARQ – selective repeat ARQ- Sliding window – HDLC - Multiple Access – Random Access –Channelization-Wired LAN - Ethernet IEEE 802.3 - IEEE 802.4 –Token Ring-FDDI – IEEE802.11.

UNIT III : NETWORK LAYER 9

Logical Addressing-IPV4 Addresses - IPV6 Addresses-Inter Networking – Address Mapping – ARP, RARP,DHCP, ICMP- Delivery-Forwarding-Unicast Routing protocols- Intra Domain Routing-Inter domain Routing- Distance Vector Routing – Link State Routing – Path Routing – Multicast Routing Protocol- Subnetting – Congestion avoidance in network layer.

UNIT IV : TRANSPORT LAYER 9

Duties of transport layer –Process to Process Delivery-Client Vs Server Paradigm - Multiplexing – DeMultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Flow Control – Error Control – Congestion Control – Open loop congestion control - closed loop congestion control - Quality of services (QOS)- Techniques to improve up QoS.

UNIT V: APPLICATION LAYER 9

Domain Name Space (DNS) – Name Space- Domain Name Space –Distribution of Name Space –DNS in the Internet- DDNS – Electronic Mail- SMTP – POP – IMAP - FTP – HTTP - WWW – Cryptography-

Symmetric Key Cryptography - Asymmetric Key Cryptography- Network Security – Security Services- Digital Signatures- IPsec-PGP.

Total Hours:45

Text Book:

1. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition,Tata McGraw-Hill, 2006.(Unit I to Unit V)

REFERENCE BOOKS:

1. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2007
2. Comer, “Computer Networks and Internets with Internet Applications”, Fourth Edition, Pearson Education, 2003.
3. Andrew S. Tanenbaum, “Computer Networks”, Fourth Edition, 2003.William Stallings, “Data and ComputerCommunication”, Sixth Edition, Pearson Education, 2000

Web links:

1. https://www.javatpoint.com/computer-network-tutorial

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Discuss the functions of each layer in OSI and TCP/IP model	K6
CO2	Examine the Flow Control and Error control of Data link layer	K4
CO3	Evaluate the various functions and components of network layer	K5
CO4	Classify the protocols and techniques of transport layer	K4
CO5	Asses the important of application layer	K5

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	-	-	-	-	3	3	-
CO2	2	3	-	2	-	-	-	2	-	-	-	1	1	-

CO3	1	2	3	3	2	-	-	3	2	2	3	2	2	-
CO4	2	3	-	-	2	-	-	2	-	2	-	2	1	-
CO5	1	-	3	-	3	3	1	3	2	-	2	2	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	INTRODUCTION TO DATA SCIENCE	3	0	2	4

Course Objectives

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and preprocessing steps
- To understand the mathematical skills in statistics
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

UNIT I : INTRODUCTION 12

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications

UNIT II : DESCRIBING DATA I 12

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency

distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked

data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

UNIT III : PYTHON FOR DATA HANDLING 12

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT IV : DESCRIBING DATA II 12

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

UNIT V : PYTHON FOR DATA VISUALIZATION 12

Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh

TOTAL HOURS : 60

Text Books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, ManningPublications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and III)
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Parts of chapters 2–4 for Units IV and V)

Reference Books:

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

Web Links:

1. https://nptel.ac.in/courses/106/106/106106179/

2. https://www.codecademy.com/learn/learn-python
3. https://www.coursera.org/learn/python-data-analysis#syllabus

COURSE OUTCOMES

CO1	Apply the skills of data inspecting and cleansing.	**K3**
CO2	Determine the relationship between data dependencies using python	**K3**
CO3	Can handle data using primary tools used for data science in Python	**K1**
CO4	Represent the useful information using mathematical skills	**K4**
CO5	Can apply the knowledge for data describing and visualization using tools.	**K2**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	2	3
CO2	3	2	2	3	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	3	1	-	-	-	-	-	-	-	2	3
CO4	3	3	2	3	2	-	-	-	-	-	-	-	2	3
CO5	2	2	3	3	2	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PCC	DATABASE MANAGEMENT SYSTEMS LAB	0	0	2	1

Course Objective:

To understand the various database management system concepts by working on databases.

Experiments:

1. DDL and DML Commands.
2. Join Queries.
3. Views and Set operations.
4. Built in functions.
5. Nested Queries
6. Triggers.
7. Aggregate Functions.
8. Roles and Privileges.
9. Cursors.
10. PL/SQL programs
11. PL/SQL cursor programs
12. Front end tools – Mini Project

TOTAL HOURS: 30

TEXT BOOKS:

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill, 3rd Edition
2. Database System Concepts, Silberschatz, Korth, McGraw Hill, V edition.

REFERENCES BOOKS:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education
3. Introduction to Database Systems, C.J. Date, Pearson Education
4. Oracle for Professionals, The X Team, S. Shah and V. Shah, SPD.

5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL, Shah, PHI.
6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition.

Web Links:

1. https://www.mongodb.com/
2. https://university.mongodb.com/

COURSE OUTCOMES

CO1	Identify the need of DML and DDL commands and Nested queries	**K3**
CO2	Examine and compare various types of Joins and Set operators and write SQL queries	**K4**
CO3	Design and develop Views, Triggers and Cursors using SQL	**K6**
CO4	Test and solve various aggregate functions and built in functions using SQL	**K6**
CO5	Discuss Roles and Privileges and develop a mini project using front end tool using SQL	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	2
CO2	2	3	-	-	-	-	-	1	2	2	2	2	3	2
CO3	3	3	3	-	-	-	-	1	2	2	-	-	-	-
CO4	3	3	3	3	3	3	3	1	2	2	-	-	-	2
CO5	2	3	3	-	-	-	-	1	2	2	2	2	3	2
Average	2.6	3	3	3	2.8	3	3	1	2	2	2	2	3	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

PCC	COMPUTER NETWORKS LAB	0	0	2	1

Course Objective:

To help the learner to understand the underlying concepts of networked systems and to be able to develop networking programs using Python.

Experiments:

1. Programs using TCP Sockets (like date and time server & client, echo server & client, etc..)
2. Programs using UDP Sockets (like simple DNS)
3. Programs using Raw sockets (like packet capturing and filtering)
4. Programs using RPC
5. Simulation of sliding window protocols
6. Experiments using simulators (like OPNET)
7. Performance comparison of MAC protocols
8. Implementing Routing Protocols
9. Performance comparison of Routing protocols
10. Implementation of Logical and Physical Address
11. Simulation of ARP/RARP Protocol
12. Study of UDP and TCP performance

TOTAL HOURS : 30

Text Book:

1. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition,Tata McGraw-Hill, 2006.

Reference Books:

1. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2007
2. Comer, “Computer Networks and Internets with Internet Applications”, Fourth Edition, Pearson Education, 2003.
3. Andrew S. Tanenbaum, “Computer Networks”, Fourth Edition, 2003.William Stallings, “Data and Computer Communication”, Sixth Edition, Pearson

Education, 2000

Web Links:

1. https://www.cse.iitk.ac.in/users/dheeraj/cs425/

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Experiment with TCP, UDP and Raw socket programming	K3
CO2	Construct an application model for RPC	K6
CO3	Model the simulation of sliding window protocol and ARP/RARP	K3
CO4	Identify the Performance comparison of MAC protocols, Routing protocol	K3
CO5	Compose the implementation of Logical and Physical Address	K6

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	2	3	2	3	2
CO2	3	3	3	-	-	-	-	-	-	2	3	2	-	-
CO3	3	3	3	3	2	2	1	1	-	-	-	-	3	2
CO4	3	3	3	3	2	2	-	-	-	2	3	2	-	-
CO5	2	3	3	3	2	2	1	1	2	2	3	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

HSC	PERSONALITY DEVELOPMENT II	2	0	0	2

UNIT I : SOFT SKILLS III 6

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

UNIT II : QUANTITATIVE APTITUDE I 6

Percentage – Profit Loss –Discount – Ratio Proportion – Time & Work – Time, Speed & Distance. Problems relating to ages– Permutation & Combination– Probability

UNIT III : QUANTITATIVE APTITUDE II 6

Mensuration – Clocks and Calendars – Boats – Simple Interest – Compound Interest – Fractions and Decimals – Square roots – Functions.

UNIT IV : ANALYTICAL PROBLEMS 6

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams – Directions.

UNIT V : LOGICAL PROBLEMS 6

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

TOTAL HOURS : 30

TEXT BOOKS:

1. K. R. Dhanalakshmi and N S Raghunathan, Personality Enrichment, Margham Publications, 2012
2. R. S. Agarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishers, 2017

REFERENCE BOOKS:

1. D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021
2. A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022

Weblinks:

https://onlinecourses.nptel.ac.in/noc19_hs32/preview

COURSE OUTCOMES

CO1	Discuss the basic, email, business, telephone and meeting etiquettes.	**K2**
CO2	Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance.	**K3**
CO3	Work with fractions, decimals and square roots.	**K3**
CO4	Analyze the cause, effect and course of action in logical problems.	**K4**
CO5	Solve problems on the letter and symbol series.	**K3**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	2	3	2	3	2
CO2	3	3	3	3	2	-	-	-	-	2	3	2	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	3	3	3	2	-	-	-	-	2	3	2	-	-
CO5	2	3	3	3	2	-	-	-	-	2	3	2	3	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

BSC	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	3

Course Objectives

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future
- To provide understanding of component of environment, their function, quality, issues related to environment, effect of quality degradation on human beings and their solutions

UNIT I : ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Bio- geographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity. Field Study of Common Plants, Insects and Birds.

Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II : ENVIRONMENTAL POLLUTION 9

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III : NATURAL RESOURCES 9

Forest resources -Use and over – Exploitation – Deforestation – Case studies –

Timber extraction – Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV : SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization -

Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V : HUMAN POPULATION AND THE ENVIRONMENT 9

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL HOURS : 45

Text Books:

1. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education (2004).
2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill,NewDelhi, (2006).

Reference Books

1. R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines,

Compliances and Standards', Vol.I and II, Enviro Media.

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_ge16/preview
2. https://ggn.dronacharya.info/APSDept/Downloads/QuestionBank/ENVIRONMENTAL- STUDIES/NPTEL-Link.pdf
3. http://eagri.org/eagri50/ENVS302/pdf/lec14.pdf
4. https://onlinecourses.nptel.ac.in/noc19_ge22/preview

COURSE OUTCOMES

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

CO1	Understand the core concepts, methods of ecological and physical sciences, their application in environmental problem-solving.	**K3**
CO2	Apply system concepts and methodologies to analyse, understand the interactions between social and environmental processes.	**K4**
CO3	Apply the ethical, cross-cultural, and historical context of environmental issues and the link between human and natural systems.	**K3**
CO4	Develop the understanding based on the observations and illustration, drawn from the experiences of physical, biological, social and cultural aspects of life, rather than abstractions	**K4**
CO5	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.	**K2**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**

CO1	1	1	2	-	-	2	-	1	1	1	-	1	-	-
CO2	1	1	-	1	1	1	-	1	1	-	-	-	-	-
CO3	-	1	-	-	-	2	-	2	-	1	-	1	-	-
CO4	-	-	-3	1	1	1	1	-	-	1	1	1	-	-
CO5	1	-	-	1	1	1	1	2	1	1	-	1	-	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

MC	**CONSTITUTION OF INDIA**	**2**	**0**	**0**	**0**

COURSE OBJECTIVES:

- The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
- To help students be familiar with the historical and significant aspects of the constitution of India.
- To make students aware of their fundamental duties and rights.
- To know about central and state government functionalities in India.

UNIT I : NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNIT II : FUNDAMENTAL RIGHTS 6

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III : DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES 6

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV : FEDERAL STRUCTURE 6

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNIT V : AMENDMENT AND EMERGENCY PROVISIONS 6

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

TOTALHOURS: 30

TEXT BOOKS:

1. V.N. Shukla, Constitutional Law of India
2. D.D. Basu, Commentary on the Constitution of India
3. J.N. Pandey, Constitution of India
4. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
5. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
6. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
7. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

1. V.D. Mahajan, Constitutional Law of India
2. H.M. Seervai, Constitution of India
3. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
4. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

5. R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.

Weblinks:

https://onlinecourses.nptel.ac.in/noc20_lw03/preview

COURSE OUTCOMES

CO1	Elaborate the constitution of India and its salient features.	K2
CO2	Know the fundamental rights and duties	K3
CO3	Discuss the Parliamentary Form of Government in India.	K3
CO4	Recognize the Directive Principles of State Policy.	K2
CO5	Understand and abide the rules of the Indian constitution and to appreciate different culture among the people.	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	2	2	2	-	-	-	2	2
CO2	3	2	2	3	2	-	2	2	2	-	-	-	3	3
CO3	3	3	2	3	3	-	3	2	3	-	-	-	3	3
CO4	3	3	3	3	3	-	3	3	3	-	-	-	3	3
CO5	3	3	3	3	3	-	3	3	3	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

PCC	JAVA AND WEB PROGRAMMING	3	0	0	3

Course Objectives

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and preprocessing steps
- To understand the mathematical skills in statistics
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

UNIT I : JAVA INTRODUCTION 9

Review of object oriented programming - Objects and classes in Java – Defining classes – Methods - Access specifiers – static members – static fields - static methods - static variables – constructors - Default constructor - parameterized constructor – finalize method – Arrays – Strings – Packages – user defined packages – Java Doc comments

UNIT II : OBJECT-ORIENTED PROGRAMMING IN JAVA 9

Inheritance – class hierarchy – polymorphism - Runtime polymorphism - compile time polymorphisms– Encapsulation - static and dynamic binding – final keyword – abstract classes – the Object class: Method of object class – java Reflection – interfaces – Properties of interfaces – object cloning – inner classes – use of inner classes – proxies-Design Patterns in Java

UNIT III : HTML,CSS CLIENT SIDE SCRIPTING 9

Understanding Internet - Understanding websites and web servers - HTML - – forms – frames – tables – web page design – CSS - Java Script: An introduction to JavaScript– JavaScript DOM Model-Date and Objects,-Regular Expressions- JavaScript Events - Event Handling and Validation -Exception Handling-

UNIT IV : SERVER SIDE PROGRAMMING 9

Understanding Java Server Pages-JSP Standard Tag Library(JSTL)-Creating HTML forms by embedding JSP code- Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server;- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example – JSP:.

UNIT V : Web Applications development with Rest APIs 9

Rest API development with spring boot, Spring boot project with STS/MAVEN, Controller and Rest Controller annotations, Request Body, Response Body annotations, Error handling with spring boot

TOTAL HOURS : 45

Text Books:

1. Herbert Schildt, “Java The complete reference”, 8th Edition, McGraw Hill Education, 2011.
2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

Reference Books:

1. Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition,

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

COURSE OUTCOMES

CO1:	Develop Java programs using OOP principles	**K2**
CO2:	Develop Java programs with the concepts inheritance and interfaces	**K4**
CO3:	Design simple web pages using markup languages like HTML and XHTML	**K3**
CO4:	Program server side web pages that have to process request from client side web pages	**K4**
CO5:	Understand various web services and how these web services interact	**K1**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	2	1	1	1	-	-	-	1	1	3

CO2	3	2	2	2	2	-	-	1	1	1	1	1	1	3
CO3	3	2	3	2	2	-	-	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	1	1	1	3
CO5	2	2	3	2	3	-	-	-	-	1	1	1	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PCC	MOBILE APPLICATION DEVELOPMENT	3	0	0	3

Course Objectives:

- Understand the basics of Android devices and Platform.
- Acquire knowledge on basic building blocks of Android programming required for App development.
- Understand persistence Data storage mechanism in Android
- Understand advanced application concepts like networking, Animations and Google Maps services etc.
- Develop and publish Android applications in to Android Market

UNIT I : JAVA FX TECHNOLOGY FOR RICH CLIENT APPLICATIONS 9

Introduction: Introduction to mobile application development, trends, introduction to various platforms, introduction to smart phones , Android platform: Android platform features and architecture, versions, comparison added features in each versions. ART(Android Runtime),ADB(Android Debug Bridge). Development environment/IDE: Android studio and its working environment, gradle build system, emulator setup Application anatomy: Application framework basics: resources layout, values, asset XML representation and generated R.Javafile,Android manifest file.

UNIT II : NDROID UI DESIGN **9**

GUI for Android: Introduction to activities, activities life-cycle, Android v7 support library form API21 for lower version support Intent :intent object, intent filters ,adding categories, linking activities, user interface design components Views and View Groups: Basic views, picker views, adapter views, Menu, App Bar etc, basics of screen design; different layouts. App widgets. Lollipop Material design: new themes, new widgets, Card layouts. Recycler View . Fragments: Introduction to activities, activities life-cycle.

UNIT III : DATA PERSISTENCE **9**

Different Data persistence schemes: Shared preferences, File Handling, Managing data using NOSQL database, Firebase, Content providers: user content provider, Android in build content providers.

UNIT IV : BACK GROUND RUNNING PROCESS, NETWORKING AND TELEPHONY SERVICES **9**

Services :introduction to services – local service, remote service and binding the service, the communication between service and activity, Intent Service. MultiThreading: Handlers ,AsyncTask Android network programming :HttpUrlConnection, Connecting to REST-based and SOAP based Web services Broad cast receivers :Local Broadcast Manager, Dynamic broadcast receiver, System Broadcast. Pending Intent

UNIT V : ADVANCED APPLICATIONS **9**

Location based services: Google maps V2 services using Google API, Animations and Graphics: Property Animation,View Animations, Drawable Animations Media and Camera API: Working with video and audio inputs, camera API Sensor programming: Motion sensors, Position sensors, Environmental sensors .

TOTAL HOURS : 45

TEXT BOOKS

1. Greg Milette,Adam Stroud,"PROFESSIONALAndroid™ Sensor Programming",John Wiley and Sons Inc2012,ISBN/978111265055, 978128 0678943,978111227459
2. Paul Deital,HarveyDeital, Alexander Wald, "Android 6 for Programmers, App Driven approach",2015, Prentice Hall ,ISBN: 9780134289366

Web links:

1. http://developer.android.com/training/index.html
2. https://www.tutorialspoint.com/android/android_overview.html

3. https://www.geeksforgeeks.org/android-studio-tutorial/
4. https://www.tutlane.com/tutorial/android/android-hello-world-app-example

COURSE OUTCOMES

course Outcome	Description	Knowledge Level
CO1	To analyze the basic concepts of Mobile application Development and well versed in the Android platform	K4
CO2	To develop the GUI design of Android	K6
CO3	To build file Handling programs in mobile application	K3
CO4	To construct a mobile application and store data in database	K3
CO5	To build animation and utilize telephony services	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	1	1	1	-	-	-	1	1	3
CO2	3	2	2	2	2	-	-	1	1	1	1	1	1	3
CO3	3	-	-	-	2	-	-	-	2	2	2	2	-	3
CO4	3	2	2	2	3	-	-	-	-	-	1	1	1	3
CO5	2	2	3	2	3	-	-	-	-	1	1	1	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓		✓	✓

PCC	DEEP LEARNING AND PREDICTIVE MODELLING	3	0	2	4

COURSE OBJECTIVES:

- To introduce the fundamental techniques and principles of Neural Networks
- To study the different models in ANN and their applications
- To familiarize deep learning concepts with Computer Vision case studies

UNIT I : NEURAL NETWORK **12**

Mechanics of Machine Learning-Neuron-Linear Perceptron-Feed-Forward Neural Networks-Sigmoid, Tanh, and ReLUNeurons- Training Feed-Forward Neural Networks-Fast-Food Problem-Gradient Descent Delta Rule and Learning Rates.

UNIT II CONVOLUTIONAL NEURAL NETWORKS **12**

TensorFlow: Creating and Manipulating TensorFlow Variables-TensorFlow Operations-Neurons in Human VisionConvolutional Layer-Building a Convolutional Network-Visualizing Learning in Convolutional Networks-LearningLower Dimensional Representations- Principal Component Analysis-Autoencoder Architecture- Implementing anAutoencoder in TensorFlow.

UNIT III RECURRENT NEURAL NETWORKS **12**

Recurrent Neural Networks- Challenges with Vanishing Gradients- Long Short-Term Memory (LSTM) UnitsTensorFlow Primitives for RNN Models-Implementing a Sentiment Analysis Model- Solving seq2seq Tasks withRecurrent Neural Networks-MemoryAugmented Neural Networks:Neural Turing Machines, Attention-Based MemoryAccess, Differentiable neural Computers (DNC) -Memory Reuse - Temporal Linking - DNCController Network –Visualizing – Implementing the DNC in TensorFlow.

UNIT IV DEEP REINFORCEMENT LEARNING **12**

Deep Reinforcement Learning - Masters Atari Games-Markov Decision Processes-Policy Versus Value Learning, PoleCart with Policy Gradients-Q-Learning and Deep RecurrentvQ-Networks.

UNIT V APPLICATIONS OF DEEP LEARNING **12**

Applications in Object Recognition and Computer Vision- Unsupervised or generative feature learningSupervisedfeature learning and classification-Applications in Multimodal and Multi-task Learning- Multimodalities: Text andimage-Speech and image- Multi-task learning within the speech, NLP or image domain

TOTAL HOURS :60

TEXT BOOKS

1. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation MachineIntelligence Algorithms”, O'Reilly Media, 2017.
2. Li Deng and Dong Yu “Deep Learning Methods and Applications”, Foundations and Trends in Signal Processing, 2013.http://link. springer.com /openurl?genre=book&isbn=978-3-319-7
3004-2

REFERENCES

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, ”Deep Learning (Adaptive Computation and Machine Learningseries”, MIT Press, 2017.
2. SandroSkansi“Introduction to Deep Learning From Logical Calculus to Artificial Intelligence”Springer, 2018.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Weblinks

https://www.oreilly.com/ai/free/files/fundamentals-of-deep-learning-sampler.pdf

COURSE OUTCOMES:

At the end of this course, the Student will be able to

Course Outcome	Description	Knowledge Level
CO1	Design a simple Neural Networks using Linear Perceptron	K5
CO2	Implement a Convolutional Neural Networks using TensorFlow	K6
CO3	Develop an application based on Recurrent Neural Network.	K3
CO4	Solve the Deep Reinforcement Learning problem.	K3
CO5	Build the Speech and Text applications based deep neural network	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	3	-	-	-	-	-	2	1	2	2
CO2	3	2	3	3	2	-	-	-	-	-	2	2	3	3
CO3	2	3	2	2	2	-	-	-	-	-	2	2	2	3
CO4	2	3	2	2	3	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	2	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓		✓	✓

PCC	JAVA AND WEB PROGRAMMING LAB	0	0	2	1

Course Objectives

- To be familiar with Web page design using HTML/XML and style sheets
- To learn to create dynamic web pages using server side scripting.
- To be exposed to creating applications with AJAX
- To be familiar in API development with Spring boot

Experiments:

1. Create a web page with HTML elements
2. Create a web page validating with Form Controls using DHTML
3. Create a web page with all types of Cascading style sheets.

4. Programs in Java using Servlets
5. Invoke servlets from HTML forms.
6. Three-tier applications using servlets, JSP and Databases.
7. Web services -Consider a case where we have two web Services- an airline service and a travel agent and the travel agent is searching for an airline. Implement this scenario using Web Services and Data base.
8. Get API development with Spring boot
9. Post API development -saving the data in database
10. Updating data in database with Put API
11. Response code 200, 400, 500 with spring boot

TOTAL HOURS : 30

Text / References

- Java The Complete Reference , Herbert Schildt 7th Edition. Tata McGrawHill Edition
- Java 6 by Rogers Cadenhead, Laura Lemay, Pearson education
- Java Programming – A Practical Approach – C Xavier, Tata McGraw-Hill Edition
- K.Arnold and J. Gosling, "The JAVA programming language", Third edition, Pearson Education, 2000
- Javascript A Beginners Guide, 3rd Edition – John Pollock - Tata McGraw-Hill Edition

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

COURSE OUTCOMES

CO1	Design simple web pages using markup languages like HTML and XHTML.	**K4**
CO2	Create dynamic web pages using DHTML and java script that is easy to navigate and use.	**K6**
CO3	Program server side web pages that have to process request from client side web pages.	**K6**
CO4	Represent web data using XML and develop web pages using JSP.	**K4**

CO5	Create Webservices for client server applications	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	-	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	-	-	-	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

PCC	**MOBILE APPLICATION DEVELOPMENT LAB**	**0**	**0**	**2**	**1**

Course Objectives

- To be familiar with mobile app
- To learn to create dynamic mobile web pages.

Experiments:

1. To implement mobile application life cycle methods.
2. To implement simple calculator application.
3. To implement simple SMS application.
4. To implement authentication verification application without and with database.
5. To implement navigation application with multiple pages / activities.
6. To implement student placement registration form with database.

7. To implement a simple notification application.
8. To implement simple intent with data passing application
9. To implement simple profile changer application through SMS.
10. To create mobile web browser application.
11. To create mobile e-mail application to send a mail.
12. Mini project.

Text Book/References:

1. Build Your Own Security Lab, Michael Gregg, Wiley India
2. Greg Milette,Adam Stroud,"PROFESSIONAL Android™ Sensor Programming", John Wiley and Sons Inc2012,ISBN/978111265055, 9781280678943,978111227459

Web links:

http://developer.android.com/training/index.html

TOTAL HOURS : 30

COURSE OUTCOMES

CO1	Build a mobile application which implements the Lifecycle method	**K1**
CO2	Create a mobile application which stores the data in the database	**K3**
CO3	Design a mobile application which implements features like SMS and email	**K4**
CO4	Evaluate the application which navigates to different web pages	**K1**
CO5	Develop a notification application	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	-	-	-	-	-	2	1	2	3
CO2	3	2	3	2	2	-	-	-	-	-	3	2	3	2
CO3	3	3	-	-	2	-	-	-	-	-	3	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	3	-	-	3

CO5	2	3	3	2	3	3	3	3	3	3	3	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

HSC	**PERSONALITY DEVELOPMENT III**	**2**	**0**	**0**	**2**

COURSE OBJECTIVE:

- To enhance the communication, interpersonal, group skills.

UNIT I : VERBAL APPTITUDE I **6**

Phonetics / Neutral Accent / Pronunciation – Speech Mechanism / Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II : VERBAL APTITUDE II **6**

Singular/plural – present tense / past tense – genders Prepositions – conjunctions – Choice of words – simple sentences – compound sentences – summarizing phrases Synonyms – Antonyms – Analogies – Similar Words.

UNIT III : SOFT SKILLS **6**

Attitude – Meaning–Features of attitude – Formation – Personality Factors –Types of attitude – change in attitude – developing Positive attitude.

UNIT IV : TIME MANAGEMENT **6**

Definition – Meaning–Importance, Value of time as an important resource – comparison of Time and Money – Circle of influence and circle of control – Definition of URGENT and IMPORTANT – Time Wasters and how to reduce – Procrastination – meaning and impact – 4 Quadrants.

UNIT V : TEAM BUILDING 6

Meaning – Aspects of team building – Process of team building – Types of Teams – Team Ethics and Understanding – Team trust and commitment.

TOTAL HORUS : 30

TEXT/REFERENCE BOOKS:

1. B N Ghosh, Managing Soft Skills and Personality, Mc graw Hill Publications
2. Shejwalkar and Ghanekar,Principles and Practices of Management,Mc Graw Hill Latest.
3. Roberta Roesch ,Time management for Busy people, Tata McGraw–Hill Edition

REFERENCE BOOKS:

R1. D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021 R2. Dr V M Selvaraj, Personality Development, Bhavani Publications

Weblinks:

1.https://onlinecourses.nptel.ac.in/noc22_hs08/preview

COURSE OUTCOMES

CO1	Articulate by understanding the rate and flow of speech.	K3
CO2	Choose words and phrases appropriately for any verbal communication.	K3
CO3	Develop a positive attitude in handling diverse situations.	K4
CO4	Prioritize important and urgent tasks using the four quadrants method.	K4
CO5	Practice team ethics and understanding when working with teams.	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	-	-	-	-	-	2	1	2	3
CO2	3	2	3	2	2	-	-	-	-	-	3	2	3	2
CO3	3	3	-	-	2	-	-	-	-	-	3	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	3	-	-	3

CO5	2	3	3	2	3	3	3	3	3	3	3	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PCC	**.NET PROGRAMMING**	**3**	**0**	**0**	**3**

Course Objectives

To assist the learner to understand the .NET Architecture, Object oriented concepts, to use ADO.NET for database connectivity and developing the ability to solve any type of problems by mapping with real world environment using ASP.NET and C#.

- Construct various applications using C# in .Net framework
- Familiar about Object Oriented concepts in C# language
- Demonstrate how to retrieve data from database using ADO.NET programming
- Create web based and windows based applications using ASP.NET
- Make the developer experience consistent across widely varying types of apps, such as Windows based apps and Web-based apps.

UNIT I : INTRODUCTION TO C 9

Introducing C# - Introduction to .Net framework and Architecture - Understanding .NET-Overview of C#- Literals Variables-Constant Variables – Scope of Variables – Boxing and Unboxing - Data Types- Operators- Expressions Branching- Looping- Methods- Arrays- Strings- Structures- Enumerations.

UNIT II : OBJECT ORIENTED ASPECTS OF C 9

Classes-Adding Variables – Adding Methods - Objects – Accessing class Members – Constructors – Abstract classes and Methods - Inheritance - Polymorphism – Interfaces - Operator Overloading - Delegates and Events - Errors and Exceptions.

UNIT III : ADO.NET 9

ADO.NET Introduction - ADO.NET Architecture : Connected and Disconnected Architecture – Data Provider Connection Object, Command Object, Data Reader - Datasets : Data Table , Data Column , Data Row , Data Constraints , Data Relation , Data Adapters

UNIT IV : WEB BASED APPLICATION DEVELOPMENT ON .NET 9

Building Windows Forms Applications -Programming Web Applications with Web Forms using ASP.NET - ASP.NET controls - Understand Data Binding and various Data Sources in ASP.NET - Understand the creation of Master Pages and themes - Configuration of web applications using IIS configurations - State management in ASP.NET Programming Web Services.

UNIT V : MVC FRAMEWORK 9

MVC basics , MVC Architecture, Web forms vs MVC, Create a controller , Create models ,Create a view,Add a service class ,Use dependency injection ,Finish the controller ,Update the layout

TOTAL HOURS: 45

TEXT BOOKS:

1: Balagurusamy. E, “Programming in C#”, Tata McGraw-Hill, 2004. (Unit I, II)
2: Liberty.J, “Programming C#”, 2nd Edition., O’Reilly, 2002.(Unit III, IV, V)
3: Bill Hamilton, Matthew MacDonald , “ ADO.NET in a Nutshell “ ,O'Reilly Media (Unit III)
4: Jesse Liberty, Dan Maharry, Dan Hurwitz . “Programming ASP.NET 3.5” 4th Edition , O'Reilly Media (Unit IV)

REFERENCES:

1: Herbert Schildt, “The Complete Reference: C#”, Tata McGraw-Hill, 2004.
2: Robinson et al, “Professional C#”, 2nd ed., Wrox Press, 2002.
3: Andrew Troelsen, “C# and the .NET Platform”, A! Press, 2003.
4: ThamaraiSelvi, R. Murugesan, “A Textbook on C#”, Pearson Education
5: ADO.NET in a Nutshell By Bill Hamilton, Matthew MacDonald Publisher: O'Reilly Media.
6: Programming ASP.NET 3.5, 4th Edition By Jesse Liberty, Dan Maharry, Dan HurwitzPublisher: O'Reilly Media

Web Links:

W1: https://ict.iitk.ac.in/courses/introduction-to-c-sharp/

W2: https://www.btechguru.com/training--dot-net--c-sharp-dot-net--framework--c-sharp- programming-tutorial-part-1-video-lecture--11285--27--139.html

COURSE OUTCOMES

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

CO1	Construct various applications using C# in .Net framework	**K1**
CO2	Familiar about Object Oriented concepts in C# language	**K5**
CO3	Demonstrate how to retrieve data from database using ADO.NET programming	**K3**
CO4	Develop ASP.NET based web application using C#	**K2**
CO5	Develop desktop based, modern web based applications using Model View Controller	**K2**

Mapping Of Course Outcomes To Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	3	2	2	2	2	2	-	-	-	-	2	1	2
CO2	3	2	2	2	2	3	2	-	-	-	-	2	1	2
CO3	2	2	3	3	2	2	2	-	-	-	-	2	3	2
CO4	2	3	2	2	2	3	2	-	-	-	-	2	3	3
CO5	3	2	3	2	2	2	3	-	--	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC	COMPUTATIONAL DATA ANALYTICS	3	0	0	3

Course Objectives

- To study the basic inferential statistics and sampling distribution.
- To understand the concept of estimation of parameters using fundamental tests and testing of hypotheses.
- To understand the techniques of analysis of variance.
- To gain knowledge in predictive analytics techniques.
- To perform a case study with any available sample data sets.

UNIT I : INFERENTIAL STATISTICS I 9

Populations – samples – random sampling – probability and statistics. Sampling distribution – creating a sampling distribution – mean of all sample means – standard error of the mean – other sampling distributions. Hypothesis testing – z-test – z-test procedure – statement of the problem – null hypothesis – alternate hypotheses – decision rule – calculations – decisions – interpretations

UNIT II : INFERENTIAL STATISTICS II 9

Why hypothesis tests? – Strong or weak decisions – one-tailed and two-tailed tests – case studies Influence of sample size – power and sample size - Estimation – point estimate – confidence interval – level of confidence – effect of sample size

UNIT III : T-TEST 9

t-test for one sample – sampling distribution of t – t-test procedure – degrees of freedom – estimating the standard error – case studies t-test for two independent samples – statistical hypotheses – sampling distribution – test procedure – p-value – statistical significance – estimating effect size – meta analysis t-test for two related samples

UNIT IV : ANALYSIS OF VARIANCE 9

F-test – ANOVA – estimating effect size – multiple comparisons – case studies Analysis of variance with repeated measures Two-factor experiments – three f-tests – two-factor ANOVA – other types of ANOVA Introduction to chi-square tests

UNIT V: PREDICTIVE ANALYTICS 9

Linear least squares – implementation – goodness of fit – testing a linear model – weighted Resampling Regression using StatsModels – multiple regression – nonlinear relationships – logistic regression – estimating parameters – accuracy Time series analysis – moving averages – missing values –serial correlation – autocorrelation Introduction to survival analysis

Total Hours : 45

Text Books:

- Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
- Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014. [Unit V]

Reference Books:

1. David Spiegelhalter, "The Art of Statistics: Learning from Data", Pelican Books, 2020.
2. Peter Bruce, Andrew Bruce, and Peter Gedek, "Practical Statistics for Data Scientists", Second Edition, O'Reilly Publishers, 2020..
3. Charles R. Severance, "Python for Everybody: Exploring Data in Python 3", Shroff Publishers, 2017.
4. Bradley Efron and Trevor Hastie, "Computer Age Statistical Inference", Cambridge University Press, 2016.

Web Links:

1. https://www.ibm.com/in-en/marketing/careereducation/bigdata-analytics/

COURSE OUTCOMES

CO1	Understand the concept of sampling	**K1**
CO2	Apply the knowledge to derive hypotheses for given data	**K3**
CO3	Demonstrate the skills to perform various tests in the given data	**K4**
CO4	Ability to derive inference using Predictive Analytics Perform statistical analytics on a data set	**K3**
CO5	Perform statistical analytics on a data set	**K5**

Mapping of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	2	-	-	-	-	-	-	-	-	3
CO2	3	2	1	2	2	-	-	-	-	-	-	-	-	3
CO3	3	2	2	2	1	-	-	-	-	-	2	2	1	3
CO4	3	3	2	2	2	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	2	-	-	2	2	1	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓		✓	✓

PCC	.NET PROGRAMMING LABORATORY	0	0	2	1

LIST OF EXPERIMENTS

1. Implement C# program
   a) Write a program in C# to count a total number of alphabets, digits and special characters in a string.
   b) Write a program in C# to count a total number of duplicate elements in an array.
   c) Design program to implement Stack in c#.
2. Basic C# program
   (a) Calculate Hypotenuse of triangle using dynamic initialization of variables
   (b) To get input from the user and perform calculations
   (c) Calculate the quadrant for the coordinates using if..else…ladder
   (d) Check whether the alphabet is a vowel or not using switch..case…
   (e) To understand about for..each loop and strings
3. Create a login page using controls.
4. Create a registration page with all controls.
5. Establish database connection using ado.net
6. Create a page with control values fetching from database
7. Create a master page for college application.
8. Apply themes and different CSS in a form.

9. Create a crud application
10. Create a web application with MVC framework

TOTAL HOURS: 30

Text Books:

1. Balagurusamy. E, “Programming in C#”, Tata McGraw-Hill, 2004.
2. Liberty.J, “Programming C#”, 2nd Edition., O’Reilly, 2002.

Reference Books:

1. Herbert Schildt, “The Complete Reference: C#”, Tata McGraw-Hill, 2004.
2. Robinson et al, “Professional C#”, 2nd ed., Wrox Press, 2002.

Web Links:

1. https://www.tutorialspoint.com/dot net/index.html
2. https://ict.iitk.ac.in/courses/introduction-to-c-sharp

Course Outcome	Description	Knowledge Level
CO1	Understanding the basic concepts, and programs in C#	K5
CO2	Establish database connection using ADO.Net	K1
CO3	Create user interactive web pages using ASP.net	K1
CO4	Applying themes and different CSS in a form	K4
CO5	Performing database operations for windows and web applications using MVC	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO11	PO 12	PSO1	PSO 2
CO1	2	3	2	2	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	2	1	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	3	-	-	-	-	-	-	-	3	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓	✓	✓	✓	✓

CC	COMPUTATIONAL DATA ANALYTICS LAB	0	0	2	1

Course Objectives

- To study and write simple programs using the basic packages for handling data
- To do various sampling and T,Z,Anova test in various samples
- To perform case study and design a system
- To demonstrate Time Series Analysis in any real time application

List of Experiments:

1. Random Sampling
2. Correlation Study
3. Z-test case study
4. T-test case studies
5. ANOVA case studies
6. Linear Regression
7. Multiple Regression
8. Logistic Regression
9. Time series Analysis
10. Exploratory Data Analysis
11. Predicition
12. Visualization

TOTAL HOURS : 30

Text Books:

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014. [Unit V]

REFERENCE BOOKS:

1. David Spiegelhalter, “The Art of Statistics: Learning from Data”, Pelican Books, 2020.
2. Peter Bruce, Andrew Bruce, and Peter Gedek, “Practical Statistics for Data Scientists”, Second Edition, O’Reilly Publishers, 2020..

Web Links:

https://www.ibm.com/in-en/marketing/careereducation/bigdata-analytics/

COURSE OUTCOMES

CO1	To become skilled to use various packages in Python	**K1**
CO2	Demonstrate the understanding of data distribution with various samples	**K3**
CO3	Ability to Implement T-Test ,Anova and Z-Test on sample data sets	**K4**
CO4	Understanding of Mathematical models in real world problems.	**K1**
CO5	Conduct time series analysis and draw conclusion.	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	-	-	-	-	-	-	2	2	3	2
CO2	2	3	2	2	-	-	-	-	-	-	2	2	3	3
CO3	3	2	3	2	-	-	-	-	-	-	2	-	-	-
CO4	2	2	3	3	-	-	-	-	-	-	2	2	3	2
CO5	3	3	3	3	-	-	-	-	-	-	2	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

HSC	PERSONALITY DEVELOPMENT IV	2	0	0	2

COURSE OBJECTIVES:

- To enhance the soft skills and prepare them towards the skills needed for their career.

UNIT I : SOFT SKILLS **6**

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication –

Merits – forms of assertion – Causes of misunderstanding

UNIT II : COMMUNICATION SKILLS **6**

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III : PRESENTATION SKILLS **6**

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience –

Types of presentations – How to make effective presentation.

UNIT IV : PRESENTATION SKILLS II **6**

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences –

Steps to eliminate Stage fear.

UNIT V CHANGE MANAGEMENT **6**

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

TOTAL HOURS : 30

TEXT BOOKS:

1. LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Spencer Johnson, Who Moved My Cheese, Vermilion, First edition
3. Adair, John, Effective Communication, London: Pan Macmillan Ltd., 2003.

REFERENCE BOOKS:

1. Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. Business Communication Today, Tenth Edition. New Jersey: Prentice Hall, 2010.

Weblinks:

1.https://onlinecourses.nptel.ac.in/noc22_hs08/preview

COURSE OUTCOMES

CO1	Be assertive in their communication.	**K3**
CO2	Differentiate the principles of formal and informal communication.	**K4**
CO3	Make an effective presentation by understanding the audience.	**K3**
CO4	Practice the rules of presentation using slides, PPT's and visuals.	**K3**
CO5	Discuss the principles of change management.	**K2**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	2	2	-	-	2	-	2	2	-	2
CO2	2	3	2	2	2	2	-	-	2	-	2	2	-	3
CO3	3	2	3	2	2	1	-	-	2	-	2	2	-	1
CO4	2	2	3	3	2	2	-	-	2	-	2	2	-	2
CO5	3	3	3	3	2	3	-	-	2	-	2	3	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

PCC	FULL STACK WEB DEVELOPMENT	3	0	0	3

Course Objectives

- To understand the various components of full stack development
- To learn Node.js features and applications
- To develop applications with MongoDB
- To understand the role of Angular and Express in web applications
- To develop simple web applications with React

UNIT I : BASICS OF FULL STACK 9

Understanding the Basic Web Development Framework - - User - Browser – Webserver - Backend Services – MVC Architecture - Understanding the different stacks –The role of Express – Angular – Node – Mongo DB – React

UNIT II : NODE JS 9

Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers - Callbacks – Handling Data I/O – Implementing HTTP services in Node.js

UNIT III : MONGO DB 9

Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications

UNIT IV : EXPRESS AND ANGULAR 9

Implementing Express in Node.js - Configuring routes - Using Request and Response objects - Angular - Typescript - Angular Components - Expressions - Data binding - Built-in directives

UNIT V : REACT 9

MERN STACK – Basic React applications – React Components – React State – Express REST APIs - Modularization and Webpack - Routing with React Router – Server-side rendering

TOTAL HOURS : 45

Text Books:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, ‘Node.js, MongoDB and Angular Web Development’, Addison-Wesley, Second Edition, 2018

2. Vasan Subramanian, ‘Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node’, Second Edition, Apress, 2019.

Reference Books:

1. Chris Northwood, ‘The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer’, Apress; 1st edition, 2018
2. Kirupa Chinnathambi, ‘Learning React: A Hands-On Guide to Building Web Applications Using React and Redux’, Addison-Wesley Professional, 2nd edition, 2018
3. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
4. https://www.coursera.org/specializations/full-stack-react
5. https://www.udemy.com/course/the-full-stack-web-development/ Web Links:

Weblinks

1. https://angular.io/
2. https://nodejs.org/en/
3. https://expressjs.com/
4. https://www.mongodb.com/

COURSE OUTCOMES

CO1	Understand the various stacks available for web application development	K1
CO2	Use Node.js for application development	K5
CO3	Develop applications with MongoDB	K4
CO4	Use the features of Angular and Express	K6
CO5	Develop React applica	K6

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	3	3
CO2	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	3

CO4	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO5	2	2	3	3	2	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PCC	FULL STACK WEB DEVELOPMENT LAB	0	0	2	1

Course Objectives

- To develop full stack applications with clear understanding of user interface, business logic and data storage.
- To design and develop user interface screens for a given scenario
- To develop the functionalities as web components as per the requirements
- To implement the database according to the functional requirements
- To integrate the user interface with the functionalities and data storage.

List of Experiments:

1. Develop a portfolio website for yourself which gives details about yourself for a potential recruiter.
2. Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items
3. Create a simple micro blogging application (like twitter) that allows people to post their content which can be viewed by people who follow them.
4. Create a food delivery website where users can order food from a particular restaurant listed in the website.
5. Develop a classifieds web application to buy and sell used products. rest api

with node

6. Develop a leave management system for an organization where users can apply different types of leaves such as casual leave and medical leave. They also can view the available number of days.
7. Develop a simple dashboard for project management where the statuses of various tasks are available. New tasks can be added and the status of existing tasks can be changed among Pending, In Progress or Completed.
8. Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions
9. Create your Own Web Application
10. Mini Project

Text Books:

1. Amos Q. Haviv, MEAN Web Development,2nd Revised edition,Packt Publishing
2. Ethan Brown,Web Development with Node and Express,Oreilly

Reference Books:

1. Colin J Ihrig , Adam Bretz Full Stack JavaScript Development With MEAN,FirstEdition

Web Links:

1. https://angular.io/

TOTAL HOURS : 30

COURSE OUTCOMES

CO1	Design full stack applications with clear understanding of user interface, business logic and data storage	**K3**
CO2	Design and develop user interface screens	**K4**
CO3	Implement the functional requirements using appropriate tool	**K6**
CO4	Design and develop database based on the requirements	**K4**
CO5	Integrate all the necessary components of the application	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	1	3	-	-	-	-	-	-	3	2	2
CO2	1	1	1	1	3	-	-	-	-	-	-	1	1	1
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	3	-	-	-	-	-	-	2	3	2
CO5	3	2	2	1	1	-	-	-	-	-	-	2	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
		✓	✓	✓
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**
✓			✓	✓

LIST OF ALL PROFESSIONAL ELECTIVE COURSES

PEC	APPLIED CRYPTOGRAPHY	3	0	0	3

Course Objective:

- To understand the mathematical background for cryptography.
- To understand the taxonomy of cryptography primitives
- To understand the Symmetric key encryption system, public key encryption system
- To implement cryptographic algorithms

UNIT I - INTRODUCTION **9**

Cryptography goals – Taxonomy of cryptography primitives – Background on functions – Basic terminology – Definition and examples – Block ciphers, stream cipher, substitution ciphers, transposition ciphers – Composition of ciphers – Digital signature – Construction of digital signature – Public key cryptography – Hash functions – Protocol and mechanism – Key establishment and management – Pseudo random numbers – Classes of attack.

UNIT II - NUMBER THEORY **9**

Probability theory – Information theory – Complexity theory – Number theory – Abstract algebra – Finite fields – Primality test – Prime number generation – Irreducible polynomial.

UNIT III - RANDOM GENERATORS **9**

Pseudo random bits and sequences – Random bit generation – Pseudorandom bit generation – statistical tests – Stream Cipher.

UNIT IV - ENCRYPTION ALGORITHMS **9**

Block cipher – DES – FEAL – IDEA – SAFAR – Public key encryption – RSA – Rabin – Elgamal –Mc Eliece – Knapsack.

UNIT V - HASH ALGORITHMS **9**

Hash function and data integrity – Classification and framework – Basic constructions and general results – Unkeyed hash functions – Keyed hash functions – data integrity and message authentication – Advanced attacks and hash function.

TOTAL: 45 hours

TEXT BOOK :

1. A.Menezes, P.Van Oorschot and S. Vanstone, “Hand book of Applied Cryptography” CRC Press, Fifth Printing, 2001.

REFERENCE BOOKS :

1. Charlie Kaufman, Radia Perlman, Mike Speciner, " Network Security, Private communication in public world" PHI 2nd edition 2002.
2. Bruce Schneier, Neils Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd, 2003
3. Douglas R Simson "Cryptography – Theory and practice", CRC Press 1995. 3. Stallings, "Cry ptography& Network Security", Pearson Education, 4th Edition 2006.

Weblinks:

1.https://onlinecourses.nptel.ac.in/noc20_cs02/preview

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Understand the basics of cryptographic algorithms and protocols	**K3**
CO2	Analyze the concept of Public key cryptography, Hash functions, Key establishment and management	**K4**
CO3	Acquire knowledge on encryption algorithms such as Block cipher, DES, FEAL, IDEA and SAFAR	**K3**
CO4	Evaluate the performance of Hash function, data integrity and message authentication	**K5**
CO5	Assess existing applications of cryptography and develop new protocols and applications that employ cryptography.	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	1	2	3	1	1	2	0	1	2	0
CO2	2	3	2	2	-	-	-	-	-	-	2	-	-	-
CO3	2	3	2	2	1	3	1	2	3	2	2	-	-	2
CO4	2	-	-	-	-	-	2	3	2	2	3	2	3	3
CO5	2	3	3	2	-	-	-	-	-	-	3	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	BIG DATA PROGRAMMING	3	0	0	3

Course Objectives

- To explore the fundamental concepts of big data analytics, Hadoop, R programming and HiveQL
- To learn big data analytics using R Programming

UNIT I : Introduction to Big Data 9

Introduction to Big Data Platform – Challenges of Conventional Systems - Nature of Data- Evolution Of Analytic Scalability - Intelligent data analysis- Analytic Processes and Tools - Analysis vs. Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error

UNIT II : Hadoop 9

History of Hadoop- The Hadoop Distributed File System – Components of Hadoop- Analyzing the Data with Hadoop Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features

UNIT III : Hive QL 9

Introduction to HiveQL- Databases in Hive-HiveQL: Queries- SELECT … FROM Clauses , Specify Columns with Regular Expressions , Computing with Column Values , Arithmetic Operators, Using Functions- Mathematical functions, Aggregate functions, Table generating functions, Other built-in functions ,LIMIT Clause ,Nested SELECT Statements, CASE … WHEN … THEN Statements, WHERE Clauses, Predicate Operators, LIKE and RLIKE, GROUP BY Clauses , HAVING Clauses ,JOIN Statements -Inner JOIN ,LEFT OUTER JOIN,RIGHT OUTER JOIN, FULL OUTER JOIN,

Cartesian Product JOINs , Map-side Joins, ORDER BY and SORT BY, DISTRIBUTE BY with SORT BY , CLUSTER BY

UNIT IV: Big Data Analytics Using R Programming 9

Analyzing, Visualization and Exploring the Data, Statistics for Model Building and Evaluation, Introduction to R and RStudio, Basic analysis in R, Intermediate R, Intermediate analysis in R, Advanced Analytics - K-means clustering, Association rules-Speedup, Linear Regression, Logistic Regression, Naïve Bayes, Decision Trees, Time Series Analysis, Text Analysis

UNIT V Frameworks 9

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services –- fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams. Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications

TOTAL HOURS : 45

Text Books :

1. Prajapati, Big Data Analytics with R and Hadoop, 2014
2. Stephan Kudyba, Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications, March 12, 2014 .
3. Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications,2013
4. Jason Rutherglen, Dean Wampler and Edward Capriolo, Programming Hive, O'REILLY, 2012

Reference Books:

1. Michael Berthold, David J. Hand, ―Intelligent Data Analysis‖, Springer, 2007.
2. Tom White ― Hadoop: The Definitive Guide‖ Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk De Roos, Tom Deutsch, George Lapis, Paul Zikopoulos, ―Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data‖, McGraw Hill Publishing, 2012
4. Anand Rajaraman and Jeffrey David Ullman, ―Mining of Massive Datasets, Cambridge University Press, 2012.

5. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, JohnWiley& sons, 2012.
6. Glenn J. Myatt, ―Making Sense of Data, John Wiley & Sons, 2007
7. Dr. Mark Gardener, Beginning R: The Statistical Programming Language (Wrox), 2013
8. PeteWarden, ―Big Data Glossary, O'Reilly, 2011.
9. Jiawei Han, MichelineKamber ―Data Mining Concepts and Techniques, Second Edition, Elsevier, Reprinted 2008.
10. Da Ruan,Guoquing Chen, Etienne E.Kerre, GeertWets, Intelligent Data Mining, Springer,2007
11. Paul Zikopoulos ,Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012.
12. Michael Minelli (Author), Michele Chambers (Author), AmbigaDhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses,Wiley Publications,2013
13. Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011

Weblinks:

1. https://nptel.ac.in/courses/106104189

COURSE OUTCOMES

CO1	Identify the purpose and need of big data programming and compare it with conventional systems.	**K3**
CO2	Examine and compare various Components of Hadoop and develop a Map Reduce application.	**K4**
CO3	Develop Hive queries using HiveQL interface.	**K3**
CO4	Discuss various statistics modeling techniques and its evaluation using R and other clustering methods.	**K6**
CO5	Discuss various big data frameworks, Applications on Big Data Using Pig, fundamentals HBASE, Zookeeper, IBM Info Sphere Big Insights and also test Visual data analysis techniques	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

PEC	CLOUD COMPUTING	3	0	0	3

Course Objectives

- To understand the concept of cloud and utility computing.
- To understand the various issues in cloud computing.
- To familiarize with the types of virtualization and the lead players in cloud.

UNIT I : INTRODUCTION, PRINCIPLES AND ARCHITECTURE **9**

Cloud Computing : Vision, reference model, characteristics and challenges – historical development – building cloud computing environment – computing platforms and Technologies – Parallel Vs distributed computing – Elements of parallel and distributed computing – Technologies for distributed computing. Cloud Computing Architecture: Cloud reference model - NIST Cloud Computing Reference Architecture – types of Clouds - economics – open challenges.

UNIT II : VIRTUALIZATION 9

Characteristics of virtualized environments - Taxonomy of virtualization techniques - Execution virtualization -Machine reference model - Hardware-level virtualization – Hypervisors - Hardware virtualization techniques -Operating system-level virtualization - Programming 210 language-level virtualization - Application-level virtualization - Other types - Virtualization and cloud computing - Pros and cons of virtualization - Technology examples - Xen: Paravirtualization - VMware: full virtualization - Full virtualization and binary translation - Microsoft Hyper-V.

UNIT III : CLOUD INFRASTRUCTURE 9

Cloud Computing and Services Model – Public, Private and Hybrid Clouds – Cloud Eco System - IaaS - PaaS – SaaS. Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources. Case Study: Amazon Web Service reference, GoGrid, Rackspace

UNIT IV : CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENT 9

Cloud capabilities and platform features – data features and databases - Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Dryad and DryadLINQ – sawzall and Pig Latin - Mapping Applications - Programming Support of Google App Engine - Amazon AWS – Microsoft Azure - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack. Case Study: Amazon Web Service reference, GoGrid, Rackspace.

UNIT V : CLOUD PLATFORMS AND APPLICATION 9

Amazon web services - Compute services - Storage services - Communication services - Google AppEngine - Architecture and core concepts – Cloud Security and Trust management. Application life cycle - Cost model – Observations - Microsoft Azure - SQL Azure – Scientific Applications –Business and Consumer Application – Energy efficiency in clouds - Market-based management of clouds - Federated clouds/Inter Cloud - Third-party cloud services.

TOTAL HOURS : 45

Text Books:

T1: Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012. T2: Rajkumar Buyya, Christian Vecchiola. S.Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, 2013.

Reference Books:

R1: James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

R2: George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly.

R3: Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India, 2010.

R4: John W.Rittinghouse and James F.Ransome, "Cloud Computing:Implementation, Management, and Security", CRC Press, 2010.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs20/preview.
2. https://www.w3schools.in/cloud-computing.

COURSE OUTCOMES

CO1	Understand the broad perspective of cloud architecture, key technologies, principles, strengths, limitations as well as the possible applications of the state-of-art of cloud computing.	K2, K3
CO2	Gain a basic knowledge of virtualization and its categorization and Design & develop highly scalable cloud-based applications by creating and configuring virtual machines.	K3, K6
CO3	Compare, contrast, and evaluate the key trade-offs between multiple approaches to cloud system design, and Identify appropriate design choices when solving real - world cloud computing problems.	K4
CO4	Interpret some important cloud computing driven commercial systems such as: Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.	K5
CO5	Build and deploy cloud application using popular cloud platforms.	K6

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	-	3	-	-	-	-	-	-	-	-	3

CO2	3	2	2	3	2	-	-	-	-	-	-	-	-	3
CO3	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO4	2	2	2	3	-	-	-	-	-	-	-	-	-	3
CO5	-	2	3	3	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Openbook test**
✓	✓		✓		

PEC	CRYTOGRAPHY AND NETWORK SECURITY	3	0	0	3

Course Objectives

- To understand the fundamental principles, algorithms of cryptographic techniques and expose them to various scenarios of cyber crime with an introduction to cyber law along with a thrust on security on the internet
- To develop an understanding of information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.

UNIT I : INTRODUCTION 9

OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption. Standard – The strength of DES - Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Multiple Encryption and Triple DES – Placement of Encryption Function – Traffic Confidentiality – Key distribution – Random Number Generation

UNIT : II PUBLIC KEY CRYPTOGRAPHY 9

Key Management - Diffie- Hellman key Exchange – Elliptic Curve Arithmetic - Elliptic Curve Cryptography

- Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography/RSA

UNIT III : AUTHENTICATION AND HASH FUNCTION **9**

Authentication requirements – Authentication functions – Message Authentication Codes – Hash. Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – CMAC Digital Signatures - Digital Signatures - Authentication Protocols – Digital Signature Standard.

UNIT IV : NETWORK SECURITY **9**

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security: Pretty good privacy, S/MIME – IP Security – Web Security: Web security considerations, Secure socket layer and Transport layer Security – Authentication Header – Encapsulating Security Payload – Combining Security Associations – Key Management.

UNIT V : SYSTEM LEVEL SECURITY **9**

Intruders: Intrusion detection – password management – Malicious software: Viruses and related. Threats, Virus Counter measures, Distributed Denial of Service Attacks – Firewalls: Firewall Design Principles, Trusted Systems, Common Criteria for Information Technology Security Evaluation – Internet standards and internet security.

TOTAL HOURS : 45

Text Books:

1 William Stallings, "Cryptography and Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.

2 Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2013

Reference Books:

1 Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.

2 Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson education

Web Links:

1. https://www.tutorialspoint.com/cryptography/index.html
2. https://onlinecourses.nptel.ac.in/noc21_cs16/preview

COURSE OUTCOMES

CO1	Understand OSI security architecture and the design principles of Block cipher	**K3**
CO2	Acquire knowledge on block cipher modes of operation	**K3**
CO3	Describe key management in public key cryptography	**K5**
CO4	Implement the Hash Functions and Authentication Protocols	**K6**
CO5	Analyze the Electronic Mail Security and IP Security	**K4**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	3	2	3	-	3	-	-	-	-	-	-	-	2	2
CO2	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO3	3	2	3	3	3	-	-	-	-	-	-	-	3	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	1
CO5	-	2	3	3	3	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓		✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

PEC	**CYBER FORENSICS**	**3**	**0**	**0**	**3**

Course Objective:

- To understand the fundamentals of Computer Forensics and computing Investigations.
- To recognize the legal underpinnings and critical laws affecting forensics
- To apply the tools and methods to uncover hidden information in digital

systems.

- To learn about current licensing and certification requirements to build the career in digital forensic.

UNIT I : INTRODUCTION 9

The Scope of Computer Forensics - Windows Operating and File Systems – Handling Computer Hardware – Anatomy of Digital Investigation.

UNIT II : INVESTIGATIVE SMART PRACTICES 9

Forensics Investigative Smart Practices – Time and Forensics – Incident closure

UNIT III : LAWS AND PRIVACY CONCERNS 9

Laws Affecting Forensic Investigations – Search Warrants and Subpoenas – Legislated Privacy Concerns – The admissibility of Evidence – First Response and Digital Investigator

UNIT IV : DATA ACQUISITION AND REPORT WRITING 9

Data Acquisition – Finding Lost Files – Document Analysis – Case Management and Report Writing – Building a Forensics Workstation

UNIT V : TOOLS AND CASE STUDIES 9

Tools of the Digital Investigator - Licensing and Certification – Case Studies: E-mail Forensics – Web Forensics – Searching the Network – Excavating a Cloud – Mobile device Forensics.

TOTAL HOURS : 45

TEXT BOOKS:

1. Michael Graves, ―Digital Archaeology: The Art and Science of Digital Forensics, Addison-Wesley Professional, 2014.
2. Darren R. Hayes, ―Practical Guide to Computer Forensics Investigation, Pearson, 2015.
3. Albert J. Marcella and Frederic Guillossou, ―Cyber Forensics: From Data to Digital Evidence ―, Wiley, 2015.

REFERENCE BOOK:

1. Bill Nelson, Amelia Phillips and Christopher Steuart, ―Guide to Computer Forensics and Investigations‖, Fourth Edition, Cengage, 2013.

Web Links:

https://nptel.ac.in/courses/106106129

https://www.techtarget.com/searchsecurity/definition/computer-forensics

COURSE OUTCOMES:

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

Course Outcome	Description	Knowledge Level
CO1	Acquire knowledge on Forensic Investigative smart practices.	**K3**
CO2	Analyze the importance and need for smart practices in computer investigation.	**K4**
CO3	Analyze the ethical standards of the profession and apply those standards to all aspects of the study and practice of digital forensics.	**K4**
CO4	Evaluate the effectiveness of available digital forensics tools and use them in a way that optimizes the efficiency and quality of digital forensics investigations.	**K5**
CO5	Describe web and mobile device forensics.	**K6**

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	3	2	2	0	3	2	2	2	2	3	2
CO3	3	3	3	3	2	2	1	3	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	2	2	2	2	3	2
CO5	2	3	3	3	2	-	-	-	-	-	-	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration**
			✓	✓

PEC	DATA WAREHOUSING AND DATA MINING	3	0	0	3

Course Objective:

- ✓ To introduce the concept of data warehousing with special emphasis on architecture and design.
- ✓ To introduce the concept of data mining with a detail coverage of basic tasks, metrics, issues, and implication.
- ✓ To learn the core topics like classification, clustering and association rules.

UNIT I : DATA WAREHOUSING 9

Data warehousing Components:Data Warehouse Database**,** Sourcing, Acquisition, Cleanup and TransformationTool, Data Warehouse Administration and Management**, Information Delivery System** – Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata.

UNIT II : BUSINESS ANALYSIS 9

Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines –Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet -Data Cube Technology, From Data warehousing to Data Mining.

UNIT III : DATA MINING 9

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems- comparison of classification and prediction methods – Data Mining Task Primitives –Integration of a Data Mining System with a Data Warehouse – Issues – Data Preprocessing.-, Mining Descriptive Statistical Measures in Large Databases.

UNIT IV : ASSOCIATION RULE MINING AND CLASSIFICATION 9

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification By Backpropagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction

UNIT V: CLUSTERING, APPLICATIONS AND TRENDS IN DATA MINING 9

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods –Hierarchical Methods - Density-Based Methods – Grid Based Methods – Model- Based Clustering Methods –Clustering High Dimensional Data- Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications.- Case Study.

TOTAL HOURS : 45

TEXT BOOKS:

1. Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", TataMcGraw – Hill Edition,Tenth Reprint 2007.(I & II)
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", SecondEdition, Elsevier, 2007.(IIIto V)

REFERENCES:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction To Data Mining",Person Education, 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory andPractice", Easter EconomyEdition, Prentice Hall of India, 2006.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter EconomyEdition, Prentice Hall of India,2006.
4. Daniel T.Larose, "Data Mining Methods and Models", Wile-Interscience, 2006.

Web Links:

W1 : Https://Onlinecourses.Nptel.Ac.In/Noc21_Cs06/Preview

COURSE OUTCOMES :

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

Course Outcome	Description	Knowledge Level
CO1	Apply the basic concepts of DBMS with datawarehousing and datamining	**K3**
CO2	Identify the datawarehouse components to build a data warehouse.	**K3**
CO3	Explain the functionalities and classifications of data mining systems	**K5**
CO5	Identify the issues and understand the integration of a data mining system with a datawarehouse	**K3**
CO5	Explain cluster analysis, outlier analysis and data mining applications	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	-	2	3	2
CO2	2	3	3	3	3	2	1	1	2	2	2	2	3	2
CO3	3	3	-	-	-	-	-	-	2	-	-	-	3	2
CO4	3	3	3	3	3	2	1	1	2	2	2	2	3	2
CO5	2	3	3	3	3	2	1	1	-	-	-	-	-	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	E COMMERCE	3	0	0	3

Course Objectives

- To understand the nature of e-Commerce and recognize the business impact and potential of e- Commerce
- To learn the technologies required to make e-Commerce viable.
- To know about the current drivers and inhibitors facing the business world in adopting and using e-Commerce

UNIT I : Introduction 9

Traditional commerce and Ecommerce - Categories of Electronic commerce – Business models – Revenue models – Business processes. Internet and WWW–role of WWW–value chains–strategic business – Revenue Strategy issues – Industry value chains - supply chain management–role of Ecommerce

UNIT II : Infrastructure for E-Commerce 9

Packet switched networks–Routing packets. TCP/IP protocol script: IP Addressing – Domain names – E- mail protocols. Internet utility programs–SGML,HTML and XML–web client and servers–Web client/server architecture– intranet and extranets – Public and private networks – Virtual private network

UNIT III : Web Based Tools for E-Commerce 9

Web server: Server computers –performance evaluation – Hardware architectures. Web server software feature sets–web server software and tools– Internet Utility programs – Data analysis software – Link checking utilities. web protocol–search engines–intelligent agents –EC software– webhosting–cost analysis

UNIT IV : Security 9

Computer security classification–copyright and Intellectual property–electronic commerce threats: Secrecy threats – Integrity threats – Necessity threats Encryption solutions. Protecting client computers–electronic payment systems– electronic cash–strategies for marketing–sales and promotion–cryptography – authentication

UNIT V: Intelligent Agents 9

Definition and capabilities–limitation of agents – History of software agents – Characteristics and properties a of agents – Tele script Agent Language – safe-Tcl – security–web based marketing– search engines and Directory registration–online advertisements– Portables and info mechanics–website design issues.

TOTAL HOURS : 45

Text books:

T1 Ravi Kalakota, Andrew B. Whinston " Frontiers of Electronic Commerce",Pearson Education, 2008

T2 Gary PSchneider "Electronic commerce", Thomson learning & James TPeny Cambridge USA, 2001 T3 Manlyn Greenstein and Miklos "Electronic commerce" McGraw-Hill, 2002.

Reference Books:

R1 Efraim TurvanJ.Lee, David Kug and Chung,"Electronic Commerce" Pearson EducationAsia2001.

R2 Brenda Kienew Ecommerce Business Prentice Hall,2001.

Weblinks:

https://archive.nptel.ac.in/content/storage2/courses/106108103/pdf/Worked_Examples/WKm13.pdf

COURSE OUTCOMES

CO1	Construct the implement various business models of E-Commerce	**K3**
CO2	Develop a policy and regulatory issues in E-commerce	**K4**
CO3	Evaluate the basic networking concepts	**K5**
CO4	Make use of the web client server architecture	**K3**
CO5	Develop and acquire knowledge on web server concepts and its performance evaluation	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	3	2	3	2	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PEC	ETHICAL HACKING	3	0	0	3

Course Objectives

- To understand how intruders escalate privileges.
- To understand Intrusion Detection, Policy Creation, Social Engineering, Buffer Overflows and different types of Attacks and their protection mechanisms
- To learn about ethical laws and tests

UNIT I : Ethical Hacking **9**

Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and Non- Repudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

UNIT II : Foot Printing and Social Engineering **9**

Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking

UNIT III : Data Security **9**

Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography – Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking

UNIT IV : Network Protection System & Hacking Web Servers **9**

Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking

UNIT V : Ethical Hacking Laws and Tests 9

An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing

TOTAL HOURS : 45

TEXT BOOKS:

T1: Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.

REFERENCE BOOKS:

R1: Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.

R2: Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series – Elsevier, August 4, 2011.

R3: Whitaker & Newman, " Penetration Testing and Network Defense" , Cisco Press, Indianapolis, IN, 2006

Weblinks:

1.https://onlinecourses.nptel.ac.in/noc22_cs13/preview

COURSE OUTCOMES

CO1	Utilize the basics of ethical hacking, elements of Information Security, authenticity, non-repudiation and security challenges	**K3**
CO2	Develop a acquire knowledge on Malicious Software (Malware), Protection Against Malware and Intruder Attacks on Computers	**K4**
CO3	Evaluate the web tools for Foot Printing, Competitive Intelligence and Google Hacking.	**K5**
CO4	Determine Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering	**K5**

	and shoulder surfing	
CO5	Develop Analyze Attacks and enhance Physical Security, and Protection	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	2	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

PEC	**INFORMATION RETRIEVAL**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the basics of information retrieval with pertinence to modeling
- To understand various components of IR system
- To understand machine learning techniques for text classification and clustering
- To explore various IR applications.

UNIT I : INTRODUCTION AND MODELING 9

Basic Concepts: Retrieval process – Architecture – Boolean retrieval; IR Models: Taxonomy and characterization of IR models – Classical IR models – Alternative

algebraic models – Models for Browsing – Retrieval Evaluation: Performance evaluation.

UNIT II : INDEXING AND QUERYING 9

Indexing: Inverted indices – Suffix trees – Suffix arrays – Compression; Querying: Query languages; Query Operations: Relevance feedback and query expansion – Automatic local and global analysis.

UNIT III : SEARCHING 9

Searching: Sequential searching – Pattern matching; Searching the Web: Characteristizing the Web – Search engines – Browsing – Searching using hyperlinks.

UNIT IV : CLASSIFICATION AND CLUSTERING 9

Text Classification: Naive Bayes; Vector Space Classification: Rocchio – k-Nearest Neighbour; Flat Clustering: K-Means – Model-based clustering – **Hierarchical clustering – Matrix decompositions and latent semantic indexing.**

UNIT V : APPLICATIONS 9

XML Retrieval – Multimedia IR – Parallel and Distributed IR – Digital Libraries – Social Media Retrieval – Content-based Image Retrieval – Online Public Access Catalogs (OPACs).

TOTAL HOURS: 45

TEXT BOOKS

1. Ricardo Baeza Yates, BerthierRibeiroNeto, “Modern Information Retrieval: The Concepts and Technology behind Search”, ACM Press Books, 2nd Edition, 2011.
2. Christopher D Manning, PrabhakarRaghavan, HinrichSchutze, “Introduction to Information Retrieval”, Cambridge University Press, 1st South Asian Edition, 2008.

REFERENCES

1. Stefan Buttcher, Charles L A Clarke, Gordon V Cormack,“Information Retrieval – Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.
2. Cheng Xiang Zhai, Sean Massung, “Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining”, ACM Books, 2016.
3. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, “Social Media Mining: An

Introduction", 1st Edition, Cambridge University Press, 2014.
4. VipinTyagi, "Content-Based Image Retrieval: Ideas, Influences, and Current Trends", 1st Edition, Springer, 2017.
5. Marcia J Bates, "Understanding Information Retrieval Systems: Management, Types, and Standards", CRC Press, 2012.

Weblinks:

1. https://nptel.ac.in/courses/106101007

COURSE OUTCOMES

CO1:	Describe various IR modeling techniques	K3
CO2:	Identify and design the various components of an Information Retrieval system	K3
CO3:	Apply machine learning techniques to text classification and clustering for efficient Information Retrieval.	K3
CO4:	Describe various IR applications	K2
CO5:	Apply IR evaluation metrics to measure the performance of IR systems	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	1	-	-	1	1	1	-	1	2	3
CO2	3	2	2	-	1	-	-	1	1	1	-	1	2	3
CO3	3	2	2	-	1	-	-	1	1	1	-	1	2	3
CO4	2	1	1	-	1	-	-	1	1	1	-	1	1	2
CO5	3	2	2	-	1	-	-	1	1	1	-	1	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**

PEC	OBJECT ORIENTED ANALYSIS AND DESIGN	3	0	0	3

Course Objective:

- To understand the system modelling and design based on requirements, converting design to code.
- To use various UML design diagrams and to apply the appropriate design patterns.
- To learn the basic Object oriented analysis and design skills through an elaborate case study.
- To apply the process of OOAD in software development.

UNIT I : INTRODUCTION 9

Introduction to OOAD – What is OOAD? – What is UML? An Overview of Object Oriented Systems Development - Object Basics – Object Oriented Systems Development Life Cycle: The Software Development Process – Building High-Quality Software – OOSD: A Use-Case Driven Approach - Use case Modeling - Relating Use cases: include,extend and generalization.

UNIT II : OBJECT ORIENTED METHODOLOGIES 9

Rumbaugh Methodology - Booch Methodology - Jacobson Methodology - Patterns – Frameworks – Unified Approach – Unified Modeling Language: Static and dynamic model – UML diagrams - UML class diagram – Use case diagramUML dynamic modeling (Sequence diagram, Collaboration Diagram, State Diagram) - Activity Diagram –Implementation diagrams (Component diagram, Deployment diagram).

UNIT III: OBJECT ORIENTED ANALYSIS 9

Identifying use cases : Business object analysis –The unified approach- Business process modeling – Use case model– Developing effective documentation - Object Analysis Classification : Classifications theory – Approaches foridentifying classes – Noun phrase approach – Common class patterns approach – Use case driven approach –Classes, responsibilities and collaborators – Naming classes - Identifying Object relationships, Attributes and Methods: Associations – Super sub class relationship – A part of relationships (aggregation) – Class responsibility – Object responsibility.

UNIT IV : OBJECT ORIENTED DESIGN 9

Design Axioms: The object oriented design process – Design axioms – Corollaries – Design patterns – Designing Classes: The process - Class visibility – Refining attributes – Designing methods and protocols. Access Layer: Object Storage and

Object Interoperability: DBMS – Distributed databases and client server computing – Object relational systems – Multidatabase systems – Designing Access layer classes.

UNIT V : SOFTWARE QUALITY AND USABILITY 9

View Layer : Designing Interface Objects : Designing view layer classes – Macro level , Micro level process – Purpose of a view layer interface – Prototyping the user interface- Software Quality Assurance: Quality Assurance Tests – Testing strategies – Impact of Object Orientation – Test Cases – Test Plan – Myer's Debugging Principles – System Usability and Measuring User Satisfaction : Usability Testing – User Satisfaction Test (Test Templates) – Mappingdesign to code.

TOTAL HOURS : 45

TEXT BOOKS:

1. Ali Bahrami, "Object Oriented Systems Development", Tata McGraw-Hill, 1999.
2. Craig Larman,"Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterativedevelopment", Third Edition, Pearson Education,2005.

REFERENCE BOOKS:

1. Mike O'Docherty, "Object-Oriented Analysis & Design: Understanding System Development with UML 2.0", JohnWiley& Sons, 2005.
2. James W- Cooper, Addison-Wesley, "Java Design Patterns – A Tutorial", 2000.

Weblinks:

1.https://onlinecourses.nptel.ac.in/noc19_cs48/preview

COURSE OUTCOMES:

CO1	Construct the Software Development Process	K6
CO2	Analyzeobject oriented design methodologies	K5
CO3	Use Attributes and Methods in use case driven approach	K3
CO4	Design Object relational and Multidatabase systems	K6
CO5	Be Familiar with thetest Cases, test Plan and Myer's Debugging Principles	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	2	3	3	2	2	2	1	2	1
CO2	3	2	3	3	2	-	-	-	-	-	-	2	3	2
CO3	2	3	2	2	2	2	2	3	2	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	3	3	3
CO5	2	3	3	3	-	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	SOFT COMPUTING	3	0	0	3

COURSE OBJECTIVES

1. To learn the basic concepts of Soft Computing
2. To study various Artificial Neural network architectures
3. To learn fuzzy sets, fuzzy logic and fuzzy inference system
4. To understand genetic algorithm for global optimization
5. To learn hybrids of neuro, fuzzy and genetic algorithm, and their applications.

UNIT I : INTRODUCTION TO SOFT COMPUTING 9

Introduction: Neural networks – Fuzzy logic – Genetic algorithm – Hybrid systems; Artificial Neural Network: Fundamental concepts – Evolution of neural networks – Basic modals of ANN – McCulloch and Pitts neuron – Linear separability – Hebb

network.

UNIT II : SUPERVISED, UNSUPERVISED, AND ASSOCIATIVE LEARNING NETWORKS 9

Supervised Learning Network: Perceptron networks – Adaptive linear neuron – Multiple adaptive linear neurons – Back propagation networks – Radial bias function network; Associative Memory Networks: Autoassociative memory network – Bidirectional associative memory – Hopfield networks; Unspervised Learning Networks: Hamming network – Kohonen neural network – Learning vector quantization – Adaptive resonance theory networks.

UNIT III : FUZZY SYSTEMS 9

Introduction to fuzzy logic – Classical sets – Fuzzy sets – Fuzzy relations – Membership functions – Defuzzification methods – Fuzzy arithmetic – Fuzzy measures – Fuzzy rule base and approximate reasoning – Fuzzy decision making.

UNIT IV : GENETIC ALGORITHMS 9

Genetic Algorithm and search space – General genetic algorithm – Operators – Stopping condition – Constraints – Classification – Genetic programming; Applications of genetic algorithm.

UNIT V : HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9

Neuro-Fuzzy hybrid systems – Genetic neuro hybrid systems – Genetic fuzzy hybrid and fuzzy genetic hybrid systems; Applications of Soft Computing: A fusion approach of multispectral images with SAR – Optimization of Traveling Salesman Problem using genetic algorithm – Soft computing based hybrid fuzzy controllers.

Total Periods: 45

TEXT BOOKS

1. S N Sivanandam, S N Deepa, “Principles of Soft Computing”, Wiley India, 2nd Edition, 2011.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2002.

REFERENCES

1. Kwang H Lee, “First course on Fuzzy Theory and Applications”, Springer, 2005.
2. George J Klir, Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1996.
3. James A Freeman, David M Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

4. S Rajasekaran, G A VijayalakshmiPai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
5. N P Padhy, S P Simon, “Soft Computing with MATLAB Programming”, Oxford University Press, 2015.

Weblinks:

1. https://archive.nptel.ac.in/courses/106/105/106105173/

COURSE OUTCOMES:

CO1	Understand various soft computing techniques	K2
CO2	Design and develop different neural network algorithms	K3
CO3	Analyse and apply fuzzy logic and fuzzy inference system	K3
CO4	Solve problems using Genetic Algorithms	K3
CO5	Apply various soft computing techniques for complex problems	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	2	-	-	-	-	-	-	-	3	-

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	SOFTWARE ENGINEERING	3	0	0	3

Course Objective:

- To understand the phases in a software project
- To understand the fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures

UNIT I : SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II : REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, PetriNets- Data Dictionary.

UNIT III : SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design -Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV : TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V : PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management –

Identification, Projection – Risk Management-Risk Identification- RMMM Plan-CASE TOOLS

TOTAL HOURS : 45

TEXT BOOKS:

1. Roger S. Pressman, ―Software Engineering – A Practitioner‟s Approach, Seventh Edition, Mc Graw- Hill International Edition, 2010.
2. Ian Sommerville, ―Software Engineering, 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

1. Rajib Mall, ―Fundamentals of Software Engineering‖, Third Edition, PHI Learning PrivateLimited, 2009.
2. Pankaj Jalote, ―Software Engineering, A Precise Approach‖, Wiley India, 2010.
3. Kelkar S.A., ―Software Engineering, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, ―Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007.

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview

COURSE OUTCOMES:

CO1	Identify the key activities in managing a software project	K2
CO2	Compare different process models	K4
CO3	Apply systematic procedure for software design and deployment	K3
CO4	Compare and contrast the various testing and maintenance	K4
CO5	Manage project schedule, estimate project cost and effort required	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

CO1	3	3	2	2	2	2	-	-	-	-	-	1	2	1
CO2	2	2	3	2	3	3	3	1	3	2	3	2	3	3
CO3	3	2	2	2	2	2	-	-	-	-	-	3	2	3
CO4	2	3	3	-	-	-	-	3	2	2	3	3	3	3
CO5	2	3	3	2	3	3	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration**
			✓	✓

PEC	SOFTWARE PROJECT MANAGEMENT	3	0	0	3

Course Objective:

- To understand the basic knowledge of software management principles.
- To familiarize in choosing an appropriate project development methodology and identifying project risks, monitoring and tracking project deadlines.
- To develop the capability to work in a team environment and be aware of different modes of communications.

UNIT I : INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT 9

Project Definition – Contract Management – Activities Covered by Software Project Management – Plans, Methods and Methodologies – Management – Objectives – Stakeholders – Requirement Specification – Management control – Activities Covered By Software Project Management – Overview Of Project Planning – Stepwise Project Planning.

UNIT II : PROJECT EVALUATION 9

Strategic Assessment – Technical Assessment – Cost Benefit Analysis –Cash Flow Forecasting – Cost Benefit Evaluation Techniques : Net Profit – Payback Period – Return on Investment – Net Present Value – Internal Rate of Return – Risk Evaluation : Identification and Ranking – Cost-benefit Analysis – Risk Profile Analysis – Using Decision Trees.

UNIT III : ACTIVITY PLANNING 9

Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning and Control.

UNIT IV : MONITORING AND CONTROL 9

Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting Project Back to Target – Change Control – Managing Contracts – Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management – Acceptance.

UNIT V : MANAGING PEOPLE AND ORGANIZING TEAMS 9

Introduction – Understanding Behavior – Organizational Behaviour : a Background – Selecting The Right Person For The Job – Instruction In The Best Methods – Motivation– The Oldman – Hackman Job Characteristics Model – Working In Groups – Becoming A Team –Decision Making – Leadership – Organizational Structures – Stress –Health and Safety – Case Studies.

TOTAL HOURS : 45

TEXT BOOK:

1. Bob Hughes, Mikecotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004.

REFERENCE BOOKS:

1. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
2. Royce, “Software Project Management”, Pearson Education, 1999.
3. Jalote, “Software Project Manangement in Practive”, Pearson Education, 2002.

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview

COURSE OUTCOMES

CO1	Determine the Plans, Methods and Methodologies of Software project Management	**K5**
CO2	Assess the project evaluation techniques based on cost and risk	**K5**
CO3	Elaborate the Sequencing and Scheduling Activities & Hazards	**K6**
CO4	Examine the Stages In Contract Placement	**K4**
CO5	Organize people in team and develop decision making skills	**K3**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	1	-	-	-	2	3
CO2	3	2	2	3	3	-	-	-	1	-	-	-	2	3
CO3	3	3	3	3	3	-	-	-	1	-	-	-	2	3
CO4	3	3	2	3	3	-	-	-	1	-	-	-	2	3
CO5	2	2	3	3	3	-	-	-	1	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PEC	SOFTWARE QUALITY ASSURANCE	3	0	0	3

Course Objective:

- To understand the quality management processes and to distinguish between various activities of quality assurance, quality planning and quality control.
- To know the importance of standards in the quality management process and their impact on the final product.
- To understand the SQA processes from planning till execution.

UNIT I : FUNDAMENTALS OF SOFTWARE QUALITY ASSURANCE 9

The Role of SQA: Objectives – Benefits – Goals – Role – Process - SQA Plan : Need and Content of SQA Plan – SQA considerations – SQA people : Roles and Responsibilities of SQA People – Characteristics of Good SQA Engineer – Quality Management – Software Configuration Management : SCM Plan – Roles – Activities – Baselines – Requirement Phase – Implementation Phase.

UNIT II : MANAGING SOFTWARE QUALITY 9

Managing Software Organizations: Commitment – Management System – Managing Software Quality: Measurement Criteria – Establishing a Software Quality Program – Estimating Software Quality – Removal Efficiency – Quality Goals and Plans – Tracking and Controlling Software Quality – Defect Prevention - Software Quality Assurance Management.

UNIT III : SOFTWARE QUALITY ASSURANCE METRICS 9

Software Quality : Views – Measuring Quality – Criteria - Total Quality Management (TQM) : Principles – Cost – TQM Implementation Approaches – Ways of Improving Quality – Methods for Generating Ideas – Advantages – Barriers – Software Quality Metrics: Product Quality – In-Process – Maintenance quality – Software Quality Metrics Analysis.

UNIT IV : SOFTWARE QUALITY PROGRAM 9

Software Quality Program Concepts – Establishment of a Software Quality Program: Tasks – Scope – Minimal Quality Assurance Effort – Quality Plan – Software Quality Assurance Planning: An Overview – Purpose & Scope: Management – Documentation – SPCM – Reviews and Audits – Validation, Verification and Testing – Problem Reporting.

UNIT V : SOFTWARE QUALITY ASSURANCE STANDARDIZATION 9

Software Standards–ISO 9000 Quality System Standards : Process Model - Capability Maturity Model and the Role of SQA in Software Development Maturity – SEI CMM Level 5 –Comparison of ISO 9000 Model with SEI's CMM : Model Orientation – ISO 9000 Weaknesses – CMM Weaknesses - SPICE (Software Process Improvement and Capability Determination).

TOTAL HOURS : 45

TEXT BOOKS:

1. Mordechai Ben-Menachem / Garry S Marliss, "Software Quality", Vikas Publishing House, Pvt, Ltd., New Delhi.(UNIT III to V), 2007.
2. Watts S Humphrey, " Managing the Software Process", Pearson Education Inc. (UNIT I and II)

REFERENCE BOOKS:

1. Gordon G Schulmeyer, "Handbook of Software Quality Assurance", Third Edition, Artech House Publishers 2007.
2. Nina S Godbole, "Software Quality Assurance: Principles and Practice", Alpha Science International, Ltd, 2004.

Weblinks:

1.https://nptel.ac.in/courses/106101163

Course Outcomes

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

Course Outcome	Description	Knowledge Level
CO1	Identify the roles and responsibilities of SQA (software quality assurance)people	K3
CO2	Create and apply a software quality assurance plan for all software projects.	K5
CO3	Maintain appropriate metrics to measure and maintain quality	K6
CO4	Facilitate inspections, product reviews, walk-throughs, and audits.	K5
CO5	Discuss the roles of SQA in software development	K6

	maturity models	

Mapping of course outcomes to program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	2	2	2	3	2
CO2	2	3	3	3	-	-	-	-	-	2	2	2	3	2
CO3	3	3	3	3	-	-	-	-	-	2	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	2	2	2	3	2
CO5	2	3	3	3	2	3	3	1	2	2	2	2	3	2
Avg	2.6	3	3	3	-	-	-	-	-	2	-	-	-	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PEC	SOFTWARE TESTING	3	0	0	3

Course Objectives

- To learn the principles of validation testing, defect testing, system and component testing
- To understand the strategies for generating system test cases
- To understand the essential characteristics of tool used for test automation

UNIT I : INTRODUCTION 9

Testing as an Engineering Activity – Role of Process in Software Quality – Testing as a Process – Basic Definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Defect Classes – The Defect Repository and Test Design – Defect Examples –

Developer/Tester Support for Developing a Defect Repository.

UNIT II : TEST CASE DESIGN 9

Introduction to Testing Design Strategies – The Smarter Tester – Test Case Design Strategies – Using Black Box Approach to Test Case Design Random Testing – Requirements based testing – positive and negative testing -–– Boundary Value Analysis – decision tables - Equivalence Class Partitioning state- based testing– cause effect graphing – error guessing - compatibility testing – user documentation testing – domain testing Using White–Box Approach to Test design – Test Adequacy Criteria –static testing vs. structural testing – code functional testing - Coverage and Control Flow Graphs – Covering Code Logic – Paths – Their Role in White–box Based Test Design – code complexity testing – Evaluating

Test Adequacy Criteria.

UNIT III : LEVELS OF TESTING 9

The Need for Levels of Testing – Unit Test – Unit Test Planning –Designing the Unit Tests. The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – scenario testing – defect bash elimination -System Testing – types of system testing - Acceptance testing –performance testing - Regression Testing – internationalization testing – ad-hoc testing -Alpha – Beta Tests – testing OO systems – usability and accessibility testing

UNIT IV : TEST MANAGEMENT 9

People and organizational issues in testing – organization structures for testing teams –testing services - Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process - Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the testspecialist – Skills needed by a test specialist – Building a Testing Group.

UNIT V : CONTROLLING AND MONITORING 9

Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation- Test metrics and measurements –project, progress and productivity metrics – Status Meetings – Reports and Control Issues – Criteria for Test Completion – SCM – Types of reviews – Developing a review program – Components of Review Plans– Reporting Review Results. – evaluating software quality – defect prevention – testing maturity Model.

TOTAL HOURS : 45

TEXT BOOKS:

1. Srinivasan Desikan and Gopalaswamy Ramesh, " Software Testing – Principles and Practices", Pearson education, 2006.
2. Aditya P.Mathur, "Foundations of Software Testing", Pearson Education,2008.

REFERENCE BOOKS:

1. Boris Beizer, "Software Testing Techniques", Second Edition, Dreamtech, 2003
2. Elfriede Dustin, "Effective Software Testing", First Edition, Pearson Education, 2003.
3. Renu Rajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill,

Weblinks:

1. https://nptel.ac.in/courses/106101163

COURSE OUTCOMES

CO1	Identify the defects by applying the testing principles	**K3**
CO2	Develop test strategies and test cases to prioritize and execute them	**K6**
CO3	Apply the testing techniques in an effective manner	**K3**
CO4	Design and implement comprehensive test plans	**K6**
CO5	Assess the various test metrics and measurements.	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	2	2	3	2
CO2	2	3	3	3	3	3	3	1	2	-	-	-	-	2
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	2
CO4	3	3	3	3	3	-	-	-	-	-	2	2	3	2
CO5	2	3	3	3	-	-	-	-	-	2	2	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PEC	SYSTEM SOFTWARE	3	0	0	3

Course Objectives

- To understand the relationship between system software and machine architecture.
- To know the design and implementation of assemblers, linkers and loaders.
- To understand the macroprocessors, system software tools and internal working of hardware and software interface of a typical system.

UNIT I : INTRODUCTION 9

System software and machine architecture – The Simplified Instructional Computer (SIC) Machine architecture: Memory- Registers-Data and instruction formats - addressing modes -instruction sets – Input / Output – SIC/XE Machine Architecture: Memory-Registers- Data and instruction formats - addressing modes -instruction sets – Input / Output – Programming examples.

UNIT II : ASSEMBLERS 8

Basic assembler functions : A simple SIC assembler – Assembler algorithm and data structures - Machine dependent assembler features : Instruction formats and addressing modes – Program relocation - Machine independent assembler features : Literals –Symbol-defining statements – Expressions – Assembler Design Options : One pass assemblers and Multi pass assemblers - Implementation example : MASM assembler.

UNIT III : LOADERS AND LINKERS 8

Basic loader functions: Design of an Absolute Loader – A Simple Bootstrap Loader -Machine dependent loader features: Relocation – Program Linking – Algorithm and Data Structures for a Linking Loader - Machine independent loader features: Automatic Library Search – Loader Options - Loader design options: Linkage Editors - Dynamic Linking – Bootstrap Loaders.

UNIT IV : MACRO PROCESSORS & VIRTUAL MACHINES 10

Basic macro processor functions : Macro Definition and Expansion – Macro Processor Algorithm and data structures - Machine-Independent Macro Processor Features : Concatenation of Macro Parameters – Generation of Unique Labels – Conditional Macro Expansion – Keyword Macro Parameters - Macro within Macro - Implementation example : MASM Macro Processor - Introduction to Virtual Machines (VM) – Computer Architecture- Virtual machine basics – Process virtual machines – System virtual machines

UNIT V : SYSTEM SOFTWARE TOOLS 10

Database Management Systems : Basic concept of a DBMS – Levels of Data Description – Use of a DBMS- Text editors : Overview of the Editing Process - User Interface – Editor Structure - Interactive debugging systems: Debugging functions and capabilities – Relationship with other parts of the system – User Interface Criteria- Instruction Set Issues – Profiling – Code optimization.

TOTAL HOURS : 45

Text Books:

1: Leland L. Beck, “System Software – An Introduction to Systems Programming”, 3rd Edition, Pearson education Asia, 2006.
2: John R. Levine, “Linkers & Loaders”, Morgan Kauffman, 2003.

Reference Books:

1: John J. Donovan “Systems Programming”, Tata McGraw-Hill Edition, 2000.
2: D. M. Dhamdhere, “Systems Programming and Operating Systems”, Second Revised Edition, Tata McGraw Hill, 2000.
3: John R. Levine, Linkers & Loaders – Harcourt India Pvt. Ltd., Morgan

Kaufmann Publishers, 2000. 4:Srimanta Pal, "Systems Programming " ,Oxford University Press, 2011.

Weblinks:

1. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs05/

COURSE OUTCOMES

After completion of course, students would be able to:

CO1	Demonstrate the machine architecture of SIC and SIC/XE.	**K4**
CO2	Identify the different assembler modes and features.	**K6**
CO3	Analyse different loaders with various linkage methods.	**K4**
CO4	Identify the functionalities of macro processing and analyse the virtual machine imeplementation.	**K6**
CO5	Apply the basic concepts of data base management systems with programming coding standards.	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	1	-	-	-	-	-	-	2	2	1
CO2	2	1	3	3	3	-	-	-	-	-	-	3	2	2
CO3	2	2	2	2	3	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	1	3	3	3
CO5	3	2	3	3	2	-	-	-	-	-	3	3	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	USER INTERFACE DESIGN	3	0	0	3

Course Objectives

- To gain knowledge about how to create a User Interface, how to use different type of controls, Menu usage.
- To learn different types and components, different methodologies used to implement User Interface and how to use multimedia, prototypes and analyzing different types of testing

UNIT I : INTRODUCTION 9

Human Computer Interface – A brief History of Screen Design - Characteristics Of Graphics Interface – Direct Manipulation Graphical System – Web User Interface – Popularity –Characteristic of Web Interface Principles of User Interface Design

UNIT II : HUMAN COMPUTER INTERACTION 9

User Interface Design Process – Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed–Business Functions and Requirement Analysis : Direct Methods and Indirect Methods – Basic Business Functions -Design Standards – System Training – Structures Of Menus – Functions Of Menus–Contents Of Menu– Formatting-Phrasing The Menu – Selecting Menu Choice–navigating Menus– Kinds of Graphical Menus.

UNIT III : WINDOWS 9

Window Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– Device Based Controls Characteristics– Screen Based Controls Characteristics – Operate Control – Text Entry Controls – Selection Control–Combination Control– Custom Control– Presentation Control.

UNIT IV : MULTIMEDIA 9

Text For Web Pages – Providing the Proper Feedback– Guidance & Assistance– International Consideration – Accessibility– Icons– Image– Multimedia – Coloring.

UNIT V : WINDOWS LAYOUT– TEST 9

Prototypes – Kinds Of Tests – Analyze ,Modify and Retest – Evaluating the Working System - Information Search – Visualization –Hypermedia – Software Tools : Interface Design Tools, Software Testing Tools

TOTAL HOURS : 45

TEXT BOOKS:

1: Wilbent. O. Galitz ,“The Essential Guide To User Interface Design”, John Wiley& Sons, 2007.

2: Ben Sheiderman, “Design The User Interface”, Pearson Education, 2008.

REFERENCES:

1: Alan Cooper, “The Essential Of User Interface Design”, Wiley – Dream Tech Ltd.,2002

Web Links:

L1: https://onlinecourses.nptel.ac.in/noc21_ar05/preview

L2: https://www.coursera.org/specializations/user-interface-design

COURSE OUTCOMES

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

CO1	Identify the concept of Human Computer Interface and Direct Manipulation Graphical System.	**K4**
CO2	Discuss User Interface Design Process, Obstacles andUsability	**K6**
CO3	Compare Window Characteristics, Presentation Styles, Organizations andOperations	**K4**
CO4	Discuss International Consideration and Accessibility ofmultimedia	**K6**
CO5	Analyze the concept of Visualization and Hypermedia	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	2	3	-	2	-	-	-	-	-	-	3	2	3
CO2	1	3	2	-	3	-	-	-	-	-	-	2	3	2
CO3	3	2	3	-	2	-	-	-	-	-	-	1	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2	2

CO5	3	3	1	-	1	-	-	-	-	-	-	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	VIRTUAL REALITY	3	0	0	3

Course Objectives

- To understand geometric modeling and Virtual environment.
- To study about Virtual Hardware and Software
- To develop Virtual Reality applications

UNIT I : INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics

–Flight Simulation – Virtual environments –requirement – benefits of virtual reality- Historical development of VR : Introduction-Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT II : GEOMETRIC MODELLING 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR Systems.

UNIT III : VIRTUAL ENVIRONMENT 9

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and nonlinear translation - shape & object inbetweening– free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field – Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT IV : VR HARDWARES & SOFTWARES 9

Human factors : Introduction – the eye - the ear- the somatic senses - VR Hardware : Introduction – sensor hardware - Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction –Modeling virtual world – Physical simulation- VR toolkits – Introduction to VRML.

UNIT V : VR APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL HOURS: 45

TEXT BOOK :

1: John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.

REFERENCE BOOKS:

1: Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.

2: Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Interscience, 2nd Edition, 2006.

3: William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 2008.

Web Links:

L1: https://nptel.ac.in/courses/106106138

L2: www.vresources.org

L3: www.vrac.iastate.edu

L4: www.w3.org/MarkUp/VRML

COURSE OUTCOMES

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

CO1	Assess the concept of Virtual Reality, Virtual Environment and 3D Computer Graphics Shading algorithms	**K4**
CO2	Explain Geometric Modelling Know ,Geometric Transformations and Generic VR system	**K6**
CO3	Appraise the details of Physical Simulation in Virtual Environment	**K4**
CO4	Explain Integrated VR systems, VR Software and VRML	**K6**
CO5	Develop a Virtual Reality Applications with different modes of interaction	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	3	2	-	-	2	-	2	3	2
CO2	2	2	2	2	2	2	2	-	-	2	-	2	3	3
CO3	3	2	2	2	2	2	2	-	-	2	-	2	2	2
CO4	2	2	3	3	2	3	2	-	-	3	-	2	3	2
CO5	2	3	2	3	2	2	3	-	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	AGILE METHODOLOGIES	3	0	0	3

Course Objectives

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I : AGILE METHODOLOGY 9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

UNIT II : AGILE PROCESSES 9

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT III : AGILITY AND KNOWLEDGE MANAGEMENT 9

Agile Information Systems – Agile Decision Making - Earl‘S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV : AGILITY AND REQUIREMENTS ENGINEERING 9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

Text Books:

T2: David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.

T3: Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate

UNIT V : AGILITY AND QUALITY ASSURANCE 9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

TOTAL HOURS : 45

Topics in Computer Science", Springer, 2009.

Reference Books:

R4: Craig Larman, "Agile and Iterative Development: A Manager's Guide", Addison-Wesley, 2004.

R5: Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.

Web Links:

1. https://www.guru99.com/scrum-testing-beginner-guide.html
2. https://www.inflectra.com/Ideas/Whitepaper/Introduction%20to%20Agile%20Development%2 0 Methods.aspx

COURSE OUTCOMES

CO1	Realize the importance of interacting with business stakeholders in determining the requirements for a software system	**K4**
CO2	Perform iterative software development processes: how to plan them, how to execute them.	**K3**

CO3	Point out the impact of social aspects on software development success	**K1**
CO4	Develop techniques and tools for improving team collaboration and software quality.	**K6**
CO5	Perform Software process improvement as an ongoing task for development teams.	**K3**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	-	-	3
CO2	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	3
CO4	2	3	2	3	3	-	-	-	-	-	-	-	-	3
CO5	1	2	3	3	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PEC	INFORMATION SECURITY	3	0	0	3

Course Objective:

- To understand the basics of Information Security and to know the legal, ethical and professional issues in Information Security.
- To know the aspects of risk management and to become aware of various standards and the technological aspects of Information Security.

UNIT I : INTRODUCTION 9

Information security: Definition, History, Critical Characteristics of Information- NSTISSC Security Model- Components of an Information System- Securing the Components-Balancing Security and Access-The System Development Life Cycle-The Security System Development Life Cycle

UNIT II : SECURITY INVESTIGATION 9

Need for Security- Business Needs: protecting the functionality of an organization, enabling the safe operation of an application, protecting the data that organization collects and use, safeguarding technology assets in organization- Threats-Attacks-Legal, Ethical and Professional Issues: Law and ethics in Information security, relevant U.S Laws, International laws and legal bodies, ethics and information security, codes of ethics and professional organization.

UNIT III : SECURITY ANALYSIS 9

Risk Management: Introduction- Risk Identification: plan and organize the process, asset identification and inventory, classifying and prioritizing information assets, information assets valuation, identifying and prioritizing threats, vulnerability identification and Assessing Risk, Assessing and Controlling Risk

UNIT IV : LOGICAL DESIGN 9

Blueprint for Security- Information Security Policy, Standards and Practices-ISO17799/BS 7799-NIST Models-VISA International Security Model- Design of Security Architecture- Planning for Continuity: Business impact analysis, incident response planning, disaster recovery planning, business continuity planning, crisis management, model for a consolidated contingency plan, law enforcement involvement.

UNIT V : PHYSICAL DESIGN 9

Security Technology- IDS- Scanning and Analysis Tools-Cryptography: Foundation of cryptology, cipher methods, cryptographic algorithms, cryptographic tools, protocols for secure communications, attacks on cryptosystems- Access Control

Devices- Physical Security-Security and Personnel

TOTAL HOURS : 45

TEXT BOOK:

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003

REFERENCE BOOKS:

1. Micki Krause, Harold F. Tipton, “ Handbook of Information Security Management”, Vol 1-3 CRC Press LLC, 2004.
2. Stuart Mc Clure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw- Hill, 2003
3. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002

Web Links:

1. http://web.cse.ohio-state.edu/~champion.17/4471/
2. https://slideplayer.com/slide/4409575/

COURSE OUTCOMES:

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

Course Outcome	Description	Knowledge Level
CO1	Discuss the development Life Cycle and components of the information security system	**K6**
CO2	Assess the protection of functionalities in an organization with Ethical and Professional Issues	**K5**
CO3	Examine the information assets Risk Assessment and Controlling of Risk	**K4**
CO4	Evaluate the Standards and Practices of various security models with Planning for Continuity	**K5**
CO5	Elaborate Scanning and Analysis Tools and cryptographic algorithms	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	3	3	3	3	-	-	-	-	-	2	2	3	2
CO2	3	3	3	3	3	-	-	-	-	-	2	2	3	2
CO3	3	3	3	3	3	-	-	-	-	-	2	2	3	2
CO4	3	3	3	3	3	-	-	-	-	-	2	2	3	2
CO5	2	3	3	3	3	-	-	-	-	-	2	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	SOFTWARE DEFINED NETWORKS	3	0	0	3

Course Objectives

- To learn about the use and application of SDN in Data centers
- To understand the separation of the data plane and the control plane

UNIT I : INTRODUCTION 9

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes

UNIT II : OPEN FLOW & SDN CONTROLLERS 9

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

UNIT III : DATA CENTERS 9

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT IV : SDN PROGRAMMING 9

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

UNIT V : SDN 9

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL HOURS : 45

Text Books:

1. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.
2. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.

Reference Books:

1. Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, ―SDN and Open Flow for Beginners, Amazon Digital Services, Inc., 2013.

Web Links:

1. https://opennetworking.org/wp-N_ARCH_1.0_06062014.pdfOnline
2. https://www.ciena.com/insights/what-is/What-Is-SDN.html

COURSE OUTCOMES

CO1	Integrating the conventional networking approaches with SDN	K3
CO2	Articulate the design of open flow specification of SDN via Hypervisor	K3
CO3	Hypothesizing the Virtualized Multitenant Data Center SDN and VxLAN	K5
CO4	Implementing the Composition of SDNs in python	K3

	programming	
CO5	Mind mapping the view of IETF SDN Framework and Data Center Orchestration	K4

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	-	-	-	1	1	-	-	2	2
CO2	3	2	2	2	2	-	-	-	1	1	-	-	2	2
CO3	2	2	2	2	3	-	-	-	1	1	-	-	2	2
CO4	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO5	2	2	3	2	3	-	-	-	1	1	-	-	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

PEC	BLOCK CHAIN TECHNOLOGIES	3	0	0	3

Course Objectives

- To introduce Bit coin and other crypto currencies
- To study the algorithms and techniques in block chain
- To understand the practical aspects in the design of crypto currency
- To understand the function of Block chains as a method of securing distributed ledgers
- To design, code, deploy and execute a smart contract

UNIT I : Introduction to Block chain 9

Basics of blockchain-Public Ledgers-Block Chain as Public Ledgers-Types of Block chains- Pillars of Block chain-Government Initiatives of Block Chain-Bitcoin- Smart Contracts

UNIT II : Architecture and Conceptualization of Block Chain, Crypto Currencies 9

Block in a Block chain-find Transactions-Distributed Consensus-Proof of work, Stake, Space-Attacks on POW-Ethereum-Pos/POW Hybrids-Crypto currency to block chain 2.0, Model of Blockchain-Algorand

UNIT III : Crypto Primitives, Securing and Interconnecting Public and Private Block Chains 9

Hash Function and Merle Tree-Security Properties-Security Considerations for block chain-Digital Signature-Public Key Cryptography-Bit coin block chain incentive structures- Nash Equilibriums- evolutionary stable strategies,-and Pareto-efficiency (game theory) Weaknesses and news Points of Failure- Mitigation Methods-Redundancies and fall-back methods

UNIT IV : Mining and Crypto Currencies - How to use and Interact 9

Mining-Pools-Impact of CPU and GPU-Transaction in Bit coin Network- Block Mining-Block propagation

and block relay

UNIT V : Blockchain Use Cases-Applications in Different Areas 9

Industry applications of Blockchain - Blockchain in Government-Government use cases-Preventing

Cybercrime through block chain-Block Chain in defense, tax payments

TOTAL HOURS : 45

Text Books:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos O'Reilly, First Edition, 2014.
2. Blockchain by Melanie Swa, O'Reilly Media 2015
3. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits

Reference Books:

1. The Basics of Bitcoins and Blockchains: An Introduction to Crypto currencies and the Technology that Powers Them, 2018 by Antony Lewis
2. The Truth Machine: The Blockchain and the Future of Everything Paperback – 5 March 2019

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc20_cs01/preview

COURSE OUTCOMES

CO1	Explain the structure of a block chain	**K5**
CO2	Analyze the incentive structure in a block chain based system	**K4**
CO3	Judge the scenario where "smart" contract is most appropriate	**K5**
CO4	Identify basic knowledge of Bitcoin, Ethereum	**K3**
CO5	Apply Blockchain in future use cases for security	**K3**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	3	3	2	2	3	-	-	-	-	-	-	-	-	3

CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓		

PEC	NATURAL LANGUAGE PROCESSING	3	0	0	3

COURSE OBJECTIVES

- To learn the fundamentals of natural processing
- To understand the way to measure one or more qualities of an algorithm or a system
- To gain knowledge of the linguistics concerned with the interactions between computers and human.

UNIT 1 : OVERVIEW AND LANGUAGE MODELLING 9

Overview: Origins and challenges of NLP Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modeling: Various Grammar- based Language Models- Statistical Language Model.

UNIT 2 WORD LEVEL ANALYSIS 9

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT 3 SYNTACTIC ANALYSIS 9

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature

structures.

UNIT 4 INFORMATION RETRIEVAL AND LEXICAL RESOURCES 9

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

UNIT 5 DISCOURSE ANALYSIS AND LEXICAL RESOURCES 9

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brills Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC). Max.45 Hours

COURSE OUTCOMES

CO1	Understand NLP problems and survey the literature about that problem	**K5**
CO2	Understand language modeling	**K4**
CO3	Describe automated natural language generation and machine translation	**K5**
CO4	Learn the natural language generation.	**K3**
CO5	Analyse the logic and semantics of world knowledge	**K3**

TOTAL HOURS -45

TEXT / REFERENCE BOOKS

1. Richard M Reese, ―Natural Language Processing with Java, OReilly Media, 2015.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition,Chapman and Hall/CRC Press, 2010.
3. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc19_cs56/preview

Mapping Of Course Outcomes to Program Outcomes

	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	-	-	-	-	-	-	1	2	1
CO2	2	2	2	2	2	-	-	-	-	-	-	1	3	2
CO3	2	3	1	2	2	-	-	-	-	-	-	2	-	-
CO4	2	3	-	-	-	2	3	2	2	3	3	2	3	3
CO5	2	3	3	3	3	1	3	2	3	3	-	-	-	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

PEC	APPLICATIONS OF AI	3	0	0	3

Course Objectives

- To give deep knowledge of AI and how AI can be applied in various fields to make the life easy

UNIT I : **9**

Linguistic aspects of natural language processing, A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business.

UNIT II : **9**

Emotion Recognition using human face and body language, AI based system to predict the diseases early, Smart Investment analysis, AI in Sales and Customer Support

UNIT III : **9**

Robotic Processes Automation for supply chain management.

UNIT IV : **9**

AI-Optimized Hardware, Digital Twin i.e. AI Modelling, Information Technology & Security using AI.

UNIT V : **9**

Recent Topics in AI/ML: AI/ML in Smart solutions, AI/ML in Social Problems handling, Block chain and AI.

TOTAL :45 hours

Text Books:

T1: Sameer Dhanrajani, AI and Analytics, Accelerating Business Decisions, John Wiley & Sons.

T2: Life 3.0: Being Human in the Age of Artificial Intelligence by Max Tegmark, published July 2018.

T3: Homo Deus: A Brief History of Tomorrow by Yuval Noah Harari, published March 2017.

T4: Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley.

Reference Books:

R1: Somogyi, Zoltán. The Application of Artificial Intelligence: Step-by-Step Guide from Beginner to Expert. Switzerland, Springer International Publishing, 2022.

R2: Artificial Intelligence Applications in Information and CommunicationTechnologies. Germany, Springer International Publishing, 2015.

Weblinks:

1.https://nptel.ac.in/courses/106102220

COURSE OUTCOMES

CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	**K 3**

CO2	To apply the Basic Concepts of Machine Learning	**K4**
CO3	To build various machine learning algorithms using Linear models	**K5**
CO4	To apply ML techniques to application and evaluate the models	**K4**
CO5	Apply basic principles of AI and ML in solutions that require problem solving, inference, perception, knowledge representation, and learning.	**K4**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	2	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	2	3
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	2	3
	2.8	2.6	2.6	2.2	2.4	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓		✓	✓

EC	INFORMATION SECURITY ANALYSIS AND AUDIT	3	0	0	3

Course Objectives

1. To introduce system security related incidents and insight on potential defenses, counter measures against common threat/vulnerabilities.
2. To provide the knowledge of installation, configuration and troubleshooting of information security devices.
3. To make students familiarize on the tools and common processes in information security audits and analysis of compromised systems.

UNIT 1 : Information Security Fundamentals 9

Definitions & challenges of security, Attacks & services, Security policies, Security Controls, Access control structures, Cryptography, Deception, Ethical Hacking, Firewalls, Identify and Access Management (IdAM).

Monitor systems and apply controls, security assessment using automated tools.

UNIT 2 : System Security 9

System Vulnerabilities, Network Security Systems, System Security, System Security Tools, Web Security, Application Security, Intrusion Detection Systems, backups of security devices, Performance Analysis, Root cause analysis and Resolution, Information Security Policies, Procedures, Standards and Guidelines.

UNIT 3 : Incident Management 9

Security requirements, Risk Management, Risk Assessment, Security incident management, third party security management, Incident Components, Incident Response Lifecycle, Record, classify and prioritize information security incidents using standard templates and tools.

UNIT 4 : Conducting Security Audits 9

Common issues in audit tasks, Infrastructure and networks, application hosting and content management, communication routes such as messaging, Features, configuration and specifications of information security systems and devices, Common audit techniques, Record and report audit tasks, Methods and techniques for testing compliance.

UNIT 5 : Information Security Audit Preparation 9

Establish the nature and scope of information security audits, Roles and responsibilities, Requirements of information security, Best Practices of a cybersecurity audit, self and work management skills, Self management skills importance, Why is self management important in the workplace.

Total Hours : 45

Text Book(s)

1. William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition, 2014.
2. Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Wiley, 2017
3. Nina Godbole, Sunit Belapure, Cyber Security- Understanding cyber-crimes, computer forensics and legal perspectives, Wiley Publications, 2016
4. Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly, 2010.

Reference Books

1. Charles P. Pfleeger, Security in Computing, 4th Edition, Pearson, 2009. Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004
2. Peter Zor, The Art of Computer Virus Research and Defense, Pearson Education Ltd, 2005Lee Allen, Kevin Cardwell, Advanced Penetration Testing for Highly-Secur Environments - Second ed Edition, PACKT Publishers, 2016
3. Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
4. David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
5. Practical Malware Analysis by Michael Sikorski and Andrew Honig, No Starch Press, 2015

Web Links:

https://www.iso.org/isoiec-27001-information-security.html
https://csrc.nist.gov/publications/detail/sp/800-55/rev-1/final
https://www.sans.org/reading-room/whitepapers/threats/paper/34180
https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

COURSE OUTCOMES

CO1	Contribute to managing information security	**K3**
CO2	Co-ordinate responses to information security incidents	**K6**
CO3	Develop knowledge, skills and competence in information security	**K3**
CO4	Contribute to information security audits.	**K6**
CO5	Support teams to prepare for and undergo information security audits	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO 1	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	2	2	1	0	2	2	-	-	-	-	-	-	2	1
CO 2	**2**	**2**	**1**	**2**	**2**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO 3	**2**	**3**	**1**	**2**	**2**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO 4	**2**	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO5	**2**	**3**	**3**	**3**	**3**	**0**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✔	✔	✔	✔	✔	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✔	✔		✔	✔	

PEC	INTELLIGENT DATA BASE SYSTEM	3	0	0	3

Course Objectives

- To analyze learning systems.
- To study the Database installation and create databases by using SQL.
- To get exposure to many real-world control problems.
- To determine which type of intelligent system methodology would be suitable for a given type of application problem.
- To design and create small real time applications.

UNIT I : SEMANTIC DATA MODELS 9

Informal definition of the domain - General characteristics of IDBSs - Data models and the relational data model - A taxonomy of intelligent database systems. Nested and semantic data models – Introduction - The nested relational model - Semantic models - Hyper-semantic data models -

UNIT II : KNOWLEDGE BASED SYSTEMS - AI CONTEXT 9

Characteristics and classification of the knowledge based systems – Introduction - The resolution principle - Inference by inheritance - Deductive database systems - Basic concepts - DATALOG language - Deductive database systems and logic programming systems—differences - Architectural approaches - Research prototypes - Updates in deductive databases - Integration of deductive database and object database technologies - Constraint databases.

UNIT III : APPLICATIONS IN IDBS 9

Introduction - Temporal databases - Basic concepts - Temporal data models - Temporal query languages

Internet indexing and retrieval - Basic indexing methods - Search engines or meta searchers - Internet spiders -

UNIT IV : SEMANTIC DATA MODELING 9

Object oriented approaches to semantic data modeling – Object oriented database systems – Basic concepts of a core object-oriented data model - Comparison with other data models.

UNIT V : DATA MINING 9

Data mining - Data mining tasks - Data mining tools - Medical and legal information systems - Medical

information systems - Legal information systems. Case study: Design and develop a project using a medical information system

TOTAL HOURS : 45

Text Books:

1 Panos Alexopoulos, "Semantic Modeling For Data: Avoiding Pitfalls And Breaking Dilemmas", O'Reilly , 2020.

2 N.P. Padhy,"Artificial Intelligence and Intelligent Systems" Oxford Press, 2015.

Reference Books:

1 Elisa Bertino, Barbara Catania, GianPieroZarri, “Intelligent Database Systems”,Collection ACM Press, 2001.

2 Leondes CT, "Intelligent Knowledge-Based Systems", Kluwer Academic Publishers, 2005.

Weblinks:

1.https://nptel.ac.in/courses/106105219

COURSE OUTCOMES

CO1	Understand the basic artificial intelligence techniques	**K3**
CO2	Understand the concepts of knowledge-based systems and apply them with AI.	**K6**
CO3	Describe the attributes of knowledge-based systems and the situations to which they are well-suited.	**K3**
CO4	Apply their knowledge to design solutions to different problems.	**K6**
CO5	Design and develop an intelligent system for a selected application.	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**

CO1	2	2	2	2	3	-	-	-	-	-	-	-	2	2
CO2	3	2	3	3	2	3	3	1	3	2	3	2	3	3
CO3	2	3	2	2	2	-	-	-	-	-	-	-	2	3
CO4	2	3	2	2	3	2	3	3	2	2	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✔	✔	✔	✔	✔	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✔	✔		✔	✔	

PEC	**RECOMMENDER SYSTEMS**	**3**	**0**	**0**	**3**

Course Objectives

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

UNIT I : INTRODUCTION 9

Introduction and basic taxonomy of recommender systems - Traditional and non-

personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS 9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III : COLLABORATIVE FILTERING 9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

UNIT IV : ATTACK-RESISTANT RECOMMENDER SYSTEMS 9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack

– Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V : EVALUATING RECOMMENDER SYSTEMS 9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

TOTAL HOURS : 45

TEXT BOOKS:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

COURSE OUTCOMES:

CO1	Understand the basic concepts of recommender systems	**K3**
CO2	Implement machine-learning and data-mining algorithms in	**K4**

	recommender systems data sets.	
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	**K5**
CO4	Design and implement a simple recommender system.	**K4**
CO5	Learn about advanced topics of recommender systems.	**K4**

Mapping of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	2	2	-	-	2	-	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	-	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	-	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	-	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC	TEXT AND SPEECH ANALYSIS	3	0	0	3

Course Objectives

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT I : NATURAL LANGUAGE BASICS 9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

UNIT II : TEXT CLASSIFICATION 9

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model –FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

UNIT III: QUESTION ANSWERING AND DIALOGUE SYSTEMS 9

Information retrieval – IR-based question answering – knowledge-based question answering –language models for QA – classic QA models – chatbots – Design of dialogue systems -–evaluating dialogue systems

UNIT IV : TEXT-TO-SPEECH SYNTHESIS 9

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing -Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

UNIT V : AUTOMATIC SPEECH RECOGNITION 9

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Total Hours : 45

TEXTBOOK

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.

REFERENCES:

1. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
2. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”,O’REILLY.

COURSE OUTCOMES

CO1	Explain existing and emerging deep learning architectures for text and speech processing	**K3**
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	**K5**
CO3	Explain coreference and coherence for text processing	**K4**
CO4	Build question-answering systems, chatbots and dialogue systems	
CO5	Apply deep learning models for building speech recognition and text-to-speech systems	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	2	2	-	-	2	2	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	2	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	2	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	3	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	2	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
	✓		✓	✓	

PEC	BUSINESS ANALYTICS	3	0	0	3

Course Objectives

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for Analytics.
- To apply analytics for different functions of a business

UNIT I : INTRODUCTION TO BUSINESS ANALYTICS 9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II: BUSINESS INTELLIGENCE 9

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence – OLAP – Analytic functions

UNIT III : BUSINESS FORECASTING 9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV : HR & SUPPLY CHAIN ANALYTICS 9

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V : MARKETING & SALES ANALYTICS 9

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning –Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL HOURS : 45

TEXT BOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016

4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.

5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

COURSE OUTCOMES

CO1:	Explain the real world business problems and model with analytical solutions.	**K5**
CO2:	Identify the business processes for extracting Business Intelligence	**K4**
CO3:	Apply predictive analytics for business fore-casting	**K5**
CO4:	Apply analytics for supply chain and logistics management	**K3**
CO5:	Use analytics for marketing and sales.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	2	2	-	-	2	2	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	2	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	2	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	3	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	2	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PEC	**IMAGE AND VIDEO ANALYTICS**	**3**	**0**	**0**	**3**

Course Objectives

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.

UNIT I : INTRODUCTION 9

Computer Vision – Image representation and image analysis tasks - Image representations –digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation – Traditional and Hierarchical image data structures.

UNIT II : IMAGE PRE-PROCESSING 9

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative – Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.

UNIT III : OBJECT DETECTION USING MACHINE LEARNING 9

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV : FACE RECOGNITION AND GESTURE RECOGNITION 9

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition-Deep Face solution by Facebook-FaceNet for Face Recognition-Implementation using FaceNet-Gesture Recognition.

UNIT V : VIDEO ANALYTICS 9

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

TOTAL HOURS : 45

TEXT BOOK:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2. Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCES

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
4. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
5. E.R.Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

COURSE OUTCOMES

CO1	Understand the basics of image processing techniques for computer vision and video analysis.	**K2, K3**
CO2	Explain the techniques used for image pre-processing.	**K3, K6**
CO3	Develop various object detection techniques.	**K4**
CO4	Understand the various face recognition mechanisms.	**K5**
CO5	Elaborate on deep learning-based video analytics.	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	-	3	-	-	-	-	-	-	-	-	3
CO2	3	2	2	3	2	-	-	-	-	-	-	-	-	3
CO3	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO4	2	2	2	3	-	-	-	-	-	-	-	-	-	3
CO5	0	2	3	3	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓		✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

PEC	COMPUTER VISION	3	0	0	3

Course Objectives

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators – Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNITII : FEATUREDETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge – Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III : FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration -Triangulation – Two-frame structure from motion - Factorization - Bundle adjustment – Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Opticalflow - Layered motion.

UNIT IV : 3D RECONSTRUCTION 9

Shape from X - Active rangefinding - Surface representations - Point-based representations-Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos..

UNIT V : IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video- based rendering-Object detection - Face recognition - Instance recognition – Category recognition – Context and scene understanding-Recognition databases and test sets.

TOTAL HOURS : 45

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Texts in Computer Science, Second Edition, 2022.

2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006. 3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

COURSE OUTCOMES:

CO1	To understand basic knowledge, theories and methods in image processing and computer vision.	**K3**
CO2	To implement basic and some advanced image processing techniques in OpenCV.	**K4**
CO3	To apply 2D a feature-based based image alignment, segmentation and motion estimations.	**K5**
CO4	To apply 3D image reconstruction techniques	**K4**
CO5	To design and develop innovative image processing and computer vision applications.	**K4**

Mapping Of Course Outcomes To Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	2	2	-	-	2	-	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	-	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	-	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	-	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC	COGNITIVE SCIENCE AND ANALYTICS	3	0	0	3

Course Objectives

- Understand the Interdisciplinary Nature of Cognitive Science
- Explore Human Cognition and Information Processing
- Apply Data Analytics Techniques to Cognitive Research
- Develop and Evaluate Cognitive Models
- Apply Cognitive Analytics in Real-world Applications

Unit I: Foundations of Cognitive Science 9

Overview and history of cognitive science -Interdisciplinary nature: psychology,

neuroscience, AI, philosophy, linguistics-Historical evolution and major paradigms-Information processing approach-Cognitive architecture: symbolic, connectionist, embodied cognition.

UNIT II: HUMAN PERCEPTION, MEMORY, AND LEARNING 9

Perceptual systems and sensory processing-Types of memory: short-term, long-term, working memory, Memory encoding, retrieval, and forgetting-Learning mechanisms and cognitive development-Implications for data interpretation and system design- Applications in UI/UX and learning systems

UNIT III: DECISION MAKING, PROBLEM SOLVING, AND REASONING 9

Cognitive processes in decision making-Heuristics, biases, and risk perception-Problem solving models and strategies- Deductive reasoning - Inductive reasoning-Applications in predictive modeling and analytics

UNIT IV: LANGUAGE, THOUGHT, AND KNOWLEDGE REPRESENTATION 9

Cognitive and computational models of language-Semantics, syntax, and pragmatics-Knowledge structures: schemas, scripts, and ontologies-NLP basics and their cognitive relevance

UNIT V: COGNITIVE DATA ANALYTICS AND APPLICATIONS 9

Behavioral data analytics and cognitive modeling-Tools and techniques: eye tracking, EEG, fMRI, sentiment analysis-Applications in healthcare, education, marketing, HCI-Ethical considerations in cognitive data analysis

TOTAL HOURS : 45

TEXT BOOKS:

1. Jay D. Friedenberg & Gordon W. Silverman, “"Cognitive Science: An Introduction to the Study of Mind", SAGE Publications, 2021.

2. Neil A. Stillings, Steven E. Weisler, Christopher H. Chase, Mark H. Feinstein, and David A. Harrison "Cognitive Science: A Student's Introduction", MIT Press, 2017.

3. Eric Margolis, Richard Samuels, and Stephen P. Stich, "The Oxford Handbook of Cognitive Science", Oxford University Press, 2012

REFERENCES:

1. Michael W. Eysenck and Mark T. Keane, "Cognitive Psychology: A Student's Handbook", Psychology Press, 2015.

2. Keith Frankish and William M. Ramsey, "The Cambridge Handbook of Cognitive Science", Cambridge University Press, 2012.

COURESE OUTCOME:

CO1:	Describe the foundational concepts and interdisciplinary scope of cognitive science	K3
CO2:	Explain key cognitive processes such as perception, attention, memory, reasoning, and decision-making,	K5
CO3:	Apply data analytics techniques to interpret and model cognitive processes	K3
CO4:	Analyze how knowledge structures such as schemas, scripts, and ontologies	K4
CO5:	Integrate cognitive theories with computational tools to develop intelligent systems and human-computer interaction.	K5

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	3	2	-	-	2	2	3	3	2	2
CO2	3	2	2	2	3	-	-	-	3	2	2	2	3	2
CO3	3	3	2	2	3	-	-	-	3	2	2	3	3	2
CO4	3	3	3	3	3	-	-	-	3	3	3	3	2	2
CO5	3	3	3	3	3	2	-	-	2	3	3	3	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓

Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓	✓	

PROFESSIONAL ELECTIVE COURSES(BLENDED)

PEC	DATA EXPLORATION AND VISUALIZATION	3	0	2	4

Course Objectives

- To understand the basics of Data Explorations and the concepts of Data visualization
- To explore and apply various data visualization techniques for a variety of tasks using R language

UNIT I : INTRODUCTION TO DATA EXPLORATION 12

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

UNIT II : INTRODUCING TWO VARIABLE AND THIRD VARIABLE 12

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatter plots and Resistant Lines – Transformations - Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data.

UNIT III : BASICS OF DATA VISUALIZATION 12

The Seven Stages of Visualizing Data - Getting Started with Processing - Mapping - Time Series - Connections and Correlations - Scatter plot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs – Acquiring Data – Parsing Data

UNIT IV: DATA EXPLORATION AND DATA VISUALIZATION IN R 12

Introduction to R and Studio - The Basics of Data Exploration - Loading Data into R - Transforming Data - Creating Tidy Data

UNIT V : TECHNIQUES AND APPLICATIONS OF DATA EXPLORATIONAND VISUALIZATION IN R 12

Basic Data Exploration Techniques – Basic Data Visualization Techniques - Visualizing Geographic Data with ggmap - R Markdown - Case Study – Wildfire Activity in the Western United States - Case Study – Single Family Residential Home and Rental Values

TOTAL HOURS : 60

Text Books:

1. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data

Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008.

2. Visualizing Data: Exploring and Explaining Data with the processing Environment, O Reily Publications, 2007

3. Claus.O.Wlike, Fundamentals of Data Visualization, A primer on making informative and compelling Figures, O'Reily Publications, 2019.

REFERENCE BOOKS:

1. Xiang Zhou, Sean, Yong Rui, Huang, Thomas S., Exploration of Visual Data, Springer Publications, 2003

2. Eric Pimple, Data Visualization and Exploration with R, Geo Spatial Training service, 2017

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_mg09/preview

2. www.geeksforgeeks.org/data-visualization-in-r/

COURSE OUTCOMES

CO1	Demonstrate the basic of Data Exploration	**K3**
CO2	Analyze the use of univariate and Multivariate Analysis for Data Exploration	**K4**
CO3	Identify the various Data Visualization methods	**K2**
CO4	Apply the concept of Data Visualization on various datasets	**K3**
CO5	Apply the data visualization techniques using R language	**K3**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	-	-	-	-	-	-	-	-	1	3
CO2	3	2	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO4	2	3	3	3	3	-	-	-	-	-	-	-	3	1

CO5	3	3	2	3	3	-	-	-	-	-	-	-	3	3
AVG	2.6	2.6	2.6	2.4	2.4	-	-	-	-	-	-	-	2.6	2.2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC	**BIG DATA ANALYTICS**	**3**	**0**	**2**	**4**

Course Objectives:

1. To understand the need of Hadoop framework to process the Big Data
2. Introduction to theoretical techniques and practical tools used in data analytics
3. Applications in various engineering and scientific domains.

UNIT I : Introduction Big Data and Hadoop Framework 12

Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks, Introduction to Hadoop ecosystems. Hadoop Framework: Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with other system - Hadoop Components –Hadoop Daemon's – Working with HDFS Commands

UNIT II : Mapreduce Programming 12

Map Reduce working principle, Map Reduce types and formats, MapReduce features, Combiner optimization,Map side join, Reduce SideJoin, Secondary sorting,

Pipelining MapReduce jobs.

UNIT III : R Programming 12

History and overview of R , Install and configuration of R programming environment , Basic language elements and data structures, Data input/output, Data storage formats , Subsettingobjects.

UNIT IV : Visualization Using R 12

Vectorization, Control structures, Functions, Scoping Rules, Loop functions, R Graphs and visualization using lattice, ggplot2

UNIT V : Spark Framework and Data Analysis Models 12

Overview of Spark – Hadoop vs Spark – Cluster Design – ClusterManagement – performance,Application Programming interface(API): Spark Context, Resilient Distributed Datasets, Creating RDD,RDD Operations, Saving RDD - Lazy Operation – Spark Jobs-spark ML library.

Association and correlation analysis- regression models- Predictive analytics - Exploratory analysis. Prescriptive analysis.

TOTAL HOURS : 60

Text Book(s)

1. Garrett Grolemund, “Hands-On Programming with R” , O'Reilly Media, Inc, 2014.
2. Seema Acharya, SubhashiniChellapan, “Big Data and Analytics”, Wiley, 2015.
3. Mike Frampton, “Mastering Apache Spark”, Packt Publishing, 2015.

Reference Books

1. Nick Pentreath, Machine Learning with Spark, Packt Publishing, 2015.
2. Donald Miner, Adam Shook, “MapReduce Design Pattern”, O’Reilly, 2012
3. Raj Kamal, PreetiSaxena ,”Big Data Analytics:Introduction to Hadoop, Spark, and Machine-Learning”, McGraw-Hill Education, 2019.

Web links:

W1:https://nptel.ac.in/courses/106104189

W2: https://nptel.ac.in/courses/106106142

Course Outcomes

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

Course Outcome	Description	Knowledge Level
CO1	Discuss the challenges and their solutions in Big Data and work on Hadoop Framework	k1
CO2	Understand the concepts of R programming and its applications.	k2
CO3	Implement different statistical methods on sample data using R Programming library.	k5
CO4	Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.	k4
CO5	Demonstrate spark programming with different programming languages	k5

ASSESSMENT METHODS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO3	3	3	3	3	2	2	1	1	2	2	2	2	3	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO5	2	3	3	3	2	2	1	1	2	2	2	2	3	2

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration**
			✓	✓

PEC	PYTHON FOR DATA SCIENCE	3	0	2	4

Course Objectives:

- To understand the basic concepts of Python
- To apply the knowledge to use advanced features of python
- To execute statistical analysis of data with NumPy and Pandas .
- To build data visualization in real-world scenarios.

UNIT I : PYTHON BASICS 12

Introduction to Python, Python Interpreter and its working, Syntax and Semantics- Data Types: Booleans – Numbers – Lists – Tuples – Set – Dictionaries – Comprehensions – Assignments and Expressions, Control Flow Statements – Fruitful functions

UNIT II : PYTHON: ADVANCED FEATURES 12

Handling text files - Reading and Writing files- format operator-command line arguments - Exception Handling -- Modules -Strings and Regular Expressions.

UNIT III : NUMPY IN PYTHON 12

Introduction to Numpy-Data Types-NumPy array in Python-NumPy Ndarray- Array indexing- NumPy String Functions-Numpy ufunc-Statistical Functions **Case Study**

UNIT IV : PANDAS IN PYTHON 12

Pandas Introduction-Pandas Data Structures- -Series-DataFrame- Accessing and Changing values of Data Frames- Pandas Data Operations-Indexing-Cleaning data-Pandas plotting –**Case study**

UNIT V : MATPLOTLIB: VISUALIZATION PYTHON 12

Introduction to Matplotlib-pyplot-Matplotlib plot types- Plotting-Subplot- Three Dimensional Plotting- Matplotlib Working With Text- Matplotlib Working With Images- Matplotlib Transforms-**Case Study**

TOTAL HOURS : 60

Text Books:

1. Mark Lutz, “Learning Python”, O Reily, 4thEdition, 2009, ISBN: 978-0-596 15806-4,5th edition, 2013
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and III)

3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Parts of chapters 2–4 for Units IV and V)

4. Fabio Nelli, “Python Data Analytics: With Pandas, NumPy, and Matplotlib”, Apress,2018.

Reference Books

1.Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

2.Magnus Lie Hetland , “Beginning Python: From Novice to Professional”, 3rd Edition, 2013

Weblink

Numpy, Matplotlib and Pandas :

https://python- course.eu/books/bernd_klein_python_data_analysis_a4.pdf

https://python-course.eu/python_and_machine_learning.pdf

CO1:	Understand the basic concepts of Python	**K1**
CO2:	Apply the knowledge to use advanced features of python	**K3**
CO3:	Demonstrate the skills with statistical analysis of data using NumPy	**K4**
CO4:	Ability to analyse the data operations using Pandas	**K3**
CO5:	Build visualizations of many different kinds of datasets using MATPLOTLIB	**K5**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	1	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	3	1	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	2	3	3	2	-	-	-	-	-	-	2	3	2
CO5	1	2	1	2	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC	NOSQL DATABASE	3	0	2	4

Course Objectives

- To explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems
- To understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
- To discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases

UNIT I : NOSQL DATA ARCHITECTURE PATTERNS 12

NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model- Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication

to scale reads, Database distributed queries to Data nodes.

UNIT II : KEY VALUE DATA STORES 12

From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Architecture and implementation Terms, Designing Structured Values, Limitations of Key- Value Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration

UNIT III : DOCUMENT ORIENTED DATABASE 12

Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: Mongo DB and/or Cassandra

UNIT IV : COLUMNAR DATA MODEL 12

Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking. Advanced techniques: Vectorized Processing, Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations, Case Studies

UNIT V : DATA MODELING WITH GRAPH 12

Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection

TOTAL HOURS : 60

Text Books:

1 Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction to Information Retrieval, Cambridge University Press

2 Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers.

Reference Books:

1 Guy Harrison, Next Generation Database: NoSQL and big data, Apress

Web Links:

1 https://www.mongodb.com/

2 https://university.mongodb.com/

3 https://www.ibm.com/cloud/learn/nosql-databases

4 https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp

COURSE OUTCOMES

CO1	Differentiate and identify right database models for real time applications	**K4**
CO2	Outline Key value architecture and characteristics	**K2**
CO3	Design Schema and implement CRUD operations, distributed data operations	**K6**
CO4	Compare data ware housing schemas and implement various column store internals	**K4**
CO5	Develop Application with Graph Data model	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	3	3	-	-	-	-	-	-	-	3	3
CO2	2	2	2	3	3	-	-	-	-	-	-	-	3	3
CO3	2	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	-	3	3
CO5	1	2	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PEC	GAME PROGRAMMING	3	0	2	4

Course Objectives

- To provide an in-depth introduction to technologies and techniques currently used in the game industry
- To understand game design and development
- To understand the processes, mechanics, issues in game design, and game engine development
- To understand modeling, techniques, handling situations, and logic
- To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive game application.

UNIT I : Introduction to Game Programming & Game engine architecture 12

Overview of game programming -Structure of a typical game team - game industry - game engine history -Real Time Game Architecture - Engine Support: Subsystem Start-Up and Shut-Down - Memory Management - Containers and Strings - Resource Management: File System, Resource Manager.

UNIT II : Basics of 2D & 3D Graphics and Mathematics in Gaming & Rendering engine 12

2D Graphics: Sprites, Tiled Images and Backgrounds - 3D Graphics: 3D Graphics Pipeline, 3D Math, Coordinates and Coordinate Systems - Quaternion Mathematics - Transformations & Geometry - The Rendering Engine: Triangle Rasterization, The Rendering Pipeline

UNIT III : Lighting and Texturing Effects in game environment 12

Ray Tracing - Lighting in Computer Graphics - Types of Light Sources - Light Models - Materials: Lambert Diffuse, Phong - Bump Mapping - Lighting Technique: Point Lights, Bloom - Shadows in Games: Real- Time Versus Preprocessed Shadows, Types of Shadows, Texture mapping techniques - Special Effects: Blurring, Particle Systems, Weapon Effects

UNIT IV : Introduction to Artificial Intelligence in Game 12

Why Games for Artificial Intelligence - Why Artificial Intelligence for Games - Game AI Panorama: Methods (Computer) Perspective, End User (Human) Perspective, Player-Game Interaction Perspective.

UNIT V : Solving search problems for Game move prediction and optimization using AI 12

Tree Search: Uninformed Search, Best-First Search, Minimax, Monte Carlo Tree Search - Evolutionary Algorithms - Supervised Learning: Artificial Neural Networks, Support Vector Machines.

TOTAL HOURS : 60

TEXT BOOKS:

1: Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019. 2: Palmer G. Physics for game programmers. Berkeley: Apress; 2005

3: Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer

REFERENCES:

1: Sherrod A. Game Graphic Programming. Cengage Learning; 2008.

2: McShaffry M. Game coding complete. Nelson Education; 2014

3: Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering

Web Links:

1: https://onlinecourses.nptel.ac.in/noc19_ge32/preview

COURSE OUTCOMES

CO1	Understand the basics of Game Programming and Game Engine Architecture	**K2**
CO2	Develop 2D and 3D Images using Mathematical coordinates	**K4**
CO3	Apply various Lighting and Texturing Effects in game environment	**K3**
CO4	Extend the Game Programming using Artificial Intelligence	**K2**
CO5	Solve search problems for Game move prediction and optimization using AI	**K6**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	2	2	2	2	3	2	3	-	-	-	-	2	2	2
CO2	2	3	2	2	2	3	2	-	-	-	-	2	2	2
CO3	2	2	3	2	2	2	3	-	-	-	-	3	2	3

CO4	3	2	3	2	2	3	2	-	-	-	-	2	3	2
CO5	2	3	2	2	3	2	1	-	--	-	-	3	2	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PEC	**ROBOTICS AND ITS APPLICATION**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES

1. To understand the basic concepts associated with the design, functioning, applications and social aspects of robots
2. To study about the electrical drive systems and sensors used in robotics for various applications
3. To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
4. To learn about various motion planning techniques and the associated control architecture
5. To understand the implications of AI and other trending concepts of robotics.

UNIT I : FOUNDATION 12

Introduction – Brief history – Definition – Anatomy – Types – Classification – Specification and need based applications – Role and need of robots for the immediate problems of the society – Future of mankind and automation-ethical issues – Industrial scenario local and global – Case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT II : BUILDING BLOCKS OF A ROBOT 12

Types of electric motors : DC – Servo – Stepper; Specification – Drives for motors –

Speed & direction control and circuitry – Selection criterion for actuators – Direct drives – Non-traditional actuators - Sensors for localization – Navigation – Obstacle avoidance and path planning in known and unknown environments – Optical – Inertial – Thermal – Chemical – Biosensor – Other common sensors – Case study on choice of sensors and actuators for maze solving robot and self driving cars.

UNIT III : KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 12

Robot kinematics – Geometric approach for 2R, 3R manipulators – homogenous transformation using D- H representation – Kinematics of WMR – Lagrangian formulation for 2R robot dynamics – Mechanical design aspects of a 2R manipulator, WMR – End-effector : Common types and design case study.

UNIT IV : NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 12

Mapping & Navigation – SLAM, Path planning for serial manipulators – Types of control architectures – Cartesian control – Force control and hybrid position/force control – Behaviour based control – Application of Neural network, fuzzy logic, optimization algorithms for navigation problems – Programming methodologies of a robot.

UNIT V : AI AND OTHER RESEARCH TRENDS IN ROBOTICS 12

Application of Machine learning – AI – Expert systems – Tele-robotics and Virtual reality – Micro &Nanorobots – Unmanned vehicles – Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL HOURS : 60

TEXT BOOKS

1. Saeed B Niku, “Introduction to Robotics, Analysis, System, Applications”, Pearson educations, 2002.
2. Roland Siegwart, Illah Reza Nourbakhsh, “Introduction to Autonomous Mobile Robots”, MIT Press, 2011.

REFERENCES

1. Richard David Klafter, Thomas A Chmielewski, Michael Negin, “Robotic engineering: An Integrated Approach”, Prentice Hall, 1989.
2. Craig, J J, “Introduction to Robotics: Mechanics and Control”, 2nd Edition, Addison-Wesley, 1989.
3. K S Fu, R C Gonzalez and C S G Lee, “Robotics: Control, Sensing, Vision and

Intelligence", McGraw-Hill, 1987.

4. Wesley E Snyder R, "Industrial Robots, Computer Interfacing and Control", Prentice Hall International Edition, 1988.
5. Robin Murphy, "Introduction to AI Robotics", MIT Press, 2000.

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc22_me39/preview

COURSE OUTCOMES

CO1	Understand the concepts of industrial robots	**K2**
CO2	Examine different sensors and actuators for applications like maze solving and self driving cars	**K2**
CO3	Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots	**K3**
CO4	Understand the navigation and path planning techniques for robot motion planning	**K2**
CO5	Understand the impact and progress of AI in the field of robotics	**K2**

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-		3	-
CO4	3	2	-	-	-	-	-	-	-	3	-	3	3	-
CO5	3	2	-	-	-	-	-	-	-		-		3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PEC	CONCEPTS OF VIRTUAL AND AUGMENTED REALITY	3	0	2	4

Course Objectives

- To learn about the principles and multidisciplinary features of virtual reality.
- To study the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behavior.
- To teach students the technology for managing large scale VR environment f ramework devel opment tools in realtime.

UNIT I : Virtual reality and virtual environments: **12**

The historical development of VR, scientific landmarks computer graphics, real-time computer graphics, virtual environments, requirements for VR, benefits of virtual reality. Hardware technologies for 3D user interfaces: visual displays, auditory displays, hap tic displays, choosing output devices for 3D user interfaces.

UNIT II : 3D user interface input hardware and Software technologies: **12**

Input device characteristics, desktop input devices, tracking devices, 3d mice, special purpose input devices, direct human input, home - brewed input devices, choosing input devices for 3D interfaces. Software technologies: database - world space, world coordinate, world environment, objects - geometry, position / orientation, hierarchy, bounding volume, scripts and other attributes, VR environment - VR database, tessellated data, LODs, Cullers and Occluders, lights and cameras, scripts, VR toolkits, available software in the market.

UNIT III : 3D interaction techniques: **12**

3D manipulation tasks, interaction techniques for 3D manipulation, design guidelines – 3D travel tasks, travel techniques, design guidelines - theoretical foundations of wayfinding, user centered wayfinding support, environment centered wayfinding support, evaluating wayfinding aids, design guidelines - system control, classification, graphical menus, voice commands, Gestrual commands, tools, multimodal system control techniques, design guidelines.

UNIT IV : Advances in 3D user interfaces: **12**

3D user interfaces for the real world, AR interfaces as3D data browsers, 3D augmented reality interfaces, augmented surfaces and tangible interfaces, agents in AR, transitional AR-VR interfaces- 3D interaction techniques, 3d UI design and development, 3D UI evaluation and other issues.

UNIT V Virtual reality applications: **12**

Engineering, architecture, education, medicine, entertainment, science, training.

TOTAL HOURS : 60

Text Books:

1. Paul Mealy, Virtual & Augmented Reality for Dummies, John Wiley & Sons.
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual RealityApplications: Foundations of Effective Design", Morgan Kaufmann.

Reference Books:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach".
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D UserInterfaces, Theory and Practice", Addison Wesley, USA

Web Links:

1. https://edu.gcfglobal.org/en/thenow/understanding-virtual-reality-and-augmented-reality
2. https://www.intel.com/content/www/us/en/tech-tips-and-tricks/virtual-reality-vs-augmented- reality.html

COURSE OUTCOMES

CO1	Articulate the historical development of VR and design of visual displays.	K3

CO2	Integrating the 3D user interface input hardware and Software technologies	K3
CO3	Hypothesizing the interaction techniques for 3D manipulation, design guidelines	K5
CO4	Implement the AR-VR interfaces in 3d UI interaction techniques	K3
CO5	Mind mapping the view of Virtual reality applications in Engineering, architecture, entertainment.	K4

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	-	-	-	1	1	2	1	2	2
CO2	3	2	2	2	2	-	-	-	1	1	2	1	2	2
CO3	2	2	2	2	3	-	-	-	1	1	2	1	2	2
CO4	2	2	2	2	2	-	-	-	1	1	2	1	2	2
CO5	2	2	3	2	3	-	-	-	1	1	2	1	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

PEC	EMBEDDED SYSTEMS FOR INTERNET OF THINGS	3	0	2	4

Course Objectives

- Comprehend the basic concepts, architecture and design components of embedded systems and IOT devices
- Synthesize design platforms used for an embedded system to incorporate IOT applications.
- Apply the concepts of embedded system design and IOT to resolve real time issues and develop new cloud based or web based IOT applications..

UNIT 1 : BASICS OF IOT 12

Purpose and requirement specification, IOT level specification, Functional view specification,Operational view specification, Device and component integration, Pillars of Embedded IOT and Physical Devices: The internet of devices.

UNIT 2 : DESIGN OF EMBEDDED SYSTEMS 12

Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.

UNIT 3 : INPUTS AND OUTPUTS 12

Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).

UNIT 4 : IOT ENABLING TECHNOLOGIES 12

Communications, RFID and NFC (Near- Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z- Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node- RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces.

UNIT 5 : WEB OF THINGS AND CLOUD OF THINGS 12

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models,

Communication API, Logical design using Python.

TOTAL HOURS : 60

Text Book(s)

1. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
2. Klaus Elk, "Embedded Software for the IoT".

Reference Book(s)

1. Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed".
2. Elizabeth Gootman et. al, "Designing Connected Products", Shroff Publisher/O'Reilly Publisher.
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

Weblinks:

1.https://nptel.ac.in/courses/128108016

COURSE OUTCOMES

CO1	Demonstrate the embedded system concepts and architecture of embedded systems	K3
CO2	Identify different software techniques for microcontroller-based embedded systems	K3
CO3	Analyze different hardware input and output methods in embedded systems	K5
CO4	Identify various techniques and methods used in IOT	K3
CO5	Develop novel IOT Applications in web/cloud based to solve real-time issues	K4

Mapping Of Course Outcomes to Program Outcomes

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2
CO1	2	2	2	2	2	3	-	-	-	-	-	-	-	-
CO 2	2	3	2	2	3	3	3	1	2	3	2	2	2	2
CO3	2	3	-	-	-	-	-	3	2	3	3	3	2	3
CO4	2	3	3	2	3	3	-	-	-	-	-	-	-	-
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

PEC	KNOWLEDGE ENGINEERING	3	0	2	4

Course Objectives

• To understand the basics of Knowledge Engineering.
• To discuss methodologies and modeling for Agent Design and Development.
• To design and develop ontologies.
• To apply reasoning with ontologies and rules.
• To understand learning and rule learning

UNIT I : REASONING UNDER UNCERTAINTY 9

Introduction to Uncertainty in AI – Abductive reasoning – Probabilistic reasoning Approaches: Enumerative Probabilities – Subjective Bayesian Reasoning – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering for Uncertain Reasoning.

UNIT II : METHODOLOGY AND MODELING 9

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT III ONTOLOGIES –DESIGN AND DEVELOPMENT 9

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching.Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT IV REASONIING WITH ONTOLOGIES AND RULES 9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT V LEARNING AND RULE LEARNING 9

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning

PRACTICAL EXERCISES:

1. Perform operations with Evidence Based Reasoning.
2. Perform Evidence based Analysis.
3. Perform operations on Probability Based Reasoning.
4. Perform Believability Analysis.
5. Implement Rule Learning and refinement.
6. Perform analysis based on learned patterns.
7. Construction of Ontology for a given domain.

TOTAL HOURS : 60

TEXT BOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)

REFERENCE BOOKS:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4. King , Knowledge Management and Organizational Learning , Springer, 2009.
5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

COURESE OUTCOME:

CO1:	Understand the basics of Knowledge Engineering.	K3
CO2:	Apply methodologies and modelling for Agent Design and Development.	K5
CO3:	Design and develop ontologies.	K3
CO4:	Apply reasoning with ontologies and rules.	K4
CO5:	Understand learning and rule learning.	K5

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	1		-	2	1	3	2	1	1
CO2	3	3	3	2	3			-	2	1	2	3	1	2
CO3	3	3	2	2	3			-	1	1	2	3	2	2
CO4	2	3	3	2	3			-	2	1	2	3	3	2
CO5	2	3	3	2	2			-	3	1	2	3	3	3
AVG	2.4	1.8	2.4	1.4	1.4	0.2	0	0	2	1.6	1.6	1.6	2.2	1.6

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

PEC	STREAM PROCESSING	3	0	2	4

Course Objectives

- Introduce Data Processing terminology, definition & concepts
- Define different types of Data Processing
- Explain the concepts of Real-time Data processing
- Select appropriate structures for designing and running real-time data services in a business environment
- Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I : FOUNDATIONS OF DATA SYSTEMS 9

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II: REAL-TIME DATA PROCESSING 9

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III : DATA MODELS AND QUERY LANGUAGES 9

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV : EVENT PROCESSING WITH APACHE KAFKA 9

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V : REAL-TIME PROCESSING USING SPARK STREAMING 9

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

PRACTICAL EXERCISES:

1. Install MongoDB
2. Design and Implement Simple application using MongoDB
3. Query the designed system using MongoDB
4. Create a Event Stream with Apache Kafka
5. Create a Real-time Stream processing application using Spark Streaming

6. Build a Micro-batch application
7. Real-time Fraud and Anomaly Detection,
8. Real-time personalization, Marketing, Advertising

TOTAL HOURS : 60

TEXT BOOKS:

1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

REFERENCE BOOKS:

1. https://spark.apache.org/docs/latest/streaming-programming-guide.html
2. Kafka.apache.org

COURESE OUTCOME:

CO1:	Understand the applicability and utility of different streaming algorithm	K3
CO2:	Describe and apply current research trends in data-stream processing	K5
CO3:	Analyze the suitability of stream mining algorithms for data stream systems	K3
CO4:	:Program and build stream processing systems, services and applications.	K4
CO5:	Solve problems in real-world applications that process data streams	K5

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	1	-	-	-	2	3	1	2	1	3
CO2	2	1	1	2	2	-	-	-	3	2	2	3	1	2
CO3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO4	2	1	3	3	3	-	-	-	3	3	1	1	1	2
CO5	3	3	1	2	2	-	-	-	3	3	2	3	2	3
AVG	2.6	1.8	1.8	2.6	2.2	-	-	-	2.6	2.6	1.4	2	1.4	2.4

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

PEC	ROBOTIC PROCESS AUTOMATION	3	0	2	4

Course Objectives

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and Methodologies.

- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and maintain the software bot.

UNIT I : INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II: AUTOMATION PROCESS ACTIVITIES 9

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III : APP INTEGRATION, RECORDING AND SCRAPING 9

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV : EXCEPTION HANDLING AND CODE MANAGEMENT 9

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V : DEPLOYMENT AND MAINTENANCE 9

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

PRACTICAL EXERCISES:

Setup and Configure a RPA tool and understand the user interface of the tool:

1. Create a Sequence to obtain user inputs display them using a message box;
2. Create a Flowchart to navigate to a desired page based on a condition;
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.

5. Create an automation process using key System Activities, Variables and Arguments
6. Also implement Automation using System Trigger
7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing

TOTAL HOURS : 60

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

REFERENCE BOOKS:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020

COURESE OUTCOME:

CO1:	Enunciate the key distinctions between RPA and existing automation techniques and platforms.	K3
CO2:	Use UiPath to design control flows and work flows for the target process	K5
CO3:	Implement recording, web scraping andprocess mining by automation	K3
CO4:	Use UIPath Studio to detect, and handle exceptions in automation	K4

	processes	
CO5:	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes**.**	K5

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	3	2	2	1	3	-	-	-	1	3	3	2	2	2
CO 2	1	1	2	3	3	-	-	-	1	2	3	1	3	2
CO 3	2	3	2	3	3	-	-	-	2	3	1	1	3	3
CO 4	1	2	1	2	2	-	-	-	1	2	1	3	3	3
CO 5	3	3	3	3	3	-	-	-	3	1	1	1	3	2
AVG	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

PEC	SECURITY AND PRIVACY IN CLOUD	3	0	2	4

Course Objectives

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I : FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II: SECURITY DESIGN AND ARCHITECTURE FOR CLOUD 9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III : ACCESS CONTROL AND IDENTITY MANAGEMENT 9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options- OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV : CLOUD SECURITY DESIGN PATTERNS 9

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V : MONITORING, AUDITING AND MANAGEMENT 9

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

PRACTICAL EXERCISES:

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. simulate resource management using cloud sim
3. simulate log forensics using cloud sim
4. simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. Implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

TOTAL HOURS : 60

TEXT BOOKS:

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:”, Wiley 2013
2. Dave shackleford, “Virtualization Security”, SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, “Cloud Security and Privacy”, OREILLY 2011

REFERENCE BOOKS:

1. Mark C. Chu-Carroll “Code in the Cloud”,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

COURESE OUTCOME:

CO1:	Understand the cloud concepts and fundamentals.	K3
CO2:	Explain the security challenges in the cloud.	K5
CO3:	Define cloud policy and Identity and Access Management.	K3
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.	K4
CO5:	Define the various architectural and design considerations for security in the cloud.	K5

Mapping Of Course Outcomes to Program Outcomes

	PO 1	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	3	3	3	1	2	-	-	-	1	1	1	3	3	1
CO 2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO 3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO 4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO 5	1	3	3	1	1	-	-	-	2	3	3	2	2	3
AV G	2	2.4	2.4	2.2	1.8	-	-	-	2.2	1.8	2.2	2.4	2.2	1.8

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

OPEN ELLECTIVE COURSES

OEC	INTERNET OF THINGS	3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of IoT and its application sectors
- To understand M2M and IoT
- To understand and become proficient in IoT platforms
- To understand and apply IoT protocols appropriately
- To design and develop IoT based applications

UNIT I : INTRODUCTION AND CONCEPTS OF IOT 9

Introduction to IOT, definition and characteristics of IOT - Architecture of Internet of Things, Physical and logical design of IOT, IOT enabling technologies, IOT levels and deployment templates-Domain specific IOTs, home automation, cities, environment, Domain specific IOTs, Energy, retail, agriculture, industry, health and lifestyle

UNIT II : IOT AND M2M COMMUNICATION 9

M2M, difference between IOT and M2M, ETSI M2M Architecture, system architecture -ETSI M2M SCL resource structure, Security in ETSI M2M framework, SDN and NFV for IOT, IOT system management, need for IOT system management -SNMP, Network operator requirements, NETCONF-YANG, IOT system management with NETCONF-YANG, IoT Design methodology-case study on IOT system for Weather Monitoring

UNIT III : IOT PLATFORMS 9

Introduction to Hardware used for IoT: Microcontrollers, Microprocessors, SoC, Sensors -Introduction to Arduino, Pi, Spark, Intel Galileo

UNIT IV : IOT TECHNICAL STANDARDS AND PROTOCOLS 9

RF Protocols: RFID, NFC;IEEE 802.15.4: ZigBee, Z-WAVE, THREAD; Bluetooth Low Energy (BLE), IPv6 for Low Power and Lossy Networks (6LoWPAN) and Routing Protocol for Low power and lossy networks (RPL) -CoAP,XMPP, Web Socket, AMQP, MQTT, WebRTC, PuSH -Architectural Considerations in Smart Object Networking

UNIT V : DEVELOPING INTERNET OF THINGS 9

IoT platforms design methodology, IoT Physical devices and endpoints -IoT Systems: Logical design using Python, IoT physical servers and cloud offerings (Cloud computing for IoT)

TOTAL HOURS : 45

TEXT BOOKS:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things, A Hands -on Approach”, 1st Edition 2015, University Press, ISBN: 978-81-7371- 954-7
2. Oliver Hersent, David Boswarthick, Omar Elloumy, “The Internet of Things”,1st Edition2015,ISBN: 978-81-265-5686-1
3. Michael Miller, “The Internet of Things, How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are changing the World”, First edition ,2015, Pearson, ISBN:978-93-325-5245-6

WEB LINKS:

- https://archive.nptel.ac.in/courses/106/105/106105166/
- https://nptel.ac.in/courses/108108098
- https://thingsee.com/blog/quality-hardware-list-for-your-iot-projects
- https://tools.ietf.org/html/rfc7452
- http://dret.net/lectures/iot-spring15/protocols
- http://iot.intersog.com/blog/overview-of-iot-development-standards-and-frameworks

COURSE OUTCOMES:

CO1	Apply IOT architecture at various application domains	K3
CO2	Examine M2M Communication and architecture	K4
CO3	Experiment with various IoT platforms	K3
CO4	Utilize different standards and protocols	K3
CO5	Construct Cloud computing for IoT	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	3	3	2	-	-	-	-	-	2	3	2
CO2	1	3	3	3	3	2	-	-	-	-	-	2	3	2
CO3	1	3	3	3	3	2	-	-	-	-	-	2	3	2

CO4	1	3	3	3	3	2	-	-	-	-	-	2	3	2
CO5	2	3	3	3	3	2	-	-	-	-	-	2	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

OEC	ARTIFICIAL INTELLIGENCE	3	0	0	3

COURSE OBJECTIVES:

- To know about the basic knowledge representation, problem solving and learning methods,
- To design an intelligent agent that can solve ontological problems and to learn about the search strategies,
- To learn the applicability, strengths and weaknesses to solve particular engineering problems.

UNIT I : INTRODUCTION 9

Artificial Intelligence: Definition-Turing Test-Relation with other Disciplines-History of AI Applications- Agent: Intelligent Agent-Rational Agent - Nature of Environments-Structure of Agent-Problem Solving Agent - Problems: Toy Problems and Real-world Problems-Uninformed Search Strategies: BFS, DFS, DLS, IDS, Bidirectional Search - comparison of uninformed search strategies

UNIT II : PROBLEM SOLVING 9

Informed Search Strategies-Greedy best-first search-A* search-Heuristic functions-Local search Algorithms and Optimization problems - Online Search Agent-Constraint Satisfaction Problems- Backtracking Search for CSP's – Local Search for Constraint Satisfaction Problems-Structure of Problems

-Adversarial Search-Optimal Decision in Games-Alpha-Beta Pruning-Imperfect Real Time Decisions- Games that Include an Element of Chance

UNIT III : KNOWLEDGE REPRESENTATION 9

First-Order Logic:Syntax and Semantics of First-Order Logic: Models for first-order logic, Symbols and Interpretations, Terms, Atomic sentences, Complex sentences, Quantifiers, Equality - Using First-Order- Logic-Knowledge Engineering in First-Order-Logic- Inference in First-Order Logic: Inference rules- Unification and Lifting-Forward Chaining-Backward Chaining-Resolution

UNIT IV : LEARNING 9

Learning from Observations: Forms of Learning - Learning Decision Trees: Decision Trees as Performance elements, Expressiveness of decision trees, Inducing decision trees from examples, Choosing Attribute tests, Assessing the performance of the learning algorithm, Noise and Overlifting, Broadening the applicability of decision trees – Ensemble Learning - A Logical Formulation of Learning - Knowledge in Learning - Explanation-Based Learning - Learning using Relevance Information - Inductive Logic Programming

UNIT V : APPLICATIONS 9

Communication –Communication as action -A formal grammar for a fragment of English – Syntactic Analysis – Augmented Grammars – Semantic Interpretation – Ambiguity and Disambiguation – Discourse Understanding – Grammar Induction. Perception –Image Formation –Early Image Processing Operations – Extracting Three Dimensional Information – Object Recognition – Using Vision for Manipulation and Navigation

TOTAL HOURS : 45

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education/ Prentice Hall of India 2010
2. Poole, D. and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press
3. Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd, 2003.

REFERENCE BOOKS:

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.

2. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson

WEB LINKS:

1. https://nptel.ac.in/courses/106105078
2. https://nptel.ac.in/courses/106105079

COURSE OUTCOMES:

CO1	Evaluate Artificial Intelligence (AI) methods and describe their foundations.	K5
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.	K3
CO3	Interpret the knowledge representation and reasoning for solving real world problems	K2
CO4	Formulate a learning framework involving AI methods	K5
CO5	Determinean efficient strategy for various applications of AI	K6

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	2	2	-	-	-	-	2	3	2
CO2	2	2	2	2	2	2	2	-	-	-	-	2	3	3
CO3	3	2	2	2	2	2	2	-	-	-	-	2	2	2
CO4	2	2	3	3	3	3	3	-	-	-	-	2	3	2
CO5	2	3	2	3	2	3	2	-	-	-	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

OEC	INTRODUCTION TO DATA ANALYTICS	3	0	0	3

Course Objectives

- To provide the knowledge and expertise to become a proficient data scientist
- To explore the fundamental concepts of big data & data analytics.
- To gain knowledge on Hadoop related tools such as MongoDB, Cassandra, Pig, and Hive for big data analytics

UNIT I : Introduction to Big Data 9

Types of Digital Data-Characteristics of Data – Evolution of Big Data – Definition of Big Data – Challenges with Big Data – 3Vs of Big Data – Non Definitional traits of Big Data – Business Intelligence vs. Big Data – Data warehouse and Hadoop environment – Coexistence.

UNIT II : Big Data Analytics 9

Classification of analytics – Data Science – Terminologies in Big Data – CAP Theorem – BASE Concept. NoSQL: Types of Databases – Advantages – NewSQL – SQL vs. NOSQL vs NewSQL

UNIT III : Introduction to Hadoop 9

Features – Advantages – Versions – Overview of Hadoop Eco systems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS – Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression. Hadoop 2 (YARN): Architecture – Interacting with Hadoop Eco systems

UNIT IV : No SQL databases 9

Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export. Cassandra: Introduction – Features – Data types – CQLSH – Key spaces – CRUD operations – Collections – Counter – TTL – Alter commands – Import and Export – Querying System tables.

UNIT V : Hadoop Eco systems 9

Hive – Architecture – data type – File format – HQL – SerDe – User defined functions – Pig: Features – Anatomy – Pig on Hadoop – Pig Philosophy – Pig Latin overview – Data types – Running pig – Execution modes of Pig – HDFS commands – Relational operators – Eval Functions – Complex data type – Piggy Bank – User defined Functions – Parameter substitution – Diagnostic operator

TOTAL HOURS : - 45

TEXT BOOKS:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015

REFERENCE BOOKS:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.
2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011.
3. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.
4. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc20_cs01/preview

COURSE OUTCOMES

CO1	Identify the need of big data	K3
CO2	Interpret basic concepts of data analytics	K5
CO3	Analyze the framework for storing the data	K4
CO4	Examine about NoSQL databases	K4
CO5	Choose an appropriate framework to solve real world problems	K3

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	2	2	-	-	2	2	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	2	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	2	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	3	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	2	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

OEC	FUNDAMENTALS OF AI AND ML	3	0	0	3

Course Objectives

- To understand the basics of Machine Learning (ML)
- To program in Python ML Packages
- To understand the methods of Machine Learning
- To visualize a dataset

UNIT I : INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents- Structure of agents – Problem solving agents –Uninformed search strategies – Breadth first search – Uniform cost search – Depth first search – Depth limited search

UNIT II : INTRODUCTION TO MACHINE LEARNING 9

Machine learning: Types of Machine Learning - Understanding data – Continuous variable, categorical variable, Independent variable, dependent variable -Regression and classification- linear regression - Machine Learning Life cycle - Data Preprocessing techniques – Feature selection

UNIT III : MACHINE LEARNING ALGORITHMS 9

Classification and Regression- Naïve bayes- Decision trees- Support Vector Machine (SVM) – Random forest- Linear Regression-Logistic Regression - Unsupervised learning - K-means clustering- Principal component analysis

UNIT IV : MODEL EVALUATION 9

Model Evaluation and Selection methods, Precision-Recall and ROC Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics

UNIT V : MACHINE LEARNING APPLICATIONS 9

Image Recognition – Speech Recognition – Email spam and Malware Filtering – Online fraud detection – Medical Diagnosis

TOTAL HOURS : 45

TEXT BOOKS:

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
2. SebastainRaschka, “Python Machine Learning”, Packt publishing (open source).

REFERENCE BOOKS:

1. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009
2. Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning” (2nd ed)., Springer, 2008

WEB LINKS:

1. https://machinelearningmastery.com/types-of-learning-in-machine-learning/Online
2. https://www.coursera.org/learn/machine-learning
3. https://nptel.ac.in/courses/106/106/106106139/
4. https://www.timberlake.co.uk/machinelearning

COURSE OUTCOMES:

CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	K3
CO2	To apply the Basic Concepts of Machine Learning	K4
CO3	To build various machine learning algorithms using Linear models	K5
CO4	To apply ML techniques to application and evaluate the models	K4
CO5	Apply basic principles of AI and ML in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K4

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	3	2	2	2	-	2	2	-	-	2	-	2	3	2
CO2	2	2	2	2	-	2	2	-	-	2	-	2	3	3
CO3	3	2	2	2	-	2	2	-	-	2	-	2	2	2
CO4	2	2	3	3	-	3	3	-	-	3	-	2	3	2
CO5	2	3	2	3	-	3	2	-	-	3	-	3	1	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

OEC	UI AND UX DESIGN	3	0	0	3

Course Objectives

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I : FOUNDATIONS OF DESIGN 9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II : FOUNDATIONS OF UI DESIGN 9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III : FOUNDATIONS OF UX DESIGN 9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV : WIREFRAMING, PROTOTYPING AND TESTING 9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V : RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

TOTAL HOURS : 45

TEXT BOOKS:

T1: Joel Marsh, “UX for Beginners”, O’Reilly , 2022

T2: Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

REFERENCE BOOKS:

R1: Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020

R2: Steve Schoger, Adam Wathan “Refactoring UI”, 2018

R3: Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015

Weblinks:

https://www.nngroup.com/articles/

5. https://www.interaction-design.org/literature

COURSE OUTCOMES

CO1:	Build UI for user Applications	K6
CO2:	Evaluate UX design of any product or application	K5
CO3:	Demonstrate UX Skills in product development	K4
CO4:	Implement Sketching principles	K5
CO5:	Create Wireframe and Prototype	K6

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	3	1			-	3	3	2	2	3	1
CO2	2	3	1	3	2			-	2	2	2	2	3	2
CO3	1	3	3	2	2			-	3	2	2	2	2	3
CO4	1	2	3	3	1			-	2	3	3	2	3	3
CO5	1	2	3	2	1			-	1	2	2	3	1	3

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

OEC	DEVOPS	3	0	0	3

Course Objectives

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I : INTRODUCTION TO DEVOPS 9

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II : COMPILE AND BUILD USING MAVEN & GRADLE 9

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III : CONTINUOUS INTEGRATION USING JENKINS 9

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV : CONFIGURATION MANAGEMENT USING ANSIBLE 9

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V : BUILDING DEVOPS PIPELINES USING AZURE 9

Create Github Account, Create Repository, Create Azure Organization, Create a new

pipeline, Build a sample code, Modify azure-pipelines.yaml file

TOTAL HOURS : 45

TEXT BOOKS:

T1: Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.

T2: Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

REFERENCE BOOKS:

R1: Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020

R2. by Mitesh Soni 3. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.

R3: David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.

R4. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.

Weblinks:

https://www.jenkins.io/user-handbook.pdf

https://maven.apache.org/guides/getting-started/

COURSE OUTCOMES

CO1:	Understand different actions performed through Version control tools like Git.	K1
CO2:	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	K5
CO3:	Ability to Perform Automated Continuous Deployment	K4
CO4:	Ability to do configuration management using Ansible	K5

CO5:	Understand to leverage Cloud-based DevOps tools using Azure DevOps	K1

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3			-					2	2
CO2	3	3	3	2	3			-					2	2
CO3	3	3	3	2	3			-					2	2
CO4	3	3	3	2	3			-					2	2
CO5	3	3	3	2	3			-					2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

OEC	**MULTIMEDIA AND ANIMATION**	**3**	**0**	**0**	**3**

Course Objectives

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To learn the process of Authoring multimedia presentations
- To learn the techniques of animation in 2D and 3D and for the mobile UI
- To explore different popular applications of multimedia

UNIT I : INTRODUCTION TO MULTIMEDIA 9

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning

UNIT II : MULTIMEDIA FILE FORMATS AND STANDARDS 9

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.

UNIT III : MULTIMEDIA AUTHORING 9

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools,

Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools,

audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.

UNIT IV : ANIMATION 9

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.

UNIT V : MULTIMEDIA APPLICATIONS 9

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries

TOTAL HOURS : 45

TEXT BOOKS:

T1: Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCE BOOKS:

R1 John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.

2. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.

3. Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.

4. Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.

5. Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.

6. Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.

7. Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.

Weblinks:

1. https://itsfoss.com/
2. https://www.ucl.ac.uk/slade/know/3396
3. https://handbrake.fr/
4. https://opensource.com/article/18/2/open-source-audio-visual-production-tools

   https://camstudio.org/
5. https://developer.android.com/training/animation/overview

6. https://developer.android.com/training/animation/overview (UNIT-IV)

COURSE OUTCOMES

CO1:	Understand the basic concepts of AR and VR	K1
CO2:	Understand the tools and technologies related to AR/VR	K5
CO3:	Know the working principle of AR/VR related Sensor devices	K4
CO4:	Design of various models using modeling techniques	K5
CO5:	Develop AR/VR applications in different domains	K1

Mapping Of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3			-	2	2	3	3	2	2
CO2	3	2	3	2	3			-	3	2	2	3	2	2
CO3	3	3	2	2	3			-	3	2	2	3	2	2
CO4	3	3	3	2	3			-	3	2	3	3	2	2
CO5	3	3	3	2	3			-	2	2	3	3	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	

OEC	VIDEO CREATION AND EDITING	3	0	0	3

Course Objectives

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

UNIT I : FUNDAMENTALS 9

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT II : STORYTELLING 9

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.

UNIT III : USING AUDIO AND VIDEO 9

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.

UNIT IV : WORKING WITH FINAL CUT PRO 9

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences

UNIT V : WORKING WITH AVID XPRESS DV4 9

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

TOTAL HOURS : 45

TEXT BOOKS:

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.

REFERENCE BOOKS:

1. Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.
2. Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw – Hill 2003

COURESE OUTCOME:

CO1:	Compare the strengths and limitations of Nonlinear editing	K3
CO2:	Identify the infrastructure and significance of storytelling	K5
CO3:	Apply suitable methods for recording to CDs and VCDs.	K3

CO4:	Address the core issues of advanced editing and training techniques.	K4
CO5:	Design and develop projects using AVID XPRESS DV 4	K5

Mapping Of Course Outcomes to Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3			-	2	2	3	3	2	2
CO2	3	2	3	2	3			-	3	2	2	3	2	2
CO3	3	3	2	2	3			-	3	2	2	3	2	2
CO4	3	3	3	2	3			-	3	2	3	3	2	2
CO5	3	3	3	2	3			-	2	2	3	3	2	2

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	