SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution &
Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Department of Information Technology

BoS Meeting – II

(8.4.2021)

Minutes

Department of Information Technology
Minutes of Board of Studies

The Second Board of Studies meeting of Department of Information Technology was held on 8th April 2021 from 10:45 A.M to 2:00 P.M in the Seminar Hall, Department of IT with the Head of the Department as the Chair.
The following members were present for the BoS meeting.

Sl.No	Name of the Member with Designation and official Address	Members as Per University norms
1	**Dr. R. Raju, M.Tech, Ph.D** Professor & Head Department of IT, SMVEC	Chairman
2	**Dr. R. Geetha Ramani, M.Tech, Ph.D** Professor, Department of Information Science and Technology, College of Engineering Guindy, Anna University, Chennai	Subject Expert (University Nominee)
3	**Dr. A.S. Anakath, M.E, Ph.D** Professor, Department of IT, E.G.S. Pillay Engineering College, Nagapattinam	Subject Expert (Academic Council Nominee)
4	**Dr. S. Padmavathi, M.E, Ph.D** Professor, Department of IT, Thiagarajar College of Engg., Madurai	Subject Expert (Academic Council Nominee)
5	**Mr. L. Ashok** CEO - Futurenet Technologies (India) Private Limited, Chennai.	Representative from Industry
6	**Dr. G. Arun Kumar** Associate Professor, Department of CSE, Mandanapalli Institute of Technology and Science, Andhara Pradesh	Post Graduate Alumnus (nominated by Principal)
7	**Dr. T. Vigneswari, ME, Ph.D** Professor Department of IT, SMVEC	Internal Member
8	**Dr. C. Punitha Devi, M.Tech, Ph.D** Professor Department of IT, SMVEC.	Internal Member
9	**Dr. S. Geetha, M.Tech, Ph.D** Associate Professor Department of IT, SMVEC	Internal Member
10	**Dr.N.S.N. Cailassame** Professor& Head, Department of Management Studies, SMVEC	Internal Member

11	**Dr. K. Karthikeyan** Associate Professor , Department. of Chemistry, SMVEC	Internal Member
12	**Prof. M. Devanathan** Assistant Professor, Department of Mathematics, SMVEC	Internal Member
13	**Prof. G. Namitha** Assistant Professor, Department of English, SMVEC	Internal Member
14	**Prof. C. Bhavani** Assistant Professor , Department. of Physics, SMVEC	Internal Member

Agenda of the Meeting

1) Welcome Address, Introduction about the Institution, Department and BoS Members, Academic Year 2021- Achievements.
2) Review of Minutes of BoS – I.
3) To appraise and approve the revised Department Vision and Mission.
4) To discuss and approve Curriculum Structure of B.Tech – Information Technology.
5) To discuss and approve the B.Tech. Information Technology Syllabi from V to VIII semesters for the students admitted in the Academic Year 2019-20 (Second Year).
6) To discuss and approve the B.Tech Information Technology Syllabi from V to VIII semesters for the students admitted in the Academic Year 20-21 (First Year).
7) Review of Evaluation Systems and suggestions.
8) Brief Analysis about the End semester results published for III, V and VII semesters.
9) To discuss about the Innovative Teaching practices and its implications.
10) To discuss and approve the panel of examiners.
11) Any other item with the permission of chair.

Minutes of the Meeting

Dr. R. Raju, Chairman, BoS /B.Tech Information Technology officially announced the opening of the meeting and introduced the external, internal and co-opted members. He also thanked them for accepting the invitation for being the member of the Board of Studies and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

Item:1	**About the Institution and Department.** • The Board of Studies Chairman highlighted the unique features of our Institution, Department and also briefed the achievements of the Department.
Item:2	**Review of Minutes of BoS – I** • The First BoS was held on 20.7.20 and the points discussed were reviewed by the members. The following variations are incorporated in the curriculum as per the members suggestion and approved by BoS members - The courses Genetic engineering, Fundamentals of Virtualization and Advanced Database may be excluded. - A course on Knowledge engineering / course related to biomedical Engineering /Deep learning may be included. - The course Distributed system may be restructured as Parallel and Distributed systems. - Streaming Analytics may be renamed as Multimedia streaming. The general suggestions offered are - The total number of credits may further be reduced and can be gradually Increased in succeeding regulations. - The relevant Mandatory/ Audit courses recommended by AICTE should be considered in the curriculum. - NSS should not come under mandatory course. - Skill development courses should be specified in the regulation. - The proposition of BS, HS, ES, PC, PE and OE should be as per recommendation of AICTE. The Curriculum of Regulation 2019 and Regulation 2020 are revised as per members' suggestion and the same was presented before the BoS members and it was approved. **(Annexure I)**
Item:3	**To appraise and approve revised Department Vision and Mission** The revised Vision and Mission was presented to the members. The members offered suggestion in M4 of the department mission. **M4: Exemplar:** To instil **moral values**, ethical responsibilities and empowering graduates to be socially responsible and technically competent. • Members suggested to change the word **"moral values"** as "**Human values**" in Mission M4 of the Department. **(Annexure 2)**
Item:4	**Curriculum Structure of B.Tech – Information Technology** The following suggestions are recommended by the BoS members to the Academic council regarding the curriculum structure • The experts recommended to increase the credits for lab courses as two or to integrate them with the corresponding theory courses. • Mandatory courses may have at least four choices so that students may opt a course of their own interest. • BoS chairman represented that the curriculum structure was common as recommended by the curriculum and syllabus framing committee of the institution and hence it will be discussed and proper action would be taken.
Item:5	**B.Tech. Degree Syllabi for V to VIII semesters under Autonomous Regulations 2020 for the students admitted in the Academic Year 2020-2021 (First Year)**

Course Code / Course Name	Suggestions
U20ITT510/Mobile Application Development	• Wireless Application Protocols may be added in unit-II • The topic Essential of Traditional Routing Protocols is yet to be removed from Unit II
U20ITT511/ Data Warehousing and Data mining	• The topic Mapping the Data warehouse to a Multiprocessor Architecture from Unit-I is yet to be removed. • Pattern mining may be excluded in unit-III • Lazy Learners and Bayesian belief Classification is yet to be removed from Unit-IV.
U20ITT512/Network Security	• Number Theory is moved to Unit-II from Unit I • Key range and Key size topics are yet to be added in Unit-II • Key Management and MD5 message digest is yet to be removed from Unit-III. • Schnorr Digital Signature Scheme from Unit V is yet to be removed.
U20ITT614/IoT and Edge Computing	• Include Phased Application of Security in an Operational Environment in Unit - IV. • NETCONF-YANG and IoT Code Generator is yet to be excluded from Unit-V
U20ITE612/E-Commerce	• The topic Firewall Protection may be included in Unit-IV • The topic Inter-organizational Electronic Commerce- Software Agents is yet to be included in Unit-V
U20ITE613/Parallel and Distributed Systems	• The topic Trends in Distributed Systems and case study in WWW is yet to be included in Unit-IV • The topics Network Virtualization: Overlay Networks is yet to be included in Unit-V
U20ITE615/Bio-Inspired Computing	• Suggested to reduce the content in Unit-V

(Annexure 3)

- CO-PO- PSO mapping maybe revisited by forming a committee.

(Annexure 4)

Item:6

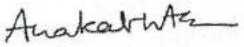
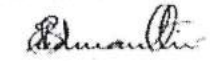
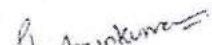
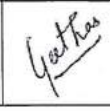
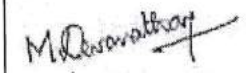
B.Tech. Degree Syllabi for V to VIII semesters under Autonomous Regulations 2019 for the students admitted in the Academic Year 2019-2020 (Second Year)

- The BoS members recommended to follow the same suggestions provided for semesters V to VIII of Regulation 2020 in Regulation 2019 also.

Item:7	**Review of the Evaluation Systems**
	• The mark distribution for project phase II may be revised as 50 marks for internal and 50 marks for external instead of 40 for internal and 60 for external.
Item:8	**Brief analysis about the End Semester results published for III, V and VII semesters.**
	• The BoS members appreciated the Department for their efforts in providing better results.
Item:9	**Discussion about the Innovative Teaching / Practices Methodology**
	• ICT Tools and Teaching Pedagogy were discussed and members appreciated the blended teaching learning method adopted during the pandemic situation.
Item:10	**Approval for the panel of examiners**
	• The list of question paper setters and evaluators for End Semester Examination was presented and recommended by BoS Members to Academic Council.**(Annexure 5)**

The meeting for the above Agenda regarding B.Tech – Information Technology was concluded by 2:00 pm with by **Dr. R.Raju**, Chairman-BOS and Head of Department, Department of Information Technology, Sri Manakula Vinayagar Engineering College.

Members Present:

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	**Dr. R. Raju, M.Tech, Ph.D** Professor & Head Department of IT, SMVEC	Chairman	
External Members			
2	**Dr. R. Geetha Ramani, M.Tech, Ph.D** Professor, Department of Information Science and Technology, College of Engineering Guindy, Anna University, Chennai	Subject Expert	
3	**Dr. A.S. Anakath, M.E, Ph.D** Professor, Department of IT, E.G.S. Pillay Engineering College, Nagapattinam	Subject Expert	
4	**Dr. S. Padmavathi, M.E, Ph.D** Professor, Department of IT, Thiagarajar College of Engg., Madurai	Subject Expert	
5	**Mr. L. Ashok** CEO - Futurenet Technologies (India) Private Limited, Chennai.	Member from Industry	
6	**Dr. G. Arun Kumar** Associate Professor, Department of CSE, Mandanapalli Institute of Technology and Science, Andhara Pradesh	Member from Meritorious Alumni	
Internal Members			
7	**Dr. T. Vigneswari, ME, Ph.D** Professor Department of IT, SMVEC	Member	
8	**Dr. C. Punitha Devi, M.Tech, Ph.D** Professor Department of IT, SMVEC.	Member	
9	**Dr. S. Geetha, M.Tech, Ph.D** Associate Professor Department of IT, SMVEC	Member	
Co-opted Members			
10	**Dr.N.S.N. Cailassame** Professor& Head, Department of Management Studies, SMVEC	Member	
11	**Dr. K. Karthikeyan** Associate Professor , Department. of Chemistry, SMVEC	Member	
12	**Prof. M. Devanathan** Assistant Professor, Department of Mathematics, SMVEC	Member	

13	**Prof. G. Namitha** Assistant Professor, Department of English, SMVEC	Member	
14	**Prof. C. Bhavani** Assistant Professor , Department. of Physics, SMVEC	Member	

Dr. R. Raju
Chairman- BoS (IT)

Dr.V.S.K. Venkatachalapathy
Director cum Principal
Chairman-Academic Council

Department of Information Technology

Minutes of Board of Studies

The Second Board of Studies meeting for M.Tech Programmes of Department of Information Technology was held on 8th April 2021 from 2:30 P.M to 3:30 P.M in the Seminar Hall, Department of Information Technology, Sri Manakula Vinayagar Engineering College with Head of the Department as BoS Chairman.

Sl.No	Name of the Member with Designation and official Address	Members as Per University norms
1	**Dr. R. Raju, M.Tech, Ph.D** Professor & Head Department of IT, SMVEC	Chairman
2	**Dr. R. Geetha Ramani, M.Tech, Ph.D** Professor, Department of Information Science and Technology, College of Engineering Guindy, Anna University, Chennai	Subject Expert (University Nominee)
3	**Dr. A.S. Anakath, M.E, Ph.D** Professor, Department of IT, E.G.S. Pillay Engineering College, Nagapattinam	Subject Expert (Academic Council Nominee)
4	**Dr. S. Padmavathi, M.E, Ph.D** Professor, Department of IT, Thiagarajar College of Engg., Madurai	Subject Expert (Academic Council Nominee)
5	**Mr. L. Ashok** CEO - Futurenet Technologies (India) Private Limited, Chennai.	Representative from Industry
6	**Dr. G. Arun Kumar** Associate Professor, Department of CSE, Mandanapalli Institute of Technology and Science, Andhara Pradesh	Post Graduate Alumnus (nominated by Principal)
7	**Dr. T. Vigneswari, ME, Ph.D** Professor Department of IT, SMVEC	Internal Member
8	**Dr. C. Punitha Devi, M.Tech, Ph.D** Professor Department of IT, SMVEC.	Internal Member
9	**Dr. S. Geetha, M.Tech, Ph.D** Associate Professor Department of IT, SMVEC	Internal Member

10	**Dr.N.S.N. Cailassame** Professor& Head, Department of Management Studies, SMVEC	Internal Member
11	**Dr. K. Karthikeyan** Associate Professor , Department. of Chemistry, SMVEC	Internal Member
12	**Prof. M. Devanathan** Assistant Professor, Department of Mathematics, SMVEC	Internal Member
13	**Prof. G. Namitha** Assistant Professor, Department of English, SMVEC	Internal Member
14	**Prof. C. Bhavani** Assistant Professor , Department. of Physics, SMVEC	Internal Member

Agenda of the Meeting

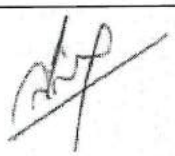
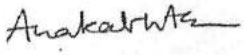
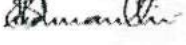
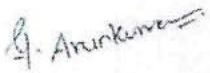
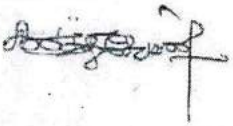
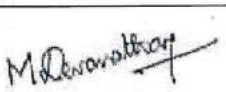
1) Review of Minutes of BoS – I
2) To discuss and recommend the syllabi for III and IV Semesters under R-2020 Regulations for PG Programme: M.Tech. Networking for the students admitted in the year 2020-21
3) Review of Evaluation Systems and suggestions any based on last ESE.
4) Brief Analysis about the End semester results published for III semester.
5) To discuss and approve the panel of examiners.
6) To discuss about curriculum and syllabi of new course M.Tech Data Science.
7) Any other item with the permission of chair.

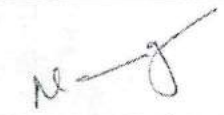
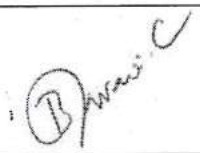
Item:1	**Review of Minutes of BoS – I**
	• The First BoS was held on 20.7.20 and the points discussed were reviewed by the members. **Annexure 6**
Item:2	**Discussed Syllabi for III and IV semesters of M.Tech - Networking for the students admitted in the Academic Year 2020-21**
	• The BoS members approved the Syllabi for III and IV semester for the course M.Tech Networking.
Item:3	**Review of Evaluation Systems and suggestions any based on last ESE**
	• The evaluation system as per PG regulation 2020 was reviewed and approved.

Item:4	**Brief Analysis about the End Semester results published for III semester**
	• The BoS Members appreciated the III semester results of M.Tech Networking.
Item:5	**Approval for the panel of examiners**
	• The BoS Members approved the Panel of Examiners.
Item: 6	**Discussion about Curriculum and Syllabi of New course M.Tech Data Science**
	The Subject Experts, having carefully considered the content of the curriculum and syllabi, suggested the following changes. The chairman agreed to their suggestions. • Mathematics course should include the components such as Probability, Complex variables and Fourier Analysis apart from Statistics • The following courses may be included in core courses - Advanced Data Structures and Algorithm Lab - Image Processing - Information Retrieval and Data Visualization - Creative and Innovative Lab • The courses Seminar & Technical report writing and Internship may be excluded. Seminar & Technical report writing may be included in Creative and Innovative Lab. Internship may be included in Project Phase I and credit for Project Phase I may be increased as 8. • The following courses may be included in Professional Elective - Open Stack - ETL Methodology - Social Network Analysis - Cognitive Computing and analytics - Information Security **(Annexure 7)**

The meeting was concluded by 3:30 pm with vote of thanks by **Dr. R.Raju**, Chairman-BOS and Head of Department, Department of Information Technology, Sri Manakula Vinayagar Engineering College.

Members Present:

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	**Dr. R. Raju, M.Tech, Ph.D** Professor & Head Department of IT, SMVEC	Chairman	
External Members			
2	**Dr. R. Geetha Ramani, M.Tech, Ph.D** Professor, Department of Information Science and Technology, College of Engineering Guindy, Anna University, Chennai	Subject Expert	
3	**Dr. A.S. Anakath, M.E, Ph.D** Professor, Department of IT, E.G.S. Pillay Engineering College, Nagapattinam	Subject Expert	
4	**Dr. S. Padmavathi, M.E, Ph.D** Professor, Department of IT, Thiagarajar College of Engg., Madurai	Subject Expert	
5	**Mr. L. Ashok** CEO - Futurenet Technologies (India) Private Limited, Chennai.	Member from Industry	
6	**Dr. G. Arun Kumar** Associate Professor, Department of CSE, Mandanapalli Institute of Technology and Science, Andhara Pradesh	Member from Meritorious Alumni	
Internal Members			
7	**Dr. T. Vigneswari, ME, Ph.D** Professor Department of IT, SMVEC	Member	
8	**Dr. C. Punitha Devi, M.Tech, Ph.D** Professor Department of IT, SMVEC.	Member	
9	**Dr. S. Geetha, M.Tech, Ph.D** Associate Professor Department of IT, SMVEC	Member	
Co-opted Members			
10	**Dr.N.S.N. Cailassame** Professor& Head, Department of Management Studies, SMVEC	Member	
11	**Dr. K. Karthikeyan** Associate Professor , Department. of Chemistry, SMVEC	Member	
12	**Prof. M. Devanathan** Assistant Professor, Department of Mathematics, SMVEC	Member	

13	**Prof. G. Namitha** Assistant Professor, Department of English, SMVEC	Member	
14	**Prof. C. Bhavani** Assistant Professor , Department. of Physics, SMVEC	Member	

Dr. R. Raju
Chairman- BoS (IT)

Dr.V.S.K. Venkatachalapathy
Director cum Principal
Chairman-Academic Council

ANNEXURE-I

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH. INFORMATION TECHNOLOGY

ACADEMIC REGULATION 2019
(R-2019)

CURRICULUM

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1 :	**Quality Education**	:	To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices
M2 :	**Research and Innovation**	:	To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues
M3:	**Employability and Entrepreneurship**	:	To inculcate the employability and entrepreneurial skills through value and skill-based training
M4 :	**Ethical Values**	:	To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

DEPARTMENT VISION AND MISSION

Vision

To be a pioneer in the field of Information Technology by achieving academic excellence, involving in research & development and promoting technical & professional expertise

Mission

M1: Expertise: To impart quality education and create excellent engineers with strong analytical, Programming and Problem solving Skills to meet the ever changing demands of IT industry

M2: Eminence: To kindle creative thinking, innovation and foster value-based research in the field of information technology

M3: Complaisant: To enrich the employability skills, inculcate entrepreneurial ideology and promote professional expertise

M4: Exemplar: To instil moral values, ethical responsibilities and empowering graduates to be socially responsible and technically competent

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

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

PO6: The engineer and 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.

PO7: 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.

PO8: Ethics:

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

PO9: Individual and team work:

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

PO10: 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.

PO11: 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.

PO12: 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 EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Fortify

To prepare the students with fundamental knowledge in programming languages and in developing applications.

PEO2: Equip

To develop skill in understanding the complexity in networking, security, data mining, web technology and mobile communication so as to develop innovative applications and projects in these areas for the betterment of society, as well as to enable them to pursue higher education

PEO3: Endow

To enable the students as full-fledged professionals by providing opportunities to enhance their analytical, communication skills and problem solving skills along with organizing abilities

PEO4: Conventional

To familiarize the students with the ethical issues in engineering profession, issues related to the World-wide economy, nurturing of current job related skills and emerging technologies

PROGRAMME SPECIFIC OBJECTIVES (PSOs)

PSO1: Establishment of Mathematical and computer systems concepts

To use mathematical and system concepts to solve multidisciplinary problems using appropriate mathematical analysis, system and programming concepts on various computing environments.

PSO2: Establishment of applications and information concepts

To inculcate good breadth of knowledge to create applications and enhance informatics with cutting edge technologies

PSO3: Establishment of Business, Technological concepts

The ability to interpret and respond to business agility with relevant software tools and skills and provide newer ideas and innovations in information technology research

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	9
2	Basic Sciences(BS)	38
3	Engineering Sciences (ES)	40
4	Professional Core (PC)	57
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Internship / Project Work	12
8	Employability Enhancement Courses (EEC) **	-
9	Mandatory courses (MC) **	-
Total		**183**

SCHEME OF CREDIT DISTRIBUTION-SUMMARY

Sl.No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	4	-	-	-	3	1	1	9
2	Basic Sciences(BS)	12	16	4	3	3	-	-	-	38
3	Engineering Sciences (ES)	18	10	8	4	-	-	-	-	40
4	Professional Core (PC)	-	-	10	8	12	15	9	3	57
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship(PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC)**	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC)**	-	-	-	-	-	-	-	-	-
Total		**30**	**30**	**22**	**21**	**21**	**21**	**20**	**18**	**183**

***** EEC and MC course Credits are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T101	Mathematics – I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Laboratory	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	2	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Laboratory	ES	0	0	3	2	50	50	100
							30	**300**	**600**	**900**

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T107	Mathematics – II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T110	Basic Civil And Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Laboratory	BS	0	0	3	2	50	50	100
8	P105	Chemistry Laboratory	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
Mandatory Course										
10	P107	NSS/NCC*	MC	0	0	0	-	-	-	-
							30	**300**	**600**	**900**

To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ITT31	Numerical Methods	BS	2	2	0	3	25	75	100
2	U19ITT32	Data Structures	ES	3	0	0	3	25	75	100
3	U19ITT33	Digital Design and Microprocessors	ES	3	0	0	3	25	75	100
4	U19ITT34	Database Management Systems	PC	3	0	0	3	25	75	100
5	U19ITT35	Computer Networks	PC	3	0	0	3	25	75	100
6	U19ITT36	Software Engineering and Project Management	PC	3	0	0	3	25	75	100
Practical										
7	U19ITP31	Numerical Methods Using C Laboratory	BS	0	0	2	1	50	50	100
8	U19ITP32	Data Structures Laboratory	ES	0	0	2	1	50	50	100
9	U19ITP33	Digital Design and Microprocessors Laboratory	ES	0	0	2	1	50	50	100
10	U19ITP34	Database Management Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19ITC3X	Certification Course-I **	EEC	0	0	4	-	100	-	100
12	U19ITS31	Skill Development Course1: General Proficiency – I	EEC	0	0	2	-	100	-	100
13	U19ITS32	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19ITM31	Physical Education	MC	0	0	2	-	100	-	100
							22	800	600	1400

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ITT41	Discrete Mathematics and Graph Theory	BS	2	2	0	3	25	75	100
2	U19ITT42	Programming in Java	ES	3	0	0	3	25	75	100
3	U19ITT43	Operating System	PC	3	0	0	3	25	75	100
4	U19ITT44	Internet and Web Technology	PC	3	0	0	3	25	75	100
5	U19ITE4X	Professional Elective – I#	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U19ITP41	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U19ITP42	Operating System Laboratory	PC	0	0	2	1	50	50	100
9	U19ITP43	Web Technology Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ITC4X	Certification Course-II**	EEC	0	0	4	-	100	-	100
11	U19ITS41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19ITS42	Skill Development Course 4*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ITM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

**** Certification courses are to be selected from the list given in Annexure III**

*** Skill Development Courses (2 and 4) are to be selected from the list given in Annexure IV**

SEMESTER – V										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ITT51	Probability and Statistics	BS	2	2	0	3	25	75	100
2	U19ITT52	Mobile Computing	PC	3	0	0	3	25	75	100
3	U19ITT53	Data Warehousing and Data Mining	PC	3	0	0	3	25	75	100
4	U19ITT54	Network Security	PC	3	0	0	3	25	75	100
5	U19ITE5X	Professional Elective - II#	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective-II$	OE	3	0	0	3	25	75	100
Practical										
7	U19ITP51	Mobile Computing Laboratory	PC	0	0	2	1	50	50	100
8	U19ITP52	Data Warehousing and Data Mining Laboratory	PC	0	0	2	1	50	50	100
9	U19ITP53	Network Security Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ITC5X	Certification Course-III**	EEC	0	0	4	-	100	-	100
11	U19ITS51	Skill Development Course 5: Foreign Language/ IELTS-I	EEC	0	0	2	-	100	-	100
12	U19ITS52	Skill Development Course 6 : Presentation Skills Using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ITM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VI											
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory											
1	U19ITT61	Artificial Intelligence	PC	3	0	0	3	25	75	100
2	U19ITT62	IoT and Edge Computing	PC	3	0	0	3	25	75	100
3	U19ITT63	Design Thinking	PC	3	0	0	3	25	75	100
4	U19ITT64	Block Chain Technology	PC	3	0	0	3	25	75	100
5	U19ITE6X	Professional Elective - III #	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III$	OE	3	0	0	3	25	75	100
Practical											
7	U19ITP61	Artificial Intelligence Laboratory	PC	0	0	2	1	50	50	100
8	U19ITP62	IoT and Edge Computing Laboratory	PC	0	0	2	1	50	50	100
9	U19ITP63	Creative Innovative Project Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course											
10	U19ITC6X	Certification Course-IV**	EEC	0	0	4	-	100	-	100
11	U19ITS61	Skill Development Course 7: Foreign Language/ IELTS-II	EEC	0	0	2	-	100	-	100
12	U19ITS62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19ITS63	Skill Development Course 9: NPTEL/MOOC-I	EEC	0	0	0	-	100	-	100
Mandatory Course											
14	U19ITM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ITT71	Cloud Computing	PC	3	0	0	3	25	75	100
2	U19ITT72	Data Science and Analytics	PC	3	0	0	3	25	75	100
3	U19ITE7X	Professional Elective – IV#	PE	3	0	0	3	25	75	100
4	U19ITO7X	Open Elective – IV$	OE	3	0	0	3	25	75	100
Practical										
5	U19ITP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19ITP72	Cloud Computing Lab	PC	0	0	2	1	50	50	100
7	U19ITP73	Data Science Lab	PC	0	0	2	1	50	50	100
8	U19ITP74	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19ITP71	Project Phase – I	PW	0	0	4	2	50	50	100
10	U19ITP72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ITT81	C # and .Net	PC	3	0	0	3	25	75	100
2	U19ITE8X	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U19ITE8X	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Practical										
4	U19ITP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19ITP81	Project Phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19ITS81	Skill Development Course 10: NPTEL/MOOC-II	EEC	0	0	0	-	100	-	100
							18	315	285	600

ANNEXURE I

PROFESSIONAL ELECTIVE COURSES (18 CREDITS)

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE41	Storage Technologies
2	U19ITE42	Computer Vision
3	U19ITE43	Object Oriented Analysis and Design
4	U19ITE44	Agile Methodologies
5	U19ITE45	Information Coding Techniques
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE51	Software Testing
2	U19ITE52	Data Visualization
3	U19ITE53	Brain Computer Interface and Its Application
4	U19ITE54	Linux Internals
5	U19ITE55	Automation Techniques and Tools-Dev Ops
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE61	Open Source Software
2	U19ITE62	E-Commerce
3	U19ITE63	Parallel and Distributed Systems
4	U19ITE64	Big Data
5	U19ITE65	Bio inspired Computing
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE71	Machine Learning
2	U19ITE72	Information Management
3	U19ITE73	Robotics Process automation
4	U19ITE74	Wireless sensor network
5	U19ITE75	Green Computing
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE80	Assistive Technology
2	U19ITE81	Business Intelligence
3	U19ITE82	Social Network Analytics
4	U19ITE83	Mixed Reality
5	U19ITE84	Game Development
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ITE85	Cyber security
2	U19ITE86	Computer Animation: Algorithms and Techniques
3	U19ITE87	Deep Learning
4	U19ITE88	High Performance Computing
5	U19ITE89	Multimedia Streaming Analytics

ANNEXURE II

OPEN ELECTIVE COURSES (12 CREDITS)

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech**

2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	(Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics

Open Elective – IV (Offered in Semester VII)				
1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH
6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics
8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

ANNEXURE III

EMPLOYABILITY ENHANCEMENT COURSES-(A) CERTIFICATION COURSES

Sl.No.	Course Code	Course Title
1.	U19ITCX1	Advanced Python Programming
2.	U19ITCX2	Android Programming
3.	U19ITCX3	CCNA – I
4.	U19ITCX4	CCNA - II
5.	U19ITCX5	Edge Computing
6.	U19ITCX6	Hyper Automation
7.	U19ITCX7	Internet of Things
8.	U19ITCX8	Machine Learning
9.	U19ITCX9	Web Programming (HTML, CSS, Javascript)

ANNEXURE IV

EMPLOYABILITY ENHANCEMENT COURSES-(B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1.	U19ITS31	SDC 1:General Proficiency – I
2.	U19ITS32	SDC 2*
		1) Object Oriented Programming
		2) Hardware and Troubleshooting
		3) Electronic Devices and Circuits
3.	U19ITS41	SDC 3:General Proficiency - II
4.	U19ITS42	SDC 4:*
		1) Graphic Design
		2) Networking
		3) Communication Engineering
5.	U19ITS51	SDC 5:Foreign Language/ IELTS-I
6.	U19ITS52	SDC 6:Presentation Skills Using ICT
7.	U19ITS61	SDC 7:Foreign Language/ IELTS-II
8.	U19ITS62	SDC 8: Technical Seminar
9.	U19ITS63	SDC 9: NPTEL/MOOC-I
10.	U19ITS81	SDC 10: NPTEL/MOOC-II

**** Any one course to be selected from the list***

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B. TECH.
INFORMATION TECHNOLOGY

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1 :	**Quality Education**	:	To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices
M2 :	**Research and Innovation**	:	To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues
M3:	**Employability and Entrepreneurship**	:	To inculcate the employability and entrepreneurial skills through value and skill-based training
M4 :	**Ethical Values**	:	To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

DEPARTMENT VISION AND MISSION

Vision

To be a pioneer in the field of Information Technology by achieving academic excellence, involving in research & development and promoting technical & professional expertise

Mission

M1: Expertise: To impart quality education and create excellent engineers with strong analytical, Programming and Problem solving Skills to meet the ever changing demands of IT industry

M2: Eminence: To kindle creative thinking, innovation and foster value-based research in the field of information technology

M3: Complaisant: To enrich the employability skills, inculcate entrepreneurial ideology and promote professional expertise

M4: Exemplar: To instil moral values, ethical responsibilities and empowering graduates to be socially responsible and technically competent

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

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

PO6: The engineer and 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.

PO7: 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.

PO8: Ethics:

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

PO9: Individual and team work:

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

PO10: 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.

PO11: 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.

PO12: 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 EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Fortify

To prepare the students with fundamental knowledge in programming languages and in developing applications.

PEO2: Equip

To develop skill in understanding the complexity in networking, security, data mining, web technology and mobile communication so as to develop innovative applications and projects in these areas for the betterment of society, as well as to enable them to pursue higher education

PEO3: Endow

To enable the students as full-fledged professionals by providing opportunities to enhance their analytical, communication skills and problem solving skills along with organizing abilities

PEO4: Conventional

To familiarize the students with the ethical issues in engineering profession, issues related to the World-wide economy, nurturing of current job related skills and emerging technologies

PROGRAMME SPECIFIC OBJECTIVES (PSOs)

PSO1: Establishment of Mathematical and computer systems concepts

To use mathematical and system concepts to solve multidisciplinary problems using appropriate mathematical analysis, system and programming concepts on various computing environments.

PSO2: Establishment of applications and information concepts

To inculcate good breadth of knowledge to create applications and enhance informatics with cutting edge technologies

PSO3: Establishment of Business, Technological concepts

The ability to interpret and respond to business agility with relevant software tools and skills and provide newer ideas and innovations in information technology research

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

Sl.No	Course Category	Breakdown of Credits
1.	Humanities and Social Sciences (HS)	7
2.	Basic Sciences (BS)	16
3.	Engineering Sciences (ES)	31
4.	Professional core (PC)	71
5.	Professional Electives (PE)	18
6.	Open Electives (PE)	9
7.	Project work/ Internship	12
8.	Employability Enhancement Courses (EEC)*	-
9.	Mandatory Courses (MC)*	-
	Total	**164**

SCHEME OF CREDIT DISTRIBUTION - SUMMARY

Sl.No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	-	1	1		3	1	1	7
2	Basic Sciences(BS)	3	3	4	3	3	-	-	-	16
3	Engineering Sciences (ES)	15	4	8	4	-	-	-	-	31
4	Professional Core (PC)	-	14	10	8	12	15	9	3	71
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship(PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC)*	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC)*	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**23**	**22**	**21**	**21**	**20**	**18**	**164**

**** EEC and MC are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20EST106	Introduction to Engineering: Distinction, Principles and Application	ES	3	0	0	3	25	75	100
3	U20EST107	Micro Electronics and Digital System Design	ES	2	2	0	3	25	75	100
4	U20EST109	Problem Solving Approach	ES	3	0	0	3	25	75	100
5	U20EST110	Programming in Python	ES	3	0	0	3	25	75	100
Practical										
6	U20ESP108	Micro Electronics and Digital System Design Laboratory	ES	0	0	2	1	50	50	100
7	U20ESP111	Programming in Python Laboratory	ES	0	0	2	1	50	50	100
8	U20ESP112	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20ITC1XX	Certification Course-I **	EEC	0	0	4	-	100	-	100
Mandatory Course										
10	U20ITM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	375	525	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics – II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST201	Programming in C	ES	3	0	0	3	25	75	100
3	U20ITT201	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100
4	U20ITT202	Front End Web Development	PC	3	0	0	3	25	75	100
5	U20ITT203	Computer Organization and Architecture	PC	3	0	0	3	25	75	100
6	U20ITT204	Information Systems: Theory and Applications	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C Laboratory	ES	0	0	2	1	50	50	100
8	U20ITP201	Microprocessor and Microcontroller Laboratory	PC	0	0	2	1	50	50	100
9	U20ITP202	Front End Web Development Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ITC2XX	Certification Course-II**	EEC	0	0	4	-	100	-	100
11	U20ITS201	Skill Development Course1: Demonstration of Workshop Practices	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20ITM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST322	Numerical Methods	BS	3	0	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20EST359	Programming in C++	ES	3	0	0	3	25	75	100
4	U20ITT305	Computer Networks	PC	3	0	0	3	25	75	100
5	U20ITT306	Database Management Systems	PC	3	0	0	3	25	75	100
6	U20ITT307	Software Engineering and Project Management	PC	3	0	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U20BSP323	Numerical Methods Laboratory	BS	0	0	2	1	50	50	100
9	U20ESP357	Data structures Laboratory	ES	0	0	2	1	50	50	100
10	U20ESP360	Programming in C++ Laboratory	ES	0	0	2	1	50	50	100
11	U20ITP303	Database Management System Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
12	U20ITC3XX	Certification Course - III**	EEC	0	0	4	-	100	-	100
13	U20ITS302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20ITM303	Physical Education	MC	0	0	2	-	100	-	100
							23	700	700	1400

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST432	Discrete Mathematics and Graph Theory	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in Java	ES	3	0	0	3	25	75	100
3	U20ITT408	Operating System	PC	3	0	0	3	25	75	100
4	U20ITT409	Web Application Development	PC	3	0	0	3	25	75	100
5	U20ITE4XX	Professional Elective - I#	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective – I$	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency - II	HS	0	0	2	1	100	-	100
8	U20ESP468	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
9	U20ITP404	Operating System Laboratory	PC	0	0	2	1	50	50	100
10	U20ITP405	Web Application Development Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ITC4XX	Certification Course - IV**	EEC	0	0	4	-	100	-	100
12	U20ITS403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ITM404	NSS	MC	0	0	2	-	100	-	100
							22	700	600	1300

 # Professional Electives are to be selected from the list given in Annexure I
$ Open electives are to be selected from the list given in Annexure II
**** Certification courses are to be selected from the list given in Annexure III**
*** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV**

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST546	Probability and Statistics	BS	2	2	0	3	25	75	100
2	U20ITT510	Mobile Computing	PC	3	0	0	3	25	75	100
3	U20ITT511	Data Warehousing and Data Mining	PC	3	0	0	3	25	75	100
4	U20ITT512	Network Security	PC	3	0	0	3	25	75	100
5	U20ITE5XX	Professional Elective - II#	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective-II$	OE	3	0	0	3	25	75	100
Practical										
7	U20ITP506	Mobile Computing Laboratory	PC	0	0	2	1	50	50	100
8	U20ITP507	Data Warehousing and Data Mining Laboratory	PC	0	0	2	1	50	50	100
9	U20ITP508	Network Security Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ITC5XX	Certification Course-V**	EEC	0	0	4	-	100	-	100
11	U20ITS504	Skill Development Course 4: Foreign Language/ IELTS-I	EEC	0	0	2	-	100	-	100
12	U20ITS505	Skill Development Course 5: Presentation Skills Using ICT	MC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ITM505	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ITT613	Artificial Intelligence	PC	3	0	0	3	25	75	100
2	U20ITT614	IoT and Edge Computing	PC	3	0	0	3	25	75	100
3	U20ITT615	Design Thinking	PC	3	0	0	3	25	75	100
4	U20ITT616	Block Chain Technology	PC	3	0	0	3	25	75	100
5	U20ITE6XX	Professional Elective - III#	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective – III$	HS	3	0	0	3	25	75	100
Practical										
7	U20ITP609	Artificial Intelligence Laboratory	PC	0	0	2	1	50	50	100
8	U20ITP610	IoT and Edge Computing Laboratory	PC	0	0	2	1	50	50	100
9	U20ITP611	Creative Innovative Project Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ITC6XX	Certification Course - VI**	EEC	0	0	4	-	100	-	100
11	U20ITS606	Skill Development Course 6: Foreign Language/ IELTS-II	EEC	0	0	2	-	100	-	100
12	U20ITS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20ITS608	Skill Development Course 8: NPTEL/MOOC-I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20ITM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ITT717	Cloud Computing	PC	3	0	0	3	25	75	100
2	U20ITT718	Data Science and Analytics	PC	3	0	0	3	25	75	100
3	U20ITE7XX	Professional Elective – IV#	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective – IV$	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics For Entrepreneur	HS	0	0	2	1	100	-	100
6	U20ITP712	Cloud Computing Laboratory	PC	0	0	2	1	50	50	100
7	U20ITP713	Data Science Laboratory	PC	0	0	2	1	50	50	100
8	U20ITP714	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20ITW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20ITW702	Internship / Inplant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20ITM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ITT819	C # and .Net	PC	3	0	0	3	25	75	100
2	U20ITE8XX	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U20ITE8XX	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	3	1	100	-	100
Project Work										
5	U20ITW803	Project Phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20ITS809	Skill Development Course 9: NPTEL/MOOC-II	EEC	0	0	0	-	100	-	100
							18	315	285	600

ANNEXURE I

PROFESSIONAL ELECTIVE COURSES (18 CREDITS)

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE401	Storage Technologies
2	U20ITE402	Computer Vision
3	U20ITE403	Object Oriented Analysis and Design
4	U20ITE404	Agile Methodologies
5	U20ITE405	Information Coding Techniques
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE506	Software Testing
2	U20ITE507	Data Visualization
3	U20ITE508	Brain Computer Interface and Its Application
4	U20ITE509	Linux Internals
5	U20ITE510	Automation Techniques and Tools-Dev Ops
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE611	Open Source Software
2	U20ITE612	E-Commerce
3	U20ITE613	Parallel and Distributed Systems
4	U20ITE614	Big Data
5	U20ITE615	Bio inspired Computing
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE716	Machine Learning
2	U20ITE717	Information Management
3	U20ITE718	Robotics Process automation
4	U20ITE719	Wireless sensor network
5	U20ITE720	Green Computing
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE821	Assistive Technology
2	U20ITE822	Business Intelligence
3	U20ITE823	Social Network Analytics
4	U20ITE824	Mixed Reality
5	U20ITE825	Game Development
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ITE826	Cyber Security
2	U20ITE827	Computer Animation: Algorithms and Techniques
3	U20ITE828	Deep Learning
4	U20ITE829	High Performance Computing
5	U20ITE830	Multimedia Streaming Analytics

ANNEXURE-II

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Control System Engineering	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics

21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)				
1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics

17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT

Open Elective – IV (Offered in Semester VII)

1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE

19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

ANNEXURE-III

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20ITCX01	3ds Max
2	U20ITCX02	Advance Structural Analysis of Building using ETABS
3	U20ITCX03	Advanced Java Programming
4	U20ITCX04	Advanced Python Programming
5	U20ITCX05	Analog System Lab Kit
6	U20ITCX06	Android Medical App Development
7	U20ITCX07	Android Programming
8	U20ITCX08	ANSYS -Multiphysics
9	U20ITCX09	Artificial Intelligence
10	U20ITCX10	Artificial Intelligence and Edge Computing
11	U20ITCX11	Artificial Intelligence in Medicines
12	U20ITCX12	AutoCAD for Architecture
13	U20ITCX13	AutoCAD for Civil
14	U20ITCX14	AutoCAD for Electrical
15	U20ITCX15	AutoCAD for Mechanical
16	U20ITCX16	Azure DevOps
17	U20ITCX17	Basic Course on ePLAN
18	U20ITCX18	Basic Electro Pneumatics
19	U20ITCX19	Basic Hydraulics
20	U20ITCX20	Bio Signal and Image Processing Development System
21	U20ITCX21	Blockchain
22	U20ITCX22	Bridge Analysis
23	U20ITCX23	Building Analysis and Construction Management
24	U20ITCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20ITCX25	CATIA
26	U20ITCX26	CCNA (Routing and Switching)
27	U20ITCX27	CCNA (Wireless)
28	U20ITCX28	Cloud Computing
29	U20ITCX29	Computer Programming for Medical Equipments
30	U20ITCX30	Corel Draw
31	U20ITCX31	Creo (Modeling and Simulation)
32	U20ITCX32	Cyber Security
33	U20ITCX33	Data Science and Data Analytics
34	U20ITCX34	Data Science using Python
35	U20ITCX35	Data Science using R
36	U20ITCX36	Deep Learning
37	U20ITCX37	Design and Documentation using ePLAN Electric P8
38	U20ITCX38	Design of Biomedical Devices and Systems
39	U20ITCX39	Digital Marketing
40	U20ITCX40	Digital Signal Processing Development System
41	U20ITCX41	DigSILENT Power Factory

42	U20ITCX42	Electro Hydraulic Automation with PLC
43	U20ITCX43	Embedded System using Arduino
44	U20ITCX44	Embedded System using C
45	U20ITCX45	Embedded System with IoT
46	U20ITCX46	ePLAN Data Portal
47	U20ITCX47	ePLAN Electric P8
48	U20ITCX48	ePLAN Fluid
49	U20ITCX49	ePLAN PPE
50	U20ITCX50	Fusion 360
51	U20ITCX51	Fuzzy Logic and Neural Networks
52	U20ITCX52	Google Analytics
53	U20ITCX53	Hydraulic Automation
54	U20ITCX54	Industrial Automation
55	U20ITCX55	Industry 4.0
56	U20ITCX56	Internet of Things
57	U20ITCX57	Introduction to C Programming
58	U20ITCX58	Introduction to C++ Programming
59	U20ITCX59	IoT using Python
60	U20ITCX60	Java Programming
61	U20ITCX61	Machine Learning
62	U20ITCX62	Machine Learning and Deep Learning
63	U20ITCX63	Machine Learning for Medical Diagnosis
64	U20ITCX64	Mechatronics
65	U20ITCX65	Medical Robotics
66	U20ITCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20ITCX67	Mobile Edge Computing
68	U20ITCX68	Modeling and Visualization using Micro station
69	U20ITCX69	MX Road
70	U20ITCX70	Photoshop
71	U20ITCX71	PLC
72	U20ITCX72	Pneumatics Automation
73	U20ITCX73	Project Management
74	U20ITCX74	Python Programming
75	U20ITCX75	Revit Architecture
76	U20ITCX76	Revit Inventor
77	U20ITCX77	Revit MEP
78	U20ITCX78	Robotics
79	U20ITCX79	Search Engine Optimization
80	U20ITCX80	Software Testing
81	U20ITCX81	Solar and Smart Energy System with IoT
82	U20ITCX82	Solid Works
83	U20ITCX83	Solid Works with Electrical Schematics
84	U20ITCX84	Speech Processing
85	U20ITCX85	STAAD PRO V8i
86	U20ITCX86	Structural Design and Analysis using Bentley
87	U20ITCX87	Total Station
88	U20ITCX88	Video and Image Processing Development System
89	U20ITCX89	VLSI Design

90	U20ITCX90	Web Programming - I
91	U20ITCX91	Web Programming - II

ANNEXURE-IV

EMPLOYABILITY ENHANCEMENT COURSES-(B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1.	U20ITS201	Skill Development Course 1 :Demonstration of Workshop Practices
2.	U20ITS302	Skill Development Course 2 *
		1) Hardware and Troubleshooting
		2) Electronic Devices and Circuits
		3) Industrial Management
3.	U20ITS403	Skill Development Course 3 *
		1) Graphic Design
		2) Networking
		3) Communication Engineering
4.	U20ITS504	Skill Development Course 4 : Foreign Language/ IELTS -I
5.	U20ITS505	Skill Development Course 5 : Presentation Skills using ICT
6.	U20ITS606	Skill Development Course 6 : Foreign Language/ IELTS - II
7.	U20ITS607	Skill Development Course 7 : Technical Seminar
8.	U20ITS608	Skill Development Course 8 : NPTEL / MOOC - I
9.	U20ITS809	Skill Development Course 9 : NPTEL / MOOC-II

**** Any one course to be selected from the list***

ANNEXURE-II

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Existing:

VISION OF THE DEPARTMENT

To be a pioneer in the field of Information Technology by achieving academic excellence, involving in research & development and promoting technical & professional expertise

MISSION OF THE DEPARTMENT

Expertise: To impart quality education and create excellent engineers with strong analytical, Programming and Problem solving Skills to meet the ever changing demands of IT industry

Eminence: To kindle creative thinking, innovation and foster value-based research in the field of information technology

Complaisant: To enrich the employability skills, inculcate entrepreneurial ideology and promote professional expertise

Exemplar: To instil **moral values**, ethical responsibilities and empowering graduates to be socially responsible and technically competent

Revised:

VISION OF THE DEPARTMENT

To be a pioneer in the field of Information Technology by achieving academic excellence, involving in research & development and promoting technical & professional expertise

MISSION OF THE DEPARTMENT

Expertise: To impart quality education and create excellent engineers with strong analytical, Programming and Problem solving Skills to meet the ever changing demands of IT industry

Eminence: To kindle creative thinking, innovation and foster value-based research in the field of information technology

Complaisant: To enrich the employability skills, inculcate entrepreneurial ideology and promote professional expertise

Exemplar: To instil **Human values**, ethical responsibilities and empowering graduates to be socially responsible and technically competent

HOD- IT

ANNEXURE-III

U20BST546	PROBABILITY AND STATISTICS	L	T	P	C	Hrs
	(Common to CSE, IT)	2	2	0	3	60

Course Objectives

- To acquire skills in handling situation including more than one random variable.
- To familiarize the student about the continuous random variables and their applications.
- To study the basic concepts of Statistics.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling.

Course Outcomes

After completion of the course, the students will be able to

CO 1 - Apply the concept of probability in random variables. **(K3)**
CO 2 - Apply the basic rules of continuous random variables. **(K3)**
CO 3 - Understand the basic concepts of Statistics. **(K2)**
CO 4 - Derive the inference for various problems using testing of hypothesis in large samples **(K3)**
CO 5 - Solve the problems related to testing of hypothesis in small samples **(K3)**

UNIT I DISCRETE RANDOM VARIABLES **(12Hrs)**

Random Variables and their event spaces – The probability mass function – Distribution functions – Binomial – Geometric – Negative Binomial and Poisson.

UNIT II CONTINUOUS RANDOM VARIABLES **(12 Hrs)**

Some important distributions – Exponential distribution – Gamma – Weibull – Gaussian distributions. Application of distribution – Reliability – Failure density and Hazard function.

UNIT III STATISTICS **(12 Hrs)**

Measures of central tendency – Arithmetic Mean, Median and Mode – Measures of dispersion and Standard deviation – Skewness and Measures of Skewness – Pearson's coefficient of skewness – Moments – Correlation – Rank correlation and regression.

UNIT IV LARGE SAMPLES **(12 Hrs)**

Curve fitting by the method of least squares – fitting of straight lines – second degree parabolas and more general curves – Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES **(12 Hrs)**

Test for single mean – Difference of means and correlations of coefficients – Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes.

Text Books

1. B.S.Grewal, "Higher Engineering Mathematics", KHANNA PUBLISHERS - Paperback – 3rd Edition - 2017.
2. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2008.
3. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 1 2019.

Reference Books

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", McGraw-Hill, 1st Edition, 2017.
2. William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning; 15th Edition 2019.
3. Richard .A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, "An Introduction to Probability and Statistics", Wiley – 2008.
5. E. Rukmangadachari, "Probability and Statistics", Pearson Education India – 2012.

Web Resources

1. http:// www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
3	2	1	-	-	-	1	-	-	-	-	-	1	3	1	1
4	3	2	1	1	-	1	-	-	-	-	-	1	3	1	1
5	3	2	1	1	-	1	-	-	-	-	-	1	3	1	1

U20ITT510	MOBILE APPLICATION DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K1)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K6)**

UNIT I INTRODUCTION **(9 Hrs)**

Mobile Computing – Mobile Computing Vs Wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER **(9 Hrs)**

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

UNIT III MOBILE TELECOMMUNICATION SYSTEM **(9 Hrs)**

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT IV MOBILE AD-HOC NETWORKS **(9 Hrs)**

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS **(9 Hrs)**

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,"Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition,TataMcGraw Hill Edition ,2006.

3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

Web References

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. Windows Phone DevCenter : http://developer.windowsphone.com 9. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2
3	1	-	-	-	1	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	-	1	-	-	-	-	-	-	3	-	3
5	2	1	-	-	2	1	-	-	-	-	-	-	2	-	3

U20ITT511	DATA WAREHOUSING AND DATA MINING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Be familiar with the concepts of data warehouse and data mining.
- Be acquainted with the tools and techniques used for Knowledge Discovery in Databases.
- To understand data pre-processing and data visualization techniques.
- To study algorithms for finding hidden and interesting patterns in data.
- To understand and apply various classification and clustering techniques using tools.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe a data warehouse **(K2)**
CO2 - Apply pre-processing techniques **(K3)**
CO3 - Interpret correlation based frequent patterns in large data sets **(K2)**
CO4 - Compare and contrast the various classifiers **(K2)**
CO5 - Apply data mining techniques and methods to large data sets **(K3)**

UNIT I INTRODUCTION TO DATA WAREHOUSING **(9 Hrs)**

Data Warehouse: Data warehouse -basic concepts- Modeling – Design and usage- Implementation –Data generalization by Attribute-oriented induction approach – Data cube computation methods.

UNIT II DATA MINING **(9 Hrs)**

Data Mining: Introduction- Kinds of Data and Patterns–Major issues in data mining- Data Objects and attribute types –Statistical description of data - Measuring data similarity and dissimilarity. Data preprocessing: Overview-Data cleaning- Data integration –Data reduction-Data transformation and discretization.

UNIT III ASSOCIATION RULE MINING **(9 Hrs)**

Association Rule Mining: Basic concepts- Frequent item set mining methods : Apriori algorithm- A pattern growth approach for mining frequent item sets—Pattern evaluation methods- Mining multilevel, multi dimensional space constraint based frequent pattern mining

UNIT IV CLASSIFICATION **(9 Hrs)**

Classification: Basic concepts- Decision Tree Induction - Bayes Classification Methods – Rule Based Classification- Model evaluation and selection techniques to improve classification accuracy –Support Vector Machines Classification using frequent patterns- Other Classification Methods.

UNIT V CLUSTERING **(9 Hrs)**

Clustering: Cluster analysis- Partitioning methods- Hierarchical methods- Density based methods – Grid based methods – Model-Based Clustering Methods – Clustering High Dimensional Data- Constraint based Cluster Analysis – Introduction to outlier analysis -Data Mining Applications.

Text Books

1. Jiawei Han and Micheline Kamber, —Data Mining Concepts and Techniques‖, 3rd Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007.

Reference Books

1. Gupta G.K., —Introduction to Data Mining with Case Studies‖, Eastern Economy Edition, Prentice Hall of India, 2006.
2. Charu C. Aggarwal, Data Mining: The Textbook‖, Kindle Edition, Springer, 2015.
3. Margret H. Dunham, Data Mining: Introductory and Advanced Topics‖, 17th Edition, Pearson, 2013.

Web References

1. www.cs.waikato.ac.nz/ml/weka

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	2	-	-	-	-	2	3	2	-
2	3	2	1	1	-	-	2	-	-	-	-	2	2	3	-
3	2	1	-	-	-	2	3	-	-	-	-	2	2	3	-
4	2	1	-	-	-	2	3	-	-	-	-	2	2	3	-
5	3	2	1	1	-	-	3	-	-	-	-	2	2	3	-

		L	T	P	C	Hrs
U20ITT512	**NETWORK SECURITY**	3	0	0	3	45

Course Objectives

- To provide students with contemporary knowledge in Cryptography and Security and various threats and attacks in a network
- To introduce fundamental concepts of symmetric and asymmetric cipher model.
- To know the concepts of Key management techniques and Cryptographic Hash algorithms
- To understand the various authentication schemes and system control mechanisms
- To understand necessary approaches and techniques to build protection mechanisms in order to secure computer networks.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Classify cryptographic techniques using a mathematical approach by examining nature of attack. **(K2)**
CO2 - Apply the different cryptographic operations using public and private key cryptography **(K3)**
CO3 - Summarize solutions for effective key management distribution and maintain message integrity **(K2)**
CO4 - Identify and use appropriate algorithms for assuring System security and authentication. **(K3)**
CO5 - Outline the security requirements and solutions for wireless networks and distributed systems. **(K2)**

UNIT I INTRODUCTION **(9 Hrs)**

Security Attack - Non-cryptographic Protocol Vulnerabilities - Software Vulnerabilities - The need for security - Security services - Security Mechanisms- Classical encryption: Classical Techniques

UNIT II SYMMETRIC AND ASYMMETRIC CIPHER **(9 Hrs)**

Symmetric Ciphers: Symmetric and asymmetric cryptography- Key size and Key Range- DES - Triple DES - AES - Blowfish - RC5- Pseudorandom Number Generators - Asymmetric Ciphers: RSA Algorithms - Security of RSA - Knapsack Algorithm - Differential and Linear Cryptanalysis-Number Theory

UNIT III KEY MANAGEMENT AND DATA INTEGRITY ALGORITHMS **(9 Hrs)**

Diffie Hellman key exchange -Elgamal Cryptographic System - Elliptic Curve Arithmetic - Elliptic Curve Cryptography - Cryptographic Hash Functions: Secure Hash Algorithm (SHA-1) -Message authentication codes: HMAC.

UNIT IV AUTHENTICATION **(9 Hrs)**

Digital Signatures -Elgamal Digital Signature Scheme - NIST Digital Signature Algorithm - Elliptic Curve Digital Signature Algorithm – RSA-PSS Digital Signature - Biometric Authentication – Kerberos - X.509 Authentication Service - Public Key Infrastructure.

UNIT V NETWORK AND WIRELESS SECURITY'S **(9 Hrs)**

Email Security: Pretty good privacy – S/MIME-IP Security - Web Security: SSL/ Transport Layer Security - Secure electronic transaction (SET) –System Security- Firewalls design principles. Intrusion detection System - Virtual Private Networks - Wireless security: IEEE 802.11 overview and its security – WEP - WPA.
Case Studies: Snort and Stenographic tools - Bit coin and Crypto currency system.

Text Books

1. William Stallings, "Cryptography & Network Security- Principles and Practices",Pearson Publishers, Seventh Edition, 2017.
2. AtulKahate, "Cryptography and Network Security",McGraw Hill, 3rd Edition, 2011.

Reference Books

1. Charles P. Pfleeger, Shari Lawrence Pfleeger , "Security in computing", Prentice Hall of India,Fifth Edition,2015.
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, "Network Security: PRIVATE Communication in a PUBLIC World", Prentice Hall, ISBN 0-13-046019-2
3. Wenbo Mao, "Modern Cryptography: Theory and Practice",Prentice Hall PTR, First Edition,2003.
4. William Stallings, "Network Security Essentials: Applications and Standards",Prentice Hall, Fourth Edition 2007.
5. Douglas R. Stinson, "Cryptography: Theory and Practice",CRC press, Third Edition,2006.

Web References

1. https://www.coursera.org/learn/crypto
2. https://www.mitel.com/articles/web-communication-cryptography-and-network-security
3. http://williamstallings.com/Cryptography/Crypto7e-Student/
4. http://www.maths.usyd.edu.au/u/afish/Math2068/index_lectures.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	3	-
3	2	1	-	-	-	-	-	-	-	-	-	-	2	3	-
4	3	2	1	1	-		-	-	-	-	-	-	2	3	-
5	2	1	-	-	-	-	-	-	-	-	-	-	2	3	-

U20ITP506	MOBILE APPLICATION LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the components and structure of mobile application development.
- To understand how to work with various mobile application development frameworks.
- To learn the basic and important design concepts of development of mobile applications.
- To understand the capabilities and limitations of mobile devices.
- To develop a new Mobile Application.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Develop mobile applications using GUI and Layouts. **(K3)**
CO2 - Develop mobile applications using Event Listener. **(K3)**
CO3 - Develop mobile applications using Databases. **(K3)**
CO4 - Develop mobile applications using RSS Feed, SMS, Multithreading and GPS. **(K3)**
CO5 - Analyze and discover own mobile app for simple needs. **(K4)**

LIST OF EXPERIMENTS

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers.
3. Develop an application that uses event listeners.
4. Write an application that draws basic graphical primitives on the screen
5. Develop an application that makes use of databases.
6. Develop an application that makes use of Notification Manager
7. Implement an application that uses Multi-threading
8. Develop a native application that uses GPS location information
9. Implement an application that writes data to the SD card.
10. Implement an application that creates an alert upon receiving a message
11. Write a mobile application that makes use of RSS feed
12. Develop a mobile application to send an email.
13. Develop a Mobile application for simple needs (Mini Project).

Reference Books

1. Build Your Own Security Lab, Michael Gregg, Wiley India, 2012

Web References

1. http://www.edutechlearners.com/mobile-computing-lab-manual/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	3	3	3	-
2	3	2	1	1	-	-	-	-	-	-	-	3	3	3	-
3	3	2	1	1	1	-	-	-	-	-	-	3	3	3	-
4	3	2	1	1	-	1	-	-	-	-	-	3	3	3	-
5	3	3	2	1	2	1	-	-	-	-	-	3	3	3	-

		L	T	P	C	Hrs
U20ITP507	DATA WAREHOUSING AND DATA MINING LABORATORY	0	0	2	1	30

Course Objectives

- To perform data mining tasks using a data mining toolkit (such as open source WEKA).
- To understand the data sets and data pre-processing.
- To demonstrate the working of algorithms for data mining tasks such association rule mining, classification, clustering and regression.
- To work with data mining techniques with varied input values for different parameters.
- To obtain Practical Experience Working with all real data sets.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the various kinds of tools. **(K1)**

CO2 - Demonstrate the classification, clustering and etc. in large data sets. **(K3)**

CO3 - Apply mining algorithms as a component to the exiting tools. **(K3)**

CO4 - Apply mining techniques for realistic data. **(K3)**

CO5 - Explore hands-on experience working with all real data sets. **(K3)**

LIST OF EXPERIMENTS

1. Explore various commands given in PL/SQL in Oracle 8.0
2. Execute multi-dimensional data model using SQL queries.
3. Implement various OLAP operations such as slice, dice, roll up, drill up, pivot etc.
4. Implementation of Text Mining on the data warehouse
5. Explore the correlation-ship analysis between the data set
6. Evaluate attribute relevance analysis on a weather data warehouse
7. Evaluate Information Gain of an attribute in the student database
8. Experiment to predict the class using the Bayesian classification
9. Find out a weight & bias updating using the Back Propagation Neural Network
10. To perform various data mining algorithms on the give data base using WEKA

Reference Books

1. Ramesh Sharda, Dursun Delen, David King Business Intelligence, 2/E; Efraim Publisher Turban,pearson Education, 2011.

2. Berry, Gordon S. Linoff, "Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management", John Wiley & Sons Inc publishers, 3 rd Edition, 2011.

3. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques" 3rd edition ,Morgan Kaufmann, 2012.

Web References

1. www.cs.waikato.ac.nz/ml/weka

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	2	-	-	-	-	2	3	2	-
CO2	3	2	1	1	-	-	2	-	-	-	-	2	2	3	-
CO3	3	2	1	1	-	2	3	-	-	-	-	2	2	3	-
CO4	3	2	1	1	-	2	3	-	-	-	-	2	2	3	-
CO5	3	2	1	1	-	-	3	-	-	-	-	2	2	3	-

U20ITP508	NETWORK SECURITY LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn different cipher techniques
- To implement the algorithms DES, RSA,SHA-3
- To implement the authentication algorithms.
- To develop a digital signature scheme using Digital signature standard.
- To use network security tools and vulnerability assessment tools

Course Outcomes

After completion of the course, the students will be able to

CO1 - Develop code for classical Encryption Techniques to solve the information security problems. **(K3)**

CO2 - Build cryptosystems by applying symmetric and public key encryption algorithms. **(K3)**

CO3 - Construct code for key exchange and message authentication algorithms. **(K3)**

CO4 - Develop a digital signature scheme using Digital signature standard. **(K3)**

CO5 - Demonstrate the network security system using open source tools, Snort, Net Stumbler KF Sensor. **(K3)**

LIST OF EXPERIMENTS

- Implement the following substitution & transposition techniques:
  a. Caesar Cipher
  b. Playfair Cipher
  c. Hill Cipher
  d. Vigenere Cipher
  e. Rail fence-row & Column Transformation
- Apply DES algorithm for practical applications.
- Implement RSA Algorithm for public key cryptography
- Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
- Design a method to simulate the HTML injections and cross-site scripting (XSS) to exploit the attackers.
- Implementation of RSA based signature system using Digital signature standard
- Calculate the message digest of a text using the SHA-3 algorithm
- Learn to install Virtual Box or any other equivalent software on the host OS
- Demonstrate how to provide secure data storage, secure data transmission and f,or creating digital signatures (GnuPG).
- Setup a honey pot and monitor the honeypot on network (KF Sensor)
- Perform wireless audit on an access point or a router and decrypt WEP and WPA.(Net Stumbler)
- Demonstrate intrusion detection system (IDS) using Snort Tool

Text Books

1. Michael Gregg,Build Your Own Security Lab: A field guide for network Testing, Wiley,India edition, ISBN: 9788126516919.

Reference ooks

1. Arthur Cobnklin, 'Principles of Computer Security CompTIA Security+ and Beyond', Greg White 5th Edition,2018,McGraw-Hill Education

Web References

1. https://www.coursera.org/learn/crypto
2. https://www.mitel.com/articles/web-communication-cryptography-and-network-security

3. http://williamstallings.com/Cryptography/Crypto7e-Student/
4. http://www.maths.usyd.edu.au/u/afish/Math2068/index_lectures.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	1	1	-		-	-	-	-	-	-	2	3	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	2	3	-

U20ITE506	SOFTWARE TESTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the fundamentals and principles of software testing
- To learn few techniques of testing
- To software quality of the software products
- To analyze Risk management Strategies
- To apply appropriate tools to assess ongoing project performance

Course Outcomes

After completion of the course, the students will be able to

CO1 - Illustrate Manual Test cases for Software Project. **(K2)**
CO2 - Summarize the integration testing which aims to uncover interaction and compatibility problems as early as possible. **(K2)**
CO3 - Apply modern software testing processes in relation to software development and project management. **(K3)**
CO4 - Use automated testing tools. **(K3)**
CO5 - Outline and validate a test plan **(K2)**

UNIT I INTRODUCTION TO SOFTWARE TESTING **(9 Hrs)**

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 STRATEGIES **(9 Hrs)**

Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – White Box Approach to Test design – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing - Evaluating Test Adequacy Criteria.

UNIT III LEVELS OF TESTING **(9 Hrs)**

The need for Levels of Testing – Unit Test – Running the Unit tests and Recording results – Integration tests – Integration Testing- Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing – Compatibility testing – Testing the documentation – Website testing.

UNIT IV TEST MANAGEMENT **(9 Hrs)**

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group- .The Technical Training Program - Defect Management – Defect Severity.

UNIT V TESTING TOOLS, SOFTWARE TEST AUTOMATION **(9 Hrs)**

Selenium, J-Meter, 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.

Text Books

1. Srinivasan Desikan and Gopalaswamy Ramesh, —Software Testing – Principles and Practices, Pearson Education, 2006.
2. Ron Patton, —Software Testing, Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com
3. Aditya P. Mathur, —Foundations of Software Testing _ Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

Reference Books

1. Ilene Burnstein, —Practical Software Testingll, Springer International Edition, 2003.
2. Edward Kit Software Testing in the Real World – Improving the Process, Pearson Education, 1995.
3. Boris Beizer, Software Testing Techniques – 2nd Edition, Van Nostrand Reinhold, New York, 1990.

Web References

1. http://seleniumhq.org
2. http://jmeter.apache.org/
3. http://appium.io/

COs/POs/PSOs Mapping

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1	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3
2	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3
3	3	2	1	1	2	-	-	-	-	-	-	-	-	2	3
4	3	2	1	1	2	-	-	-	-	-	-	-	-	2	3
5	2	1	-	-	3	-	-	-	-	-	-	-	-	2	3

U20ITE507	DATA VISUALIZATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop skills to both design and critique visualization
- To understand why visualization is an important part of data analysis
- To understand the components involved in visualization design
- To understand the type of data impacts the type of visualization
- To understand when to use a particular data visualization, and why

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the Principles of data visualization **(K2)**
CO2 - Describe the best practices of data visualization and how to apply them to solve analytics problems **(K2)**
CO3 - Apply Core Skills for visual Analysis **(K3)**
CO4 - Demonstrate Information Dashboard **(K3)**
CO5 - Apply Visualization Techniques **(K3)**

UNIT I DATA PREPARATION **(9 Hrs)**

Importing Data - Text files -Excel spreadsheets -Statistical packages - Databases - Cleaning Data : Selecting variables - Selecting observations - Creating/Recoding variables - Summarizing data - Using pipes - Reshaping data - Missing data - Introduction to ggplot2 -ggplot- geoms - grouping scales - facets -labels- themes - Placing the data and mapping options-Graphs as objects

UNIT II UNIVARIATE GRAPHS **(9 Hrs)**

Categorical : Bar Chart -Pie Chart - Tree Map Quantitative - Histogram - Kernel Density plot - Dot Chart - Bivariate Graphs - Categorical vs. Categorical : Stacked bar chart - Grouped bar chart - Segmented bar chart - Improving the color and labeling - Other plots - Quantitative vs. Quantitative :Scatterplot - Line plot- Categorical vs. Quantitative: Bar chart - Grouped kernel density plots - Box plots -Violin plots -Ridgeline plots - Mean/SEM plots - Strip plots - Beeswarm Plots -Cleveland Dot Charts

UNIT III MAPS **(9 Hrs)**

Dot density maps-Choropleth maps:Data by country-Data by US stateData by US county -Time-dependent graphs: Time series- Dummbbell charts - Slope graphs - Area Charts - Statistical Models : Correlation plots - Linear Regression - Logistic regression - Survival plots - Mosaic plots

UNIT IV 3-D SCATTERPLOT **(9 Hrs)**

Biplots - Bubble charts - Flow diagrams -Sankey diagramsAlluvial diagrams - Heatmaps - Radar charts - Scatterplot matrix - Waterfall charts- Word clouds -Customizing Graphs - Axes: Quantitative axes - Categorical axes - Date axes- Colors: Specifying colors manually-Color palettes: Points & Lines: Points - Lines - Fonts - Legends: Legend location Legend title - Labels- Annotations: Adding text - Adding lines - Highlighting a single group - Themes- Altering theme elements - Pre-packaged themes

UNIT V SAVING GRAPHS **(9 Hrs)**

File formats -External editing - Interactive Graphs - leaflet - plotly -rbokeh - rCharts - highcharter- Best Practices: Labeling - Signal to noise ratio - Color choice- y-Axis scaling - Attribution

Text Books

1. Rob Kabacoff, Data Visualization with R, Bookdown, 2018. Chapters: 1-13

Reference Books

1. Kirthi Raman - Mastering Python Data Visualization -Packt Publishing - 2015 Helen Wright, "Introduction to Scientific Visualization", Springer, 2007. Richard S Gallagher, "Computer Visualization: Graphics Techniques for Engineering and Scientific Analysis", CRC Press, CRC Press LLC, 1994.

Web References

1. https://www.tableau.com/tft/activation
2. https://www.microstrategy.com/us/resources/introductory-guides/data-visualization-what-it-is-and-why-we-use-it

3. https://www.coursera.org/learn/datavisualization

COs/POs/PSOs Mapping

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1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	2
2	2	1	-	-	2	-	-	-	-	-	-	-	2	2	2
3	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	2	2	3

U20ITE508	BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives

- Understand the basic concepts of brain computer interface
- Study the various signal acquisition methods
- Learn about the signal processing methods used in BCI
- Understand the various machine learning methods of BCI.
- Learn the various applications of BCI

Course Outcomes

After completion of the course, the students will be able to

CO1 - Comprehend and appreciate the significance and role of this course in the present contemporary World. **(K2)**

CO2 - Outline the concept of Brain Computer Interface. **(K2)**

CO3 - Infer functions appropriately to the human and to the machine. **(K2)**

CO4 - Select appropriate feature extraction methods. **(K3)**

CO5 - Use machine learning algorithms for translation. **(K3)**

UNIT - I INTRODUCTION TO BCI **(9 Hrs)**

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous - Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

UNIT – II BRAIN ACTIVATION **(9 Hrs)**

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT - III FEATURE EXTRACTION METHODS **(9 Hrs)**

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence.

UNIT - IV MACHINE LEARNING METHODS FOR BCI **(9 Hrs)**

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis

UNIT - V APPLICATIONS OF BCI **(9 Hrs)**

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

Text Books

1. Rajesh.P.N.Rao, Brain-Computer Interfacing: An Introductionll, Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, —Brain Computer Interfaces: Principles and practicell, Oxford University Press, USA, Edition 1, January 2012.
3. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010

Reference Books

1. Ella Hassianien, A &Azar.A.T (Editors), —Brain-Computer Interfaces Current Trends and Applications‖, Springer, 2015.
2. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch,‖ A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals‖ Journal of Neural Engineering, Vol.4, 2007, PP.32-57
3. Arnon Kohen, —Biomedical Signal Processing‖, Vol I and II, CRC Press Inc, Boca Rato, Florida.
4. Bishop C.M., —Neural networks for Pattern Recognition‖, Oxford, Clarendon Press, 1995. 6. Andrew Webb, —Statistical Pattern Recognition‖, Wiley International, Second Edition, 2002.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

U20ITE509	LINUX INTERNALS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about Linux kernel system
- To gain knowledge about buffers and system calls
- To acquire knowledge about process management and scheduling mechanisms
- To learn the basic concepts in Linux Security

Course Outcomes

After completion of the course, the students will be able to

CO1 - Infer the basics of Linux kernel system. **(K2)**
CO2 - Explain the buffer cache mechanism in Linux kernel. **(K2)**
CO3 - Interpret the various system calls associated with the file system. **(K2)**
CO4 - Summarize about process management and process scheduling. **(K2)**
CO5 - Demonstrate the fundamental security concepts in Linux environment. **(K2)**

UNIT I INTRODUCTION TO LINUX KERNEL **(9 Hrs)**

History of Unix - Introduction to Linux - Overview of Operating Systems and Kernels - Linux versus Classic Unix Kernels - Linux Kernel Versions - Obtaining the Kernel Source - Building the Kernel -GNU C - Synchronization and Concurrency - Importance of Portability.

UNIT II KERNEL BUFFER CACHE **(9 Hrs)**

Cache and its Types - Buffer Headers - Structure of Buffer Pool - Buffer Retrieval Scenarios - Reading and Writing Disk Blocks – Advantages and Disadvantages of Buffer Cache - Case study: Multi-Router Traffic Grapher.

UNIT III SYSTEM CALLS FOR THE FILE SYSTEM **(9 Hrs)**

Structure of a Regular File – Directories - Open - Read - Write – LSeek - File and Record Locking – Close - File Creation - Creation of Special Files - Change Directory – Root – Owner - STAT and FSTAT – Pipes – Dup - Mounting and Unmounting File Systems – Link – Unlink - File System Abstraction - File System Maintenance.

UNIT IV PROCESS MANAGEMENT AND SCHEDULING **(9 Hrs)**

Process Management: The Process - Process Descriptor and the Task Structure - Process Creation - The Linux Implementation of Threads - Process Termination - **Process Scheduling:** Multi-Tasking -Process Scheduling Policy - The Linux Scheduling Algorithm -Process Selection – Preemption and Context Switching - Real Time Scheduling Policies.

UNIT V INTRODUCTION TO LINUX SECURITY **(9 Hrs)**

Running Linux in a Virtual Environment: The Threat Landscape - Introduction to VirtualBox and Cygwin - **Securing User Accounts:** Danger as Root User - Setting Sudo Users - Tips and Tricks for using Sudo - Enforcing Strong Passwords - Preventing Brute Force Attacks - Locking User Accounts.

Text Books

1. Maurice J.Bach, "The Design of the UNIX Operating System", AT and T Bell laboratory, 2015
2. Robert Love, "Linux Kernel Development", Addison Wesley, 2010.
3. Donald A. Tevault, "Mastering Linux Security and Hardening", Packt Publishers, 2018.

Reference Books

1. UreshVahalia, "UNIX Internals: The New Frontiers", Pearson Education 2010.
2. Elien Sevier, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell: A Desktop Quick Reference", O'Reilly, 2009
3. Daniel P. Bovet, Marco Sesati,"Understanding the Linux Kernel", O'Reilly, 3rd Edition, 2004.

Web References

1. http://www.linux-tutorial.info/modules.php?name=MContent&pageid=317
2. https://www.usenix.org/legacy/event/lisa07/tech/full_papers/plonka/plonka_html/
3. http://www.ee.surrey.ac.uk/Teaching/Unix/
4. http://www.cs.sfu.ca/~ggbaker/reference/unix
5. http://www.tutorialspoint.com/unix/unix-useful-commands.html

COs/POs/PSOs Mapping

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1	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-

U20ITE510	AUTOMATION TECHNIQUES & TOOLS DEVOPS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The Background and mind set of Devops
- To enable students appreciate the agile led development environment.
- To give the students a perspective to grasp the need for Minimum viable product led development using Sprints.
- To enable students acquire fundamental knowledge of CI/CD and CAMS.
- To enable learners realize various aspects of DevOps Ecosystem.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain traditional software development methodologies like waterfall. **(K2)**
CO2 - Apply the Agile Methodology and comparing various other software development models with agile. **(K3)**
CO3 - Explain implementing Continuous Integration and Continuous Delivery. **(K2)**
CO4 - Illustrate CAMS for DevOps (Culture, Automation, Measurement and Sharing). **(K2)**
CO5 - Construct quick MVP prototypes for modules and functionalities. **(K3)**

UNIT I TRADITIONAL SOFTWARE DEVELOPMENT (9 Hrs)

The Advent of Software Engineering - Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation - Developers vs IT Operations conflict.

UNIT II RISE OF AGILE METHODOLOGIES (9 Hrs)

Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

UNIT III INTRODUCTION DEVOPS (9 Hrs)

Introduction to DevOps - Version control - Automated testing - Continuous integration - Continuous delivery - Deployment pipeline - Infrastructure management – Databases

UNIT IV PURPOSE OF DEVOPS (9 Hrs)

Minimum Viable Product- Application Deployment- Continuous Integration- Continuous Delivery

UNIT V CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) (9 Hrs)

CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing, Test-Driven Development, Configuration Management-Infrastructure Automation- Root Cause Analysis- Blamelessness- Organizational Learning

Text Books

1. Dev Ops – Volume 1 , Pearson and Xebia Press
2. Grig Gheorghiu, Alfredo Deza, Kennedy Behrman, Noah Gift, Python for DevOps,2019

Reference Books

1. The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis
2. What is DevOps? - by Mike Loukides
3. Joakim Verona, Practical DevOps ,2016.

Web References

1. www.ibm.com/cloud/devops.
2. www.softwaretestinghelp.com>devops-automation.

COs/POs/PSOs Mapping

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3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

U20ITT503	ESSENTIALS OF DATA SCIENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

After completion of the course, the students will be able to

CO1 - Experiment with data analytics using R language. **(K3)**
CO2 - Demonstrate clustering algorithms and association rules. **(K3)**
CO3 - Use algorithms related to regression and classification. **(K3)**
CO4 - Explore data using time series analysis and text analysis. **(K2)**
CO5 - Summarize Hadoop platform to solve map reduce problems. **(K2)**

UNIT I DATA ANALYTICS USING R (9 Hrs)

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES (9 Hrs)

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms-Clustering in practise: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION (9 Hrs)

Scope of Regression Techniques-Linear Regression-Logistic Regression-Additional Regression models-Scope of Classification Techniques-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods-Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS (9 Hrs)

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights.

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS (9 Hrs)

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.

2. VigneshPrajapathi, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding opportunities in Huge DataStreams with Advanced Analytics", John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, "R Programming for Data Science", LeanPub, 2015.
2. Bart Baesens , "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014.

Web References

1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

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2	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
3	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3

U20ITT504	MOBILE APPLICATION DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Mobile Computing – Mobile Computing Vs Wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER **(9 Hrs)**

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

UNIT III MOBILE TELECOMMUNICATION SYSTEM **(9 Hrs)**

Global System for Mobile Communication (GSM) – Services & Architecture- Protocol-Connection Establishment – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS) – Handover - Security.

UNIT IV MOBILE AD-HOC NETWORKS **(9 Hrs)**

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS **(9 Hrs)**

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,"Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition,TataMcGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

Web References

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2
3	2	1	-	-	1	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	-	1	-	-	-	-	-	-	3	-	3
5	3	2	1	1	2	1	-	-	-	-	-	-	2	-	3

U20ITT613	ARTIFICIAL INTELLIGENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Study the Concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of Expert Systems and machine Learning.
- To identify problems that is amenable to solve by AI methods.
- To identify appropriate AI methods to solve a given problem.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Recognize appropriate search algorithms for any AI problem **(K2)**
CO2 - Describe a problem propositional and predicate logic **(K2)**
CO3 - Apply the APT agent strategy to solve a given problem **(K3)**
CO4 - Use various Planning and Learning strategies to solve a problem **(K3)**
CO5 - Construct applications for NLP that uses Artificial Intelligence **(K3)**

UNIT I INTRODUCTION **(9Hrs)**

Introduction: Introduction to Artificial Intelligence-History of AI- AI Techniques - Data Acquisition and Learning Aspects in AI - Typical Intelligent Agents - General Search algorithm – BFS- A* Search- AO* Search- Memory Bounded Heuristic Search.

UNIT II KNOWLEDGE AND REASONING – I **(9 Hrs)**

Knowledge Representation: Knowledge Representation-Knowledge based Agents - Propositional Logic-Predicate Logic-Unification and Lifting - Forward Chaining-Backward Chaining – Representing Knowledge using Rules-Semantic Networks - Frame Systems

UNIT III KNOWLEDGE AND REASONING – II **(9 Hrs)**

Reasoning Under Uncertainty:Inference - Probabilistic inference - Types of Reasoning- Expectation Maximization - Bayesian networks - Hidden Markov models - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV PLANNING **(9 Hrs)**

Planning and Learning: Planning Problem – Simple Planning agent - Planning as a State space Search - Knowledge based Planning - Blocks world - Execution Monitoring and Re-planning-Continuous Planning-Multi-agent Planning-Job shop Scheduling Problem - Overview of different forms of learning- Learning Decision Trees, Neural Networks.

UNIT V APPLICATIONS **(9 Hrs)**

Applications and Game Playing: Prolog Programming - Natural Language Processing - Speech Recognition – Robot – Hardware – Perception - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games - Case study in AI Applications

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
3. Patrick Henry Winston, "Artificial Intelligence", 3rd edition Pearson Education, Inc., 2001.

Reference Books

1. Bratko, Prolog,"Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
2. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.

3. Rajendraakerkar, "Introduction to Artificial Intelligence", prentice hall of India, 2005.

Web References

1. https://www.ailab.com.au/resources/online-resources/https://www.allaboutcircuits.com/video-tutorials/transistors/
2. https://aaai.org/Resources/resources.php https://nptel.ac.in/courses/117/106/117106091/
3. https://nptel.ac.in/courses/106/105/106105077/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	2	3	2	-
2	2	1	-	-	2	-	-	-	-	-	-	2	2	3	-
3	3	2	1	1	2	-	-	-	-	-	-	2	2	3	-
4	3	2	1	1	2	-	-	-	-	-	-	2	2	3	-
5	3	2	1	1	2	-	-	-	-	-	-	2	2	3	-

U20ITT614	IOT AND EDGE COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Introduce the basic of IoT and various domains that utilize IoT
- Understand the concepts of management of IOT systems that leads to platform design
- Identify various physical devices , endpoints and servers used in IOT
- Infer the role of Data Analytics & security in IT
- Explore various tools and developIoT design for certain Applications.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basic concepts of IOT and distinguish between IOT & M2M. **(K2)**

CO2 - Explore IoT system Management leading to platform design. **(K2)**

CO3 - Recognize IoT Devices and connect them to cloud servers. **(K2)**

CO4 - Illustrate the use of Data analytics and need for security in IoT. **(K3)**

CO5 – Identify the IoT tools and explore to create a real time example **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction :Definition and Characteristics of IoT - Physical Design of IoT - Things in IoT - Logical Design of IoT - IoT Communication Models - IoT Communication APIs - IoT Enabling Technologies. IoT Levels and deployment template.Domain specific IoTs – IoT and M2M - Introduction to M2M - Difference between IoT and M2M - SDN and NFV for IoT

UNIT II SYSTEM MANAGEMENT AND PLATFORM DESIGN (9 Hrs)

Need for IoT Systems Management- SNMP- Network Operator Requirements NETCONF - YANG- IoT System Management with NETCONF-YANG.

IoT Platforms Design Methodology - Case study on Weather Monitoring.

UNIT III DEVICES END POINTS AND SERVERS (9 Hrs)

IoT Physical Devices and Endpoints: Basic building blocks - Exemplary Device: Raspberry Pi andArduino – interfaces - Programming with python- Python Packages for IOT- other devices: pcDuino -BeagleBone Black -Cubieboard. IoT physical servers and cloud offerings.

UNIT IV DATA ANALYTICS AND SECURITY OF IOT (9 Hrs)

Data and Analytics for IoT: An Introduction to Data Analytics for IoT- Big Data Analytics Tools and Technology Edge Streaming Analytics-Network Analytics

Securing IoT- A Brief History of IOT Security - Common Challenges in OT Security - Security Practices and Systems Variation-Formal Risk Analysis Structures: OCTAVE and FAIR- Phased Application of Security in an Operational Environment.

UNIT V TOOLS FOR IOT AND CASE STUDIES (9 Hrs)

Tools- CHEF- CHEF Case Study,PUPPET. **Casestudies Illustrating IOT design:** Home Automation Environment – Agriculture - Productivity Application IoT in Industry: Smart and Connected Cities-Transportation-Public Safety.

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 Edition, 2017,ISBN: 978-81-265-5686-1

Reference Books

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, —"Architecting the Internet of Things", Springer, 2011.

2. Donald Norris, —"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", Mc.Graw Hill, 2015.
3. CunoPfister, —"Getting Started with the Internet of Things", O'Reilly Media, Inc.,2011
4. Olivier Hersent, David Boswarthick, Omar Elloumi, —"The Internet of Things,Key applications and Protocols", Wiley, 2012
5. Dieter Uckelmann et.al, —"Architecting the Internet of Things", Springer, 2011.

Web References

1. https:\\www.aboutthelnternetofThings.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	2	1	-	-	2	-	-	-	-	-	-	2	2	3	2
3	2	1	-	-	2	-	-	-	-	-	-	2	2	3	2
4	3	2	1	1	2	-	-	-	-	-	-	2	2	3	2
5	2	1	-	-	2	-	-	-	-	-	-	2	2	3	2

U20ITT615	DESIGN THINKING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To make use of practical design thinking methods in every stage of problem with the help of method templates.
- To apply design thinking to a problem in order to generate innovative and user-centric solutions.
- To empathize with end user and initiate a new working culture based on user-centric approach.
- To prototype and run usability tests for unbiased examination of the product in order to identify problem areas.
- To come up with exposure to design thinking for designing innovative products.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the fundamentals of Design Thinking and innovation. **(K2)**
CO2 - Empathize and analyse model action plan. **(K2)**
CO3 - Describe the principles of innovation and idea generation for product design. **(K2)**
CO4 - Apply design thinking techniques for given tasks. **(K3)**
CO5 - Apply the design thinking techniques for solving problems in various sectors. **(K3)**

UNIT I INTRODUCTION TO DESIGN THINKING **(9 Hrs)**

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design - Introduction to design thinking - history of Design Thinking - New materials in Industry.

UNIT II DESIGN THINKING **(9 Hrs)**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development.

UNIT III INNOVATION AND PRODUCT DESIGN **(9 Hrs)**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications.

UNIT IV DESIGN THINKING FOR STRATEGIC INNOVATION **(9 Hrs)**

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Startups.

UNIT V DESIGN THINKING IN VARIOUS SECTORS **(9 Hrs)**

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results.

Text Books

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking in the Class Room by David Lee, Ulysses press.
3. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall

Reference Books

1. Design the Future , by Shrrutin N Shetty , Norton Press
2. Universal principles of design- William lidwell, kritina holden, Jill butter.
3. The era of open innovation – chesbrough.H

Web References

1. https://drive.google.com/file/d/1cplqb1eOWnoNMhFWNP8TyYLF2qHdGY_K/view
2. https://nptel.ac.in/courses/110/106/110106124/#

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	1	-	-	1	1	2	2	3	3
2	2	1	-	-	-	-	1	-	-	1	1	2	2	3	3
3	2	1	-	-	-	-	1	-	-	1	1	2	2	3	3
4	3	2	1	1	-	-	1	-	-	1	1	2	2	3	3
5	3	2	1	1	-	-	1	-	-	1	1	2	2	3	3

U20ITT616	BLOCK CHAIN TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of block chain.
- To learn about Bitcoin, Cryptocurrency.
- To explore the concepts of Ethereum.
- To learn about Hyperledger Fabric model and its architecture.
- To integrate ideas from block chain technology into projects.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of Block Chain Technologies. **(K1)**
CO2 - Explain the functional /operational aspects of Cryptocurrency Ecosystem. **(K2)**
CO3 - Develop application using Ethereum. **(K5)**
CO4 - Compute models for Block Chain Technology. **(K3)**
CO5 - Illustrate Blockchain with IoT and track the emerging trends in Blockchain. **(K3)**

UNIT I INTRODUCTION TO BLOCK CHAIN **(9 Hrs)**

Block Chain - History of Block Chain – Types of Block Chain – Consensus – CAP Theorem and Block Chain – Decentralization using Block Chain – Block Chain and full ecosystem decentralization – Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY **(9 Hrs)**

Bitcoin – Digital keys and addresses – Transactions – Mining – Bitcoin Network and Payments – Wallets – Bitcoin Payments Alternative coins – Theoretical Foundations - Bitcoin limitations – Name coin – Lite coin – Prime coin – Zcash – Smart contracts – Ricardian contracts.

UNIT III ETHEREUM **(9 Hrs)**

Introduction – Ethereum network – Components of the Ethereum ecosystem – Programming Languages – Ethereum Development Environment – Development Tools and Frameworks. **Illustrative:** Setup the Ethereum development environment.

UNIT IV WEB3 AND HYPERLEDGER **(9 Hrs)**

Introduction to Web3 – Contract Deployment – Development Frameworks – Hyperledger as a protocol – Reference Architecture – Hyperledger Fabric - Sawtooth Lake – Corda. **Illustrative:** Creating and deploying a business network on Hyperledger Composer Playground, Implementation of business network in Blockchain using Hyperledger Fabric.

UNIT V BLOCK CHAIN APPLICATIONS **(9 Hrs)**

IoT with Block Chain – Block Chain based voting system - Border Control – Medical Record Management System - Alternative Blockchains – Kadena – Ripple – Rootstock – Quorum - Scalability – Privacy – Other Challenges.

Text Books

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

Reference Books

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas M. Antonopoulos.
2. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, 1st Edition.
3. Building Blockchain Projects by Narayan Prusty, 2017.

Web References

1. https://developer.ibm.com/technologies/blockchain/
2. https://www.edx.org/course/introduction-to-hyperledger-blockchain-technologie/
3. https://nptel.ac.in/courses/106104220/blockchain technology and applications/
4. https://blockgeeks.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	2	1	-	-	2	-	-	-	-	-	-	2	2	3	3
3	3	3	2	1	2	-	-	-	-	-	-	2	2	3	3
4	3	2	1	1	2	-	-	-	-	-	-	2	2	3	3
5	3	2	1	1	2	-	-	-	-	-	-	2	2	3	3

U20ITP609	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study the concepts of Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of Expert Systems and machine learning.
- To identify problems that is amenable to solve by AI methods.
- To identify appropriate AI methods to solve a given problem.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Identify appropriate idealizations for converting real world problems into AI search problems. **(K2)**
CO2 - Analyse and formalize the given search problem. **(K2)**
CO3 - Explain proofs in first order and propositional logic. **(K2)**
CO4- Choose and implement appropriate learning algorithms for supervised learning problem. **(K3)**
CO5 - Describe the basic construction of Turing machine and its recursive languages and functions. **(K2)**

LIST OF EXPERIMENTS

1. Study of PROLOG. Write the following programs using PROLOG
2. Write a program to solve 8 queens problem
3. Solve any problem using depth first search.
4. Write a program to solve the Monkey Banana problem
5. Write a program to solve water jug problem using LISP
6. Solve any problem using best first search.
7. Solve 8-puzzle problem using best first search
8. Solve Robot (traversal) problem using means End Analysis
9. Solve traveling salesman problem.
10. WAP in turbo prolog for medical diagnosis and show the advantage & disadvantage of green and red cuts
11. Implementation of A* Search Algorithm
12. Implementation of AO* Search Algorithm
13. Implementation of Wumpus World Problem
14. Implementation of Decision Tree Learning

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.

Reference Books

1. Bratko, —Prolog: "Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
2. David L. Poole and Alan K. Mackworth, - "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.
3. RajendraAkerkar, "Introduction to Artificial Intelligence", Prentice hall of India, 2005.
4. Patrick Henry Winston, "Artificial Intelligence", 3rd edition Pearson Education, Inc., 2001.

Web References

1. https://www.ailab.com.au/resources/online-resources/
2. https://aaai.org/Resources/resources.php
3. https://nptel.ac.in/courses/106/105/106105077/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	2	2	3	3
2	2	1	-	-	2	-	-	-	-	-	-	2	2	3	3
3	2	1	-	-	2	-	-	-	-	-	-	2	2	3	3
4	3	2	1	1	2	-	-	-	-	-	-	2	2	3	3
5	2	1	-	-	2	-	-	-	-	-	-	2	2	3	3

U20ITP610	IOT AND EDGE COMPUTING LAB	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To provide an Introduction about basic command of Rasberry pi working in Linux terminal.
- To demonstrate about interfacing various sensors with raspberry pi.
- To explore Rasberry Pi and IoT Tool Kits.
- To explore Arduino tool kit.
- Enable the students to do a mini project.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain basic commands of Rasberry pi. **(K2)**
CO2 - Understand the basics commands of Rasberry pi. **(K2)**
CO3 - Apply basic connectivity of sensors with Rasberry pi. **(K3)**
CO4 - Use basic connectivity of sensors with Arduino. **(K3)**
CO5 - Develop a mini project in IoT. **(K6)**

LIST OF EXPERIMENTS

1. Start Raspberry Pi and try various Linix commands in command terminal window: ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping etc.
2. Run some python programs on Pi like: Read your name and print Hello message with name Read two numbers and print their sum, difference, product and division.Word and character count of a given string Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input Print a name 'n' times, where name and n are read from standard input, using for and while loops. Handle Divided by Zero Exception. Print current time for 10 times with an interval of 10 seconds.Read a file line by line and print the word count of each line.
3. Light an LED through Python program.Get input from two switches and switch on corresponding LEDs. Flash the LED at a given on time and off time cycle, where the two times are taken from a file and also Flash an LED based on cron output (acts as an alarm)
4. Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.
5. Access images through a Pi web cam and verify whether any animal is entering a farm or similar region.
6. Control a light source using web page.
7. Use sensors to measure the vital signs of human and store it in a database.
8. Use appropriate sensors to find out the climate of a particular region
9. Implement an intruder system that sends an alert to the given email.
10. Get the status of a bulb at a remote place (on the LAN) through web.
11. Get an alarm from a remote area (through LAN) if smoke is detected.
12. Implement a fall alarm for an elder person and inform to his caretaker through mobile.

Any one mini project with team of two: (sample given below)

- Smart irrigation system
- Traffic control system
- Healthcare application
- Smart Home system

Reference Books

1. CunoPfister, —"Getting Started with the Internet of Things", O'Reilly Media, Inc.,2011.
2. Donald Norris, —"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", Mc.Graw Hill, 2015.

Web References

1. https:\\www.electronicsforu.com/iot-project-ideas.

COs/POs/PSOs Mapping

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3	3	2	1	1	2	-	-	-	-	-	-	2	2	3	3
4	3	2	1	1	2	-	-	-	-	-	-	2	2	3	3
5	3	2	2	1	2	-	-	-	-	-	-	2	2	3	3

U20ITP611	CREATIVE INNOVATIVE LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To understand the software engineering concepts practically with CASE Tools
- To learn the modelling concepts for an application
- To practice object oriented analysis and design concepts
- To understand mapping of design to code
- To demonstrate the testing concepts

Course Outcomes

After completion of the course, the students will be able to

CO1 - Select appropriate software engineering models and techniques with relevance to application. **(K2)**
CO2 - Apply UML diagrams to an application/ project **(K3)**
CO3 - Identify project management techniques for a project **(K2)**
CO4 - Use design patterns to implementation constructs **(K3)**
CO5 - Generate and develop test cases for a project **(K5)**

LIST OF EXPERIMENTS

1. Study of case tools such as rational rose or equivalent tools like Argo UML, Visual suite, SDE for Eclipse / IBM Websphere etc.
2. Problem Identification and defining Problem statement
3. Requirements Implementation of requirements engineering activities such as elicitation, validation, management and prepare SRS document
4. OO Analysis – Identify scenarios and Identify Use Cases and develop the Use Case model
5. Using the identified scenarios find the interaction between objects and represent them using UML Sequence diagrams. Draw relevant state charts and activity diagrams.
6. Study and usage of software project management tools such cost estimates and scheduling
7. Identify appropriate software architecture style and design modeling and prepare Design document
8. Documentation of the complete modeling practice using software engineering paradigms
9. Data modeling using automated tools.
10. Applying design patterns during implementation
11. Exposure towards test plan generators, test case generators, test coverage and software metrics.

Application Domain: Agriculture – Education - Health care - Digital Marketing - online shopping - Banking and finance - Smart cities - Travel.

Preferred SOFTWARE TOOLS: 30 user Licensed Rational Suite
Open Source Alternatives: ArgoUML

Web References

1. www.uml.org
2. www.holub.com/goodies/uml

COs/POs/PSOs Mapping

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3	2	1	-	-	2	-	-	-	2	2	2	2	2	3	3
4	3	2	1	1	2	-	-	-	2	2	2	2	2	3	3
5	3	2	2	1	2	-	-	-	2	2	2	2	2	3	3

U20ITE611	OPEN SOURCE SOFTWARE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Be familiar with participating in a free and open source software (FOSS) project
- Learn scripting language like Python or Perl
- Learn programming language like Ruby
- Learn some important FOSS tools and techniques
- Learn different Open source tools

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe information about Free and Open Source Software projects from software releases and from sites on the internet. **(K1)**

CO2 - Articulate and modify one or more Free and Open Source Software packages **(K2)**

CO3 - Summarize software to and interact with Free and Open Source Software development projects **(K2)**

CO4 - Use a version control system. **(K3)**

CO5 - Apply installation and run open-source operating systems. **(K3)**

UNIT I PHILOSOPHY **(9 Hrs)**

Notion of Community--Guidelines for effectively working with FOSS community--, Benefits of Community based Software Development --Requirements for being open, free software, open source software –Four degrees of freedom - FOSS Licensing Models - FOSS Licenses – GPL- AGPL-LGPL - FDL - Implications – FOSS examples.

UNIT II LINUX **(9 Hrs)**

Linux Installation and Hardware Configuration – Boot Process-The Linux Loader (LILO) - The Grand Unified Bootloader (GRUB) - Dual-Booting Linux and other Operating System - Boot-Time Kernel Options- X Windows System Configuration-System Administration – Backup and Restore Procedures- Strategies for keeping a Secure Server.

UNIT III PROGRAMMING LANGUAGES **(9 Hrs)**

Programming using languages like Python or Perl or Ruby

UNIT IV PROGRAMMING TOOLS AND TECHNIQUES **(9 Hrs)**

Usage of design Tools like Argo UML or equivalent, Version Control Systems like Git or equivalent, – Bug Tracking Systems- Package Management Systems

UNIT V FOSS CASE STUDIES **(9 Hrs)**

Open Source Software Development - Case Study – Libre office -Samba

Text Books

1. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, OReilly Media, 2009.

Reference Books

1. Philosophy of GNU URL: http://www.gnu.org/philosophy/.
2. Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/.

Web References

1. The Python Tutorial available at http://docs.python.org/2/tutorial/.
2. Perl Programming book at http://www.perl.org/books/beginning-perl/.
3. Ruby programming book at http://ruby-doc.com/docs/ProgrammingRuby/.
4. Version control system URL: http://git-scm.com/.
5. Samba: URL: http://www.samba.org/.
6. Libre office: http://www.libreoffice.org/.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	2	-	-	-	-	-	-	-	3	2	3
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

U20ITE612	E-COMMERCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamentals of E-Commerce.
- To acquire knowledge on various business applications.
- To study the infrastructure of E-commerce.
- To explore about payments and security in E-Commerce.
- To learn the legal and privacy issues in E-commerce.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basic concepts of E-Commerce. **(K2)**
CO2 - Use various applications of E-Commece. **(K3)**
CO3 - Illustrate the various infrastructure of E-commerce. **(K2)**
CO4 - Outline various payments and security in E-Commerce. **(K2)**
CO5 - Explore the various legal and privacy issues in E-Commerce. **(K2)**

UNIT I FUNDAMENTAL OF E-COMMERCE **(9 Hrs)**

Driving forces – benefits and limitations of e-commerce. Basics of Data mining, data warehousing and network infrastructure requirements. Overview of IP, TCP, HTML, OLAP and Cryptography.

UNIT II BUSINESS APPLICATIONS IN E-COMMERCE **(9 Hrs)**

Retailing in E-commerce – market research on internet customers – e- commerce for service sector – Advertising in e-commerce – B2B ecommerce.

UNIT III E-COMMERCE INFRASTRUCTURE **(9 Hrs)**

Intranet, Internet & Extranet – Structure, Architecture, Applications & Business Models.

UNIT IV E-COMMERCE PAYMENTS AND SECURITY **(9 Hrs)**

E-Payments and Protocols-Security schemes against internet fraud.Firewall Protection. Principles of e-fund transfer, credit and debit card usage, E-check and unified payment systems.

UNIT V LEGAL AND PRIVACY ISSUES IN E-COMMERCE **(9 Hrs)**

Legal, Ethics and Privacy issues – Protection needs and methodology - Consumer protection, Cyber laws, contracts and warranties. Taxation and Encryption Policies. Interorganizational Electronic Commerce-Software Agents

Text Books

1. Efraim Turban et al., 'Electronic Commerce – A managerial perspective', Pearson Education Asia, 2002.
2. Kalakota et al, 'Frontiers of Electronic Commerce', Addison Wesley, 2001.

Reference Books

1. Sandeep Krishnamurthy, 'E-Commerce Management – Text and Cases', Thomson Learning, 2003.
2. Greenstein Firsman, 'Electronic Commerce', Tata McGraw Hill, 1999.
3. Nabil Adam et al, 'Electronic Commerce – Technical, Business and Legal Issues'. Prentice Hall. 1998.

Web References

1. www.ncertbooks.guru/
2. http://www.vssut.ac.in/lecture_notes/lecture1428551057.pdf
3. https://irp-cdn.multiscreensite.com/1c74f035/files/uploaded/introduction-to-e-commerce.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3
2	3	2	1	1	-	-	-	-	-	-	-	-	-	2	3
3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3
4	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3
5	2	1	-	-	-	-	-	-	-	-	-	-	-	2	3

U20ITE613	PARALLEL AND DISTRIBUTED SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the fundamental principles and engineering trade-offs involved in designing modern parallel computers.
- Develop programming skills to effectively implement parallel architecture
- Design the future system and analyse the GPU with respect to different application
- To understand the foundations and characteristics of distributed systems.
- To understand the concepts of Inter process communication and distributed objects in distributed systems

Course Outcomes

After completion of the course, the students will be able to

CO1 - Comprehend parallel architecture and its importance in solving engineering problems. **(K2)**

CO2 - Analyze the type of cache design with respect to its access time. **(K2)**

CO3 - Demonstrate the future system and analyse the GPU with respect to different application **(K2)**

CO4 - Elucidate the foundations and issues of distributed systems **(K2)**

CO5 - Analyze the concepts of Inter process communication and distributed objects in distributed systems **(K2)**

UNIT I INTRODUCTION TO PARALLEL COMPUTER **(9 Hrs)**

The need for parallelism, Forms of parallelism (SISD, SIMD, MISD, MIMD), Moore's Law and Multicores, Fundamentals of Parallel Computers, Communication architecture, Message passing architecture.

UNIT II CACHE DESIGN **(9 Hrs)**

Shared vs. Private Caches, Centralized vs. Distributed Shared Caches, Snooping-based cache coherence protocol, directory-based cache coherence protocol, Uniform Cache Access, Non-Uniform Cache Access.

UNIT III GRAPHICS PROCESSING UNIT **(9 Hrs)**

Architecture of a modern GPU, Evolution of Graphics Pipelines, GPGPUs, Scalable GPUs, Architectural characteristics of Future Systems, Implication of Technology and Architecture for users, Vector addition, Applications of GPU.

UNIT IV INTRODUCTION TO DISTRIBUTED SYSTEMS **(9 Hrs)**

Characterization of Distributed Systems and System Models: Introduction-Examples of distributed systems-Trends in Distributed Systems- Resource sharing and the Web- Challenges-Architectural models-Fundamental models-Case study: World Wide Web.

UNIT V INTER-PROCESS COMMUNICATION AND DISTRIBUTED OBJECTS **(9 Hrs)**

System Model -Inter process Communication: Introduction- The API for the Internet protocols- External data representation and marshalling- Client -Server communication- Group communication- Network virtualization: Overlay networks. Distributed File Systems- Distributed Objects and Remote Invocation: Communication between distributed objects-Remote procedure call- RMI.

Text Books

1. D. E. Culler, J. P. Singh, and A. Gupta, Parallel Computer Architecture, MorganKaufmann, 2004
2. Rajeev Balasubramonian, Norman P. Jouppi, and Naveen Muralimanohar, Multi-Core Cache Hierarchies, Morgan & Claypool Publishers, 2011
3. Peter and Pach Eco, An Introduction to Parallel Programming, Elsevier, 2011

Reference Books

1. James R. Larus and Ravi Rajwar, Transactional Memory, Morgan & Claypool Publishers, 2007
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2010

3. Barbara Chapman, F. Desprez, Gerhard R. Joubert, Alain Lichnewsky, Frans Peters Parallel Computing: From Multicores and GPU's to Petascale, 2010
4. Andrew S. Tanenbaum "Distributed Systems: Principles and Paradigms",Pearson Education , 2nd Edition 2007.
5. Liu M.L ,"Distributed Computing, Principles and Applications", Pearson Education, First Edition ,2004.

Web References

1. https://www.coursera.org/learn/parprog1
2. https://www.pinterest.com/pin/557953841332890190/
3. https://nptel.ac.in/courses/106/106/106106168/
4. http://www.webopedia.com/TERM/D/distributed_computing.html
5. http:// www.distributed.net/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3

U20ITE614	BIG DATA	L	T	P	C	Hrs
		3	1	0	4	60

Course Objectives

- To learn tips and tricks for Big Data use cases and solutions.
- To learn about reliable, scalable, distributed systems with Apache Hadoop.
- To explore the concepts of Hadoop Architecture.
- To apply Hadoop ecosystem components.
- To understand the concepts of Hive, HBase and HIVEQL.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe the basic concepts of Big Data. **(K2)**
CO2 - Explain the functional /operational aspects of Hadoop. **(K2)**
CO3 - Illustrate the architecture of Hadoop. **(K2)**
CO4 - Explore the various Hadoop ecosystem components. **(K2)**
CO5 - Identify the various purposes of HIVEQL and HBase **(K2)**

UNIT I INTRODUCTION TO BIG DATA **(9 Hrs)**

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, big data analytics, big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

UNIT II INTRODUCTION HADOOP **(9 Hrs)**

Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT III HADOOP ARCHITECTURE **(9 Hrs)**

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering – Monitoring & Maintenance.

UNIT IV HADOOP ECOSYSTEM AND YARN **(9 Hrs)**

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New FeaturesNameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT V HIVE AND HIVEQL, HBASE **(9 Hrs)**

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase conceptsAdvanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Text Books

1. Boris Iublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012.
3. Vignesh Prajapati,"Big Data Analytics with R and Haoop", Packet Publishing 2013.

Reference Books

1. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.
2. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
3. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.

Web References

1. http://www.bigdatauniversity.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	-	2	3
2	2	1	-	-	2	-	-	-	-	-	-	-	-	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	-	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	-	2	3
5	2	1	-	-	2	-	-	-	-	-	-	-	-	2	3

U20ITE615	BIO INSPIRED COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn bio-inspired theorem and algorithms
- To understand random walk and simulated annealing
- To learn genetic algorithm and differential evolution
- To learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

Course Outcomes

After completion of the course, the students will be able to

CO1 - Implement and apply bio-inspired algorithms. **(K2)**
CO2 - Explain random walk and simulated annealing. **(K2)**
CO3 - Use and apply genetic algorithms. **(K3)**
CO4 - Outline swarm intelligence and ant colony for feature selection. **(K2)**
CO5 - Apply bio-inspired techniques in image processing **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to algorithm - Newton' s method - optimization algorithm-Search for Optimality - No-Free-Lunch Theorems - Nature-Inspired Meta heuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

UNIT II RANDOM WALK AND ANEALING **(9 Hrs)**

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy- Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT III GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION **(9 Hrs)**

Tailing, cohesive end, use of linkers, blunt end methods; Labeling and detection techniques PCR and its application, DNA Synthesis and Sequencing, site directed Mutagenesis, protein engineering

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM **(9 Hrs)**

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation – varients-Ant colony optimization toward feature selection.

UNIT -V APPLICATION IN IMAGE PROCESSING **(9 Hrs)**

Bio-Inspired Computation and its Applications in Image Processing: An Overview - FineTuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search

Text Books

1. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition ;2014
2. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image processing",Elsevier,2016

Reference Books

1. Yang ,Cui,Xlao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition ,2013
2. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer, 2015.
3. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech, 2013

Web References

1. https://programsandcourses.anu.edu.au/course/comp8420
2. https://www.uio.no/studier/emner/matnat/ifi/INF3490/index.html
3. https://swayam.gov.in/nd1_noc20_cs17/preview
4. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs23/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
3	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

ANNEXURE-IV

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution &
Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Committee for CO- PO – PSO Mapping

S. NO	Name	Designation	Signature
1.	Dr. C. Punitha Devi	Professor, Dept. of Information Technology	
2.	Dr. S. Geetha	Associate Professor, Dept. of Information Technology	
3.	Dr. S. Balaji	Associate Professor, Dept. of Information Technology	
4.	Mrs. N. Kalaiselvi	Assistant Professor, Dept. of Information Technology	
5.	Mr. K. S. Seetharaman	Assistant Professor, Dept. of Information Technology	

Responsibilities:

- Verification of Course objective and outcome
- Verification of appropriateness of Knowledge level with the syllabus
- Mapping of CO- PO- PSO for the courses.

HoD- IT

COURSE OUTCOME AND PROGRAM OUTCOME, PROGRAM SPECIFIC OUTCOME MAPPING

SEMESTER 5

K1: Remember **K2:** Understand **K3:** Apply **K4:** Analyze **K5:** Evaluate **K6:** Create

U20BST546 PROBABILITY AND STATISTICS

CO1 - Apply the concept of probability in random variables. **(K3)**
CO2 - Apply the basic rules of continuous random variables. **(K3)**
CO3 - Illustrate the basic concepts of Statistics. **(K2)**
CO4 - Derive the inference for various problems using testing of hypothesis in large samples **(K3)**
CO5 - Solve the problems related to testing of hypothesis in small samples **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO3 (K3)
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITT510 MOBILE APPLICATION DEVELOPMENT

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO3 (K3)
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITT511 DATA WAREHOUSING AND DATA MINING

CO1 - Describe the concepts of data warehouse **(K2)**
CO2 - Apply data pre-processing techniques in large datasets **(K3)**
CO3 - Interpret correlation based frequent patterns in large data sets **(K2)**
CO4 - Compare and contrast the various classification methods **(K2)**
CO5 - Apply data mining techniques and methods to large data sets **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO3 (K3)
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITT512 NETWORK SECURITY

CO1 - Classify cryptographic techniques using a mathematical approach by examining nature of attack. **(K2)**
CO2 - Apply the different cryptographic operations using public and private key cryptography **(K3)**
CO3 - Summarize solutions for effective key management distribution and maintain message integrity **(K2)**
CO4 - Identify and use appropriate algorithms for assuring System security and authentication. **(K3)**
CO5 - Outline the security requirements and solutions for wireless networks and distributed systems. **(K2)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSC (K3
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2

U20ITP506 MOBILE APPLICATION LABORATORY

CO1 - Develop mobile applications using GUI and Layouts. **(K3)**
CO2 - Develop mobile applications using Event Listener. **(K3)**
CO3 - Develop mobile applications using Databases. **(K3)**
CO4 - Develop mobile applications using RSS Feed, SMS, Multithreading and GPS. **(K3)**
CO5 - Analyze and discover own mobile app for simple needs. **(K4)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSC (K3
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3

U20ITP507 DATA WAREHOUSING AND DATA MINING LABORATORY

CO1 - Use the various kinds of Database tools. **(K3)**
CO2 - Demonstrate the classification, clustering and etc. in large data sets. **(K3)**
CO3 - Apply mining algorithms as a component to the exiting tools. **(K3)**
CO4 - Apply mining techniques for realistic data. **(K3)**
CO5 - Explore hands-on experience working with all real data sets. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PS((K
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITP508 NETWORK SECURITY LABORATORY

CO1 - Develop code for classical Encryption Techniques to solve the information security problems. **(K3)**

CO2 - Build cryptosystems by applying symmetric and public key encryption algorithms. **(K3)**

CO3 - Construct code for key exchange and message authentication algorithms. **(K3)**

CO4 - Develop a digital signature scheme using Digital signature standard. **(K3)**

CO5 - Demonstrate the network security system using open source tools, Snort, Net Stumbler KF Sensor. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3)
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

SEMESTER 6

U20ITT613 ARTIFICIAL INTELLIGENCE

CO1 - Recognize appropriate search algorithms for any AI problem **(K2)**

CO2 - Describe a problem propositional and predicate logic **(K2)**

CO3 - Apply the APT agent strategy to solve a given problem **(K3)**

CO4 - Use various Planning and Learning strategies to solve a problem **(K3)**

CO5 - Construct applications for NLP that uses Artificial Intelligence **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3)
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITT614 IOT AND EDGE COMPUTING

CO1 - Explain the basic concepts of IOT and distinguish between IOT & M2M. **(K2)**

CO2 - Explore IoT system Management leading to platform design. **(K2)**

CO3 - Recognize IoT Devices and connect them to cloud servers. **(K2)**

CO4 - Illustrate the use of Data analytics and need for security in IoT. **(K2)**

CO5 - Identify the IoT tools and explore to create a real time example **(K2)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3)
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO5	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2

U20ITT615 DESIGN THINKING

CO1 - Explain the fundamentals of Design Thinking and innovation. **(K2)**
CO2 - Empathize and analyse model action plan. **(K2)**
CO3 - Describe the principles of innovation and idea generation for product design. **(K2)**
CO4 - Apply design thinking techniques for given tasks. **(K3)**
CO5 - Apply the design thinking techniques for solving problems in various sectors. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO3	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITT616 BLOCK CHAIN TECHNOLOGY

CO1 - Describe the basic concepts of Block Chain Technologies. **(K2)**
CO2 - Explain the functional /operational aspects of Cryptocurrency Ecosystem. **(K2)**
CO3 - Build application using Ethereum. **(K3)**
CO4 - Compute models for Block Chain Technology. **(K3)**
CO5 - Illustrate Blockchain with IoT and track the emerging trends in Blockchain. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3
CO1	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO2	2	1	-	-	2	2	3	2	2	2	2	2	2	3	2
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITP609 ARTIFICIAL INTELLIGENCE LABORATORY

CO1 - Identify appropriate idealizations for converting real world problems into AI search problems. **(K3)**
CO2 - Analyse and formalize the given search problem. **(K3)**
CO3 - Implement first order and propositional logic. **(K3)**
CO4 - Choose and implement appropriate learning algorithms for supervised learning problem. **(K3)**
CO5 - Demonstrate the basic construction of Turing machine and its recursive languages and functions. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PS (K
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	

U20ITP610 IOT AND EDGE COMPUTING LAB

CO1 - Execute basic commands of Raspberry pi in Linux terminal. **(K3)**

CO2 - Demonstrate the basics commands of Raspberry pi. **(K3)**

CO3 - Apply basic connectivity of sensors with Raspberry pi. **(K3)**

CO4 - Use basic connectivity of sensors with Arduino. **(K3)**

CO5 - Develop a mini project in IoT. **(K3)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3)
CO1	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3

U20ITP611 CREATIVE INNOVATIVE LABORATORY

CO1 - Select appropriate software engineering models and techniques with relevance to application. **(K4)**

CO2 - Apply UML diagrams to an application/ project **(K3)**

CO3 – Identify and apply project management techniques for a project **(K3)**

CO4 - Use design patterns to implementation constructs **(K3)**

CO5 - Generate and develop test cases for a project **(K4)**

CO-PO-PSO Mapping

	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K3)	PO6 (K3)	PO7 (K2)	PO8 (K3)	PO9 (K3)	PO10 (K3)	PO11 (K3)	PO12 (K3)	PSO1 (K3)	PSO2 (K2)	PSO (K3)
CO1	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3

ANNEXURE-V

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution &
Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Selection Criterion for Panel of Examiners and Question paper setters

- M.Tech/ M.E with Ph.D.
- More than 10 years of experience in academics.
- Experience as Evaluators / question paper setters in reputed institution / university.
- Adherence to time schedule prescribed by the CoE.
- Willingness to evaluate answer scripts and QP setting.

HoD- IT

ANNEXURE-VI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value- based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

To be a pioneer in the field of Information Technology by achieving academic excellence, involving in research & development and promoting technical & professional expertise

Mission

M1: Expertise: To impart quality education and create excellent engineers with strong analytical, Programming and Problem solving Skills to meet the ever changing demands of IT industry

M2: Eminence: To kindle creative thinking, innovation and foster value-based research in the field of information technology

M3: Complaisant: To enrich the employability skills, inculcate entrepreneurial ideology and promote professional expertise

M4: Exemplar: To instil moral values, ethical responsibilities and empowering graduates to be socially responsible and technically competent

PROGRAMME OUTCOMES (POs)

PO1: Exploration of Research:

An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Technical Skill:

An ability to write and present a substantial technical report/document.

PO3: Expertise in Academics:

Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Problem solving:

An ability to discriminate, analyze, evaluate and synthesize the technologies to provide solution for multidimensional engineering problems.

PO5: Usage of Modern Tools:

Create, select, learn 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.

PO6: Ethical Practices and Social Responsibility:

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-1: To provide essential background in network design, management, and networking based software and tools

PEO-2: To empower the graduates to identify, formulate and solve engineering problems in Network design and management by using communication and networking platforms and tools.

PEO-3: To explore the research gaps, and apply creativity and logical reasoning to solve innovative and complex problems in the specialized/emerging areas of networking domain.

PEO-4: To solve the techno-socio-economic problems by providing automated solution in this domain by utilizing and exhibiting social, communication and ethical values.

PEO-5: To encourage and mould the graduates to be industry ready or entrepreneurs and sustain in their professional career.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO-1: To provide engineering and technological solutions to simple and complex networking problems

PSO-2: To design and demonstrate the knowledge of evolving architectures and protocols to model and design connected and wireless networks of systems

PSO-3: To apply the knowledge of acquisition, representation and management of data /information resources with focus on security and network management.

STRUCTURE FOR POST GRADUATE ENGINEERING PROGRAM

Sl.No.	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	-
2	Basic Sciences(BS)	3
3	Engineering Sciences (ES)	-
4	Professional Core (PC)	31
5	Professional Electives (PE)	18
6	Open Electives (OE)	0
7	Project Work and Internship	20
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
Total		**72**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	Course Category	Credits per Semester				Total Credits
		I	II	III	IV	
1	Humanities and Social Sciences (HS)	-	-	-	-	-
2	Basic Sciences(BS)	3	-	-	-	3
3	Engineering Sciences (ES)	-	-	-	-	-
4	Professional Core (PC)	15	16	-	-	31
5	Professional Electives (PE)	3	6	9	-	18
6	Open Electives (OE)	-	-	-	-	0
7	Project Work and Internship	-	-	8	12	20
8	Employability Enhancement Courses (EEC)*	-	-	-	-	-
9	Mandatory Courses (MC)*	-	-	-	-	-
Total		**21**	**22**	**17**	**12**	**72**

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20BST104	Fundamental Mathematics for Networking	BS	2	2	0	3	40	60	100
2	P20NWT101	Computer Network Components & Protocol	PC	3	0	0	3	40	60	100
3	P20NWT102	Information Coding Techniques	PC	3	0	0	3	40	60	100
4	P20NWT103	Network Management	PC	3	0	0	3	40	60	100
5	P20CCT101	Research Methodology and IPR	PC	2	0	0	2	40	60	100
6	P20NWE1XX	Professional Elective I	PE	3	0	0	3	40	60	100
Practical										
7	P20NWP101	Computer Network Protocol Simulation Lab	PC	0	0	4	2	50	50	100
8	P20CCP101	Technical Report Writing and Seminar	PC	0	0	4	2	100	0	100
Audit Course										
9	P20ACT10X	Audit Course - I	AC	0	0	2	0	100	0	100
Employability Enhancement Course										
10	P20NWC1XX	Employability Enhancement course I#	EEC	0	0	4	0	100	0	100
Total							**21**	**590**	**410**	**1000**

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20NWT204	Cyber Security	PC	3	0	0	3	40	60	100
2	P20NWT205	Network Performance Tuning	PC	3	0	0	3	40	60	100
3	P20NWT206	Wireless and Ad-hoc Networking	PC	3	0	0	3	40	60	100
4	P20NWT207	Data Science for Networks	PC	3	0	0	3	40	60	100
5	P20NWE2XX	Professional Elective II	PE	3	0	0	3	40	60	100
6	P20NWE2XX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical										
7	P20NWP202	Data Science for Networks Lab	PC	0	0	4	2	50	50	100
8	P20CCP202	Seminar on ICT a hands on approach	PC	0	0	4	2	100	0	100

Audit Course										
9	P20ACT20X	Audit Course - II	AC	0	0	2	0	100	0	100
Employability Enhancement Course										
10	P20NWC2XX	Employability Enhancement Course II#	EEC	0	0	4	0	100	0	100
Total							**22**	**590**	**410**	**1000**

SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory- Elective										
1	P20NWE3XX	Professional Elective IV	PE	3	0	0	3	40	60	100
2	P20NWE3XX	Professional Elective V	PE	3	0	0	3	40	60	100
2	P20NWE3XX	Professional Elective VI	PE	3	0	0	3	40	60	100
Project Work										
3	P20NWW301	Project Phase I	PW	0	0	12	6	50	50	100
4	P20NWW302	Internship	PW	0	0	0	2	100	0	100
Employability Enhancement Course										
6	P20NWS301	NPTEL/ GIAN /MOOC	EEC	0	0	0	0	100	0	100
Total							**17**	**370**	**230**	**600**

SEMESTER – IV										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Project Work										
1	P20NWW403	Project Phase II	PC	0	0	24	12	50	50	100
Total							**12**	**50**	**50**	**100**

BS-Basic Science **PC**-Professional Core **PE**-Professional Elective **PW**-Project Work
AC- Audit Course **CC**-Common Course **EEC**- Employability Enhancement course

SEMESTER WISE CREDIT DISTRIBUTION

Sem-I	Sem-II	Sem-III	Sem-IV	Total
21	22	17	12	72

- MC and EEC course are not considered for CGPA calculation

Total number of credits required to complete M.Tech in Networking : **72 Credits**

Annexure-I
PROFESSIONAL ELECTIVE COURSES

Sl.No	Course Code	Course Title
Professional Elective -I Offered in Semester -I		
1	P20NWE101	Multimedia Communication Networks
2	P20NWE102	Next Generation Networks
3	P20NWE103	Software Defined Networks
4	P20NWE104	Network System Modelling and Simulation
5	P20NWE105	Distributed and Cloud Computing
Professional Elective -II Offered in Semester -II		
1	P20NWE206	Graph Theory
2	P20NWE207	Robotic Process Automation
3	P20NWE208	Machine Learning
4	P20NWE209	Web Analytics and Development
5	P20NWE210	Human Computer interaction
Professional Elective -III Offered in Semester -II		
1	P20NWE211	High Speed Switching Architectures
2	P20NWE212	Internet Routing Design
3	P20NWE213	Wireless Sensor Protocols and Programming
4	P20NWE214	Next Generation Internetworking Protocol
5	P20NWE215	Protocol engineering
Professional Elective -IV Offered in Semester -III		
1	P20NWE316	Social Network Analysis
2	P20NWE317	Autonomous Vehicles & UAV
3	P20NWE318	BlockChain Technology
4	P20NWE319	Smart Sensors and Internet of Things
5	P20NWE320	Multicore Architecture
Professional Elective -V Offered in Semester -III		
1	P20NWE321	Cyber Physical system
2	P20NWE322	Secure Coding
3	P20NWE323	Cloud security
4	P20NWE324	Cyber Laws and Security Policies
5	P20NWE325	Digital Forensics
Professional Elective -VI Offered in Semester -III		
1	P20NWE326	Ethical Hacking
2	P20NWE327	Intrusion Detection and Prevention
3	P20NWE328	Software Architecture and Design
4	P20NWE329	Switching and Statistical Multiplexing in Telecommunication
5	P20NWE330	Network Embedded application

Annexure-II

EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Course Title
1	P20NWCX01	Advanced Python
2	P20NWCX02	Android Programmming
3	P20NWCX03	Artificial Intelligence
4	P20NWCX04	CCNA (Routing And Switching)
5	P20NWCX05	CCNA (Wireless)
6	P20NWCX06	Azure Devops
7	P20NWCX07	Cisco-Certified Design Associate (CCDA)
8	P20NWCX08	CCNA Collaboration
9	P20NWCX09	CCNA CyberOps
10	P20NWCX10	CCNA Security
11	P20NWCX11	CCNA Service Provider
12	P20NWCX12	Google Analytics
13	P20NWCX13	Google Cloud
14	P20NWCX14	Industry Internet of Things 4.0
15	P20NWCX15	IoT using Python
16	P20NWCX16	Network Programming
17	P20NWCX17	Advanced Java Programming
18	P20NWCX18	Search Engine Optimization
19	P20NWCX19	WAN Technologies
20	P20NWCX20	Data Centre: Networking & Virtualization

Annexure-III

AUDIT COURSES

Sl. No.	Course Code	Course Title
1	P20ACTX01	English for Research Paper Writing
2	P20ACTX02	Disaster Management
3	P20ACTX03	Sanskrit for Technical Knowledge
4	P20ACTX04	Value Education
5	P20ACTX05	Constitution of India
6	P20ACTX06	Pedagogy Studies
7	P20ACTX07	Stress Management by Yoga
8	P20ACTX08	Personality Development Through Life Enlightenment Skills
9	P20ACTX09	Unnat Bharat Abhiyan

P20BST104	FUNDAMENTAL MATHEMATICS FOR NETWORKING	L	T	P	C	Hrs
		2	2	0	3	45

Course Objectives

- To develop the ability to use the concepts of Special Functions for solving problems on Networks.
- To analyse the Graph Theory algorithms and understand its applications in Networks.
- To impart knowledge on planar graphs along with edges and cycles
- To impart knowledge on probability theory that will come in handy to solve the problem that arise in engineering. This will also serve as a precursor for future research.
- To acquire skills in analysing Queuing Models.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Solve problems in graph theory. **(K4)**

CO2 - Assimilate the concepts of Matching and covers algorithm along with connectivity. **(K2)**

CO3 - Explore the idea of edges and cycles of planar graphs. **(K2)**

CO4 - Explain basic concepts in probability theory. **(K2)**

CO5 - Calculate the traffic intensity, blocked traffic and the utilization of queuing systems. **(K4)**

UNIT I GRAPH THEORY INTRODUCTION **(9 Hrs)**

Introduction to Graphs - Paths - Cycles - And Trails - Vertex Degrees and Counting - Directed Graphs - Trees and Distance: Basic Properties - Spanning Trees and Enumeration - Optimization and Trees.

UNIT II MATCHING CONNECTIVITY AND FLOW **(9 Hrs)**

Matching and Covers Algorithms and Applications - Matching in General Graphs. - Connectivity and Paths: Cuts and Connectivity - k-connected graphs – Network Flow Problems.

UNIT III PLANAR GRAPHS - EDGES AND CYCLES **(9 Hrs)**

Planar Graphs - Embedding and Euler s Formula - Characterization of Planar graphs - Parameters of Planarity - Line Graphs and Edge-Coloring - Hamiltonian Cycles - Planarity - Coloring and Cycles - Applications in Networks.

UNIT IV INTRODUCTION TO PROBABILITY THEORY **(9 Hrs)**

Probability concepts - Random variables - moments - Moment Generating function - Binomial - Poisson - Geometric - Negative binominal - Exponential - Gamma - Weibull distributions - Functions of random variable - Chebyshev inequality - Application in Networks.

UNIT V QUEUING THEORY **(9 Hrs)**

Markovian queuing models - Little's formula - Multi-server queues - M/G/1 Queues - Pollaczek - Khintchine formula - Applications in Networks.

Text Books

1. R J Wilson," Introduction to Graph Theory", Pearson Education,4th Edition, 2003.
2. Reinhard Diestel ,"Graph Theory", Springer- Verlog , 2nd Edition, 2000.
3. Gunavathi K ,"Probability and Queuing Theory", S Chand & Company, December 2010.

Reference Books

1. T Veerarajan,"Probability - Statistics and Random Processes", McGraw Hill Education ,3rd edition, July 2017
2. V Sundarapandian,"Probability - Statistics and Queuing Theory", Prentice Hall India Learning Private Limited; 1st Edition ,2009

ANNEXURE-VII

STRUCTURE FOR POST GRADUATE ENGINEERING PROGRAM

Sl.No.	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	-
2	Basic Sciences(BS)	3
3	Engineering Sciences (ES)	-
4	Professional Core (PC)	31
5	Professional Electives (PE)	18
6	Open Electives (OE)	0
7	Project Work and Internship	20
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
Total		**72**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	Course Category	Credits per Semester				Total Credits
		I	II	III	IV	
1	Humanities and Social Sciences (HS)	-	-	-	-	-
2	Basic Sciences(BS)	3	-	-	-	3
3	Engineering Sciences (ES)	-	-	-	-	-
4	Professional Core (PC)	15	16	-	-	31
5	Professional Electives (PE)	3	6	9	-	18
6	Open Electives (OE)	-	-	-	-	0
7	Project Work and Internship	-	-	8	12	20
8	Employability Enhancement Courses (EEC)*	-	-	-	-	-
9	Mandatory Courses (MC)*	-	-	-	-	-
Total		**21**	**22**	**17**	**12**	**72**

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20BST104	Mathematics for Data Science	BS	2	2	0	3	40	60	100
2	P20DAT101	Advanced Data Structures & Algorithm	PC	3	0	0	3	40	60	100
3	P20DAT102	Big Data Analytics	PC	3	0	0	3	40	60	100
4	P20DAT103	Machine Learning Techniques	PC	3	0	0	3	40	60	100
5	P20CCT101	Research Methodology and IPR	PC	2	0	0	2	40	60	100
6	P20DAE1XX	Professional Elective I	PE	3	0	0	3	40	60	100
Practical										
7	P20DAP101	Big Data Management and Data Analytics Lab	PC	0	0	4	2	50	50	100
8	P20DAP102	Advanced Data Structures & Algorithm Lab	PC	0	0	4	2	100	0	100
Audit Course										
9	P20ACT10X	Audit Course - I	AC	0	0	2	0	100	0	100
Employability Enhancement Course										
10	P20DAC1XX	Employability Enhancement course I	EEC	0	0	4	0	100	0	100
Total							**21**	**590**	**410**	**1000**

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20DAT204	Image processing	PC	3	0	0	3	40	60	100
2	P20DAT205	Advanced Databases	PC	3	0	0	3	40	60	100
3	P20DAT206	Deep Learning	PC	3	0	0	3	40	60	100
4	P20DAT207	Information Retrieval and Data Visualization	PC	3	0	0	3	40	60	100
5	P20DAE2XX	Professional Elective II	PE	3	0	0	3	40	60	100
6	P20DAE2XX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical										

7	P20DAP203	Deep Learning Lab	PC	0	0	4	2	50	50	100
8	P20DAP204	Creative and Innovative Lab	PC	0	0	4	2	100	0	100
Audit Course										
9	P20ACT20X	Audit Course - II	AC	0	0	2	0	100	0	100
Employability Enhancement Course										
10	P20DAC2XX	Employability Enhancement Course II	EEC	0	0	4	0	100	0	100
Total							**22**	**590**	**410**	**1000**

SEMESTER – III

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory- Elective										
1	P20DAE3XX	Professional Elective IV	PE	3	0	0	3	40	60	100
2	P20DAE3XX	Professional Elective V	PE	3	0	0	3	40	60	100
2	P20DAE3XX	Professional Elective VI	PE	3	0	0	3	40	60	100
Project Work										
3	P20DAW301	Project Phase I	PW	0	0	16	8	50	50	100
Employability Enhancement Course										
6	P20DAS301	NPTEL/ GIAN /MOOC	EEC	0	0	0	0	100	0	100
Total							**17**	**370**	**230**	**600**

SEMESTER – IV

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Project Work										
1	P20DAW402	Project Phase II	PC	0	0	24	12	50	50	100
Total							**12**	**50**	**50**	**100**

BS-Basic Science **PC**-Professional Core **PE**-Professional Elective **PW**-Project Work

AC- Audit Course **CC**-Common Course **EEC**- Employability Enhancement course

SEMESTER WISE CREDIT DISTRIBUTION

Sem-I	Sem-II	Sem-III	Sem-IV	Total
21	22	17	12	72

□ MC and EECcoursearenotconsidered forCGPAcalculation

Total number of credits required to complete M.Tech- Data Science : **72 Credits**

PROFESSIONAL ELECTIVE COURSES

Sl.No	Course Code	Course Title
Professional Elective -I Offered in Semester -I		
1	P20DAE101	IoT & Edge Computing
2	P20DAE102	AI and Expert system
3	P20DAE103	Block Chain Technology
4	P20DAE104	Open Stack
5	P20DAE105	Distributed and Cloud Computing
Professional Elective -II Offered in Semester -II		
1	P20DAE206	Analytics of IoT
2	P20DAE207	Natural LanguageProcessing
3	P20DAE208	ETL Methodology
4	P20DAE209	Intelligent Information Retrieval
5	P20DAE210	Predictive Analytics
Professional Elective -III Offered in Semester -II		
1	P20DAE211	Health care Data Analytics
2	P20DAE212	Linked Open Data and Semantic Web
3	P20DAE213	Analytics of Financial Vertical
4	P20DAE214	Data Acquisition and Productization
5	P20DAE215	Human Resource Analytics
Professional Elective -IV Offered in Semester -III		
1	P20DAE316	Social Network Analysis
2	P20DAE317	Statistics and Exploratory analysis
3	P20DAE318	Quantum Computing
4	P20DAE319	Text mining
5	P20DAE320	Soft computing Techniques
Professional Elective -V Offered in Semester -III		
1	P20DAE321	Image and Video Analytics
2	P20DAE322	Data Mining and Analytics
3	P20DAE323	Social Network Analysis and Mining
4	P20DAE324	Precision Marketing
5	P20DAE325	Multimedia streaming analytics
Professional Elective -VI Offered in Semester -III		
1	P20DAE326	Cognitive computing and analytics
2	P20DAE327	Web Analytics
3	P20DAE328	Information Security
4	P20DAE329	Ethics for Data Science
5	P20DAE330	Optimization Methods for Analytics

- Probabilistic Graphical Models
- Graphs-Algorithms & Mining

AUDIT COURSES

Sl. No.	Course Code	Course Title
1	P20ACTX01	English for Research Paper Writing
2	P20ACTX02	Disaster Management
3	P20ACTX03	Sanskrit for Technical Knowledge
4	P20ACTX04	Value Education
5	P20ACTX05	Constitution of India
6	P20ACTX06	Pedagogy Studies
7	P20ACTX07	Stress Management by Yoga
8	P20ACTX08	Personality Development Through Life Enlightenment Skills
9	P20ACTX09	Unnat Bharat Abhiyan

P20DAT101	ADVANCED DATA STRUCTURES & ALGORITHM	L T P C Hrs 3 0 0 3 45

Course Objectives

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

Course Outcomes

After completion of the course, the students will be able to

CO1: Design data structures and algorithms to solve computing problems **(K3)**

CO2: Design algorithms using graph structure and various string matching algorithms to solve real life problems **(K3)**

CO3: Apply suitable design strategy for problem solving **(K3)**

CO4: Come up with analysis of efficiency and proofs of correctness**(K4)**

CO5: Comprehend and select algorithm design approaches in a problem specific manner.**(K2)**

UNIT I ROLE OF ALGORITHMS IN COMPUTING **(9 Hrs)**

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES **(9 Hrs)**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS **(9 Hrs)**

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm;

UNIT IV ALGORITHM DESIGN TECHNIQUES **(9 Hrs)**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V NP COMPLETE AND NP HARD **(9 Hrs)**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

P2DAT104	Mathematics for Data Science	L T P C Hrs 2 2 0 3 45

Course Objective:

- Learn fundamental mathematical concepts required for a program in data science
- Demonstrate understanding of relating to linear algebra, probability, and calculus.
- To impart knowledge on Optimization
- To impart knowledge on probability theory that will come in handy to solve the problem that arise in engineering. This will also serve as a precursor for future research.
- To acquire skills in Linear Regression

Course Outcome:

After completion of the course, the students will be able to

CO1:Employ methods related to these concepts in a variety of data science applications. **(K3)**

CO2:Apply logical thinking to problem-solving in context.**(K3)**

CO3:Use appropriate technology to aid problem-solving and data analysis**(K3)**

CO4:Demonstrate skills in writing mathematics **(K2)**

CO5:Understand the concepts of constrained optimization**(K1)**

Unit-1 **(9 Hrs)**

Basics of Data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems.

Unit-II **(9 Hrs)**

Linear Algebra: Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes.

Unit-III **(9 Hrs)**

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Expectations and moments; Covariance and correlation; Statistics and sampling distributions; Hypothesis testing of means, proportions, variances and correlations; Confidence (statistical) intervals; Correlation functions; White-noise process.

Unit-IV **(9 Hrs)**

Optimization: Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions;

Unit-V **(9 Hrs)**

Introduction to non-gradient techniques; Introduction to least squares optimization; Optimization view of machine learning.- Introduction to Data Science Methods: Linear regression as an exemplar function approximation problem; Linear classification problems.

Text Books:

1. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
2. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA:
3. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA:
4. David G. Luenberger (1969). Optimization by Vector Space Methods, John Wiley & Sons (NY)

Reference Books:

1. Cathy O'Neil and Rachel Schutt (2013). Doing Data Science, O'Reilly Media

P20DAT102 **BIG DATA ANALYTICS** **L T P C Hrs**
3 0 0 3 45

Course Objectives

- To optimize business decisions and create competitive advantage with Big Data analytics
- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.
- To understand the applications using Map Reduce Concepts.
- To introduce programming tools PIG & HIVE in Hadoop echo system.

Course Outcomes

After completion of the course, the students will be able to

CO1: Work with big data platform and explore the big data analytics techniques business applications.**(K3)**

CO2: Design efficient algorithms for mining the data from large volumes.**(K3)**

CO3: Analyze the HADOOP and Map Reduce technologies associated with big data analytics. **(K4)**

CO4: Explore on Big Data applications Using Pig and Hive.**(K4)**

CO5: Understand the fundamentals of various big data analytics techniques.**(K1)**

CO6: Build a complete business data analytics solution**(K3)**

UNIT I INTRODUCTION TO BIG DATA **(9 Hrs)**

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

UNIT II MINING DATA STREAMS **(9 Hrs)**

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

UNIT III HADOOP **(9 Hrs)**

History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing 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- Hadoop environment.

UNIT IV FRAMEWORKS **(9 Hrs)**

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams.

UNIT V PREDICTIVE ANALYTICS **(9 Hrs)**

Simple linear regression- Multiple linear regression- Interpretation of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

Text Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, —Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, —ALGORITHMS‖, Fourth Edition, Pearson Education.

References:

1. S.Sridhar,‖Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, —Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.

P20DAT103 MACHINE LEARNING TECHNIQUES L T P C Hrs
3 0 0 3 45

Course Objectives

- To introduce the basic concepts and techniques of Machine Learning.
- To develop the skills in using recent machine learning software for solving practical problems.
- To be familiar with a set of well-known supervised, semi-supervised and unsupervised
- To learn Support Vector Machine concepts and algorithms
- Understand the concept of dimensionality reduction techniques.

Course Outcomes

After completion of the course, the students will be able to

CO1: Select real-world applications that needs machine learning based solutions.
CO2: Implement and apply machine learning algorithms.
CO3: Select appropriate algorithms for solving a particular group of real-world problems.
CO4: Recognize the characteristics of machine learning techniques that are useful to solve real-world problems.
CO5: Have an understanding of the strengths and weaknesses of many popular machine learning approaches.

UNIT I INTRODUCTION (9 Hrs)

Introduction- overview of machine learning- Different forms of learning- Generative learning- Gaussian parameter estimation- maximum likelihood estimation- MAP estimation- Bayesian estimation- bias and variance of estimators- missing and noisy features- nonparametric density estimation- applications- software tools.

UNIT II CLASSIFICATION METHODS (9 Hrs)

Nearest neighbour- Decision trees- Linear Discriminant Analysis - Logistic regression- Perceptrons- large margin classification- Kernel methods- Support Vector Machines. Classification and Regression Trees.

UNIT III GRAPHICAL AND SEQUENTIAL MODELS (9 Hrs)

Bayesian networks- conditional independence- Markov random fields- inference in graphical models- Belief propagation- Markov models- Hidden Markov models- decoding states from observations- learning HMM parameters.

UNIT IV CLUSTERING METHODS (9 Hrs)

Partitioned based Clustering - K-means- K-medoids; Hierarchical Clustering – Ag glomerative- Divisive- Distance measures; Density based Clustering - DB Scan; Spectral clustering.

UNIT V NEURAL NETWORKS (9 Hrs)

The perceptron algorithm- multilayer perceptron's- back propagation nonlinear regression- multiclass discrimination- training procedures- localized network structure- dimensionality reduction interpretation.

Text 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 DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.

Reference Books:

1. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
2. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", 2nd Edition, Elsevier, Reprinted 2008.
4. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, "Intelligent Data Mining", Springer, 2007.
5.Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles , David Corrigan, "Harness the Power of Big Data The IBM Big DataPlatform", Tata McGraw Hill Publications, 2012.
6. Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands- On Approach ",VPT, 2016
7. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons,2014

P20CCT101 RESEARCH METHODOLOGY AND IPR **L T P C Hrs**
2 0 0 2 45

Course Objectives

- To introduce the basic concepts and techniques of Research.
- To gain familiarity with a phenomenon or to achieve new insights into it
- To test a hypothesis of a causal relationship between variables
- To portray accurately the characteristics of a particular individual, situation or a group (descriptive research studies)
- To determine the frequency with which something occurs or with which it is associated with something else (diagnostic research studies)

Course Outcomes

After completion of the course, the students will be able to

CO1: Formulate a research problem for a given Engineering Domain.**(K3)**
CO2: Analyze the literature for the given problem.**(K4)**
CO3: Comprehend concepts related to patents, trademark and copyright.**(K2)**
CO4: Develop new insights for the given domain **(K4)**
CO5: Develop Technical writing and presentation skills **(K4)**

UNIT I RESEARCH PROBLEM AND SCOPE FOR SOLUTION (9 Hrs)

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II FORMAT (9 Hrs)

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III PROCESS AND DEVELOPMENT (9 Hrs)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT IV PATENT RIGHTS Patent Rights: (9 Hrs)

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V NEW DEVELOPMENTS IN IPR (9 Hrs)

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

Text Books:

1. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer, 2009. 2. E. Alpaydin, "Machine Learning", MIT Press, 2010. 3. K. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. C. Bishop, "Pattern Recognition and Machine Learning, Springer", 2006.

Refernce Books:

5. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
6. John Mueller and Luca Massaron, "Machine Learning For Dummies", John Wiley & Sons, 2016.

P20DAP101 BIG DATA MANAGEMENT AND DATA ANALYTICS LAB L T P C Hrs

0 0 4 2 45

Course Objectives

- Optimize business decisions and create competitive advantage with Big Data analytics
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Introduce programming tools PIG & HIVE in Hadoop echo system.
- Developing Big Data applications for streaming data using Apache Spark

Course Outcomes

After completion of the course, the students will be able to

CO1: Preparing for data summarization, query, and analysis.**(K2)**
CO2: Applying data modelling techniques to large data set **(K3)**
CO3: Creating applications for Big Data analytics**(K5)**
CO4: Building a complete business data analytic solution**(K5)**
CO5: Deploy and configure Apache Spark Cluster **(K4)**

LIST OF EXPERIMENTS

1. (i)Perform setting up and Installing Hadoop in its two operating modes:
   - Pseudo distributed,
   - Fully distributed.

   (ii) Use web based tools to monitor your Hadoop setup.
2. (i) Implement the following file management tasks in Hadoop:
   - Adding files and directories
   - Retrieving files
   - Deleting files

   ii) Benchmark and stress test an Apache Hadoop cluster
3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   - Find the number of occurrence of each word appearing in the input file(s)
   - Performing a MapReduce Job for word search count (look for specific keywords in a file)
4. Stop word elimination problem:

   Input:
   - A large textual file containing one sentence per line
   - A small file containing a set of stop words (One stop word per line)

   Output:
   - A textual file containing the same sentences of the large input file without the words appearing in the small file.
5. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented. Find average, max and min temperature for each year in NCDC data set?
   - Filter the readings of a set based on value of the measurement, Output the lineof input files associated with a temperature value greater than 30.0 and store itin a separate file.
6. Purchases.txt Dataset
   - Instead of breaking the sales down by store, give us a sales breakdown byproduct category across all of our stores
     - What is the value of total sales for the following categories?

Reference Books:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

P20DAP102 ADVANCED DATA STRUCTURES & ALGOTITHM LAB

LT	P	C	Hrs
0	0	4	2 45

Course Objectives:

- To understand heap and various tree structures like AVL, Red-black, B and Segment trees
- To understand the problems such as line segment intersection, convex shell and Voronoi diagram
- Enables them to gain knowledge on the applications of data structures.
- To understand importance of data structures in context of writing efficient programs
- To understand Programming of sorting and pattern matching algorithms

Course Outcomes:

Upon completion of this course, the student should be able to

CO1: Ability to assess efficiency trade-offs among different data structure implementations or combinations. **(K2)**
CO2: Identify the appropriate data structure for the given problem. **(K2)**
CO3:Be able to design and analyze the time and space efficiency of the data structure.**(K4)**
CO4:Implement heap and various tree structure like AVL, Red-black, B and Segment trees **(K4)**
CO5:Solve the problems such as line segment intersection, convex shell and Voronoi diagram **(K4)**

List of Programs to be implemented

1. Min/Max Heap
2. Leftist Heap
3. AVL Trees
4. Red-Black Trees
5. B-Trees
6. Segment Trees
7. Line segment intersection
8. Convex Hull
9. Voronoi Diagram

Text Books:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.
2. Fundamentals of Data Structures, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.

Reference Books:

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein,PHI Pvt. Ltd./ Pearson Education.
2. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
3. Data structures: A Pseudocode Approach with C, R.F.Gilberg and B.A.Forouzan, , 2nd edition, Cengage Learning.

- Toys
- Consumer Electronics

- Find the monetary value for the highest individual sale for each separate store

  - What are the values for the following stores?
    - Reno
    - Toledo
    - Chandler
- Find the total sales value across all the stores, and the total number of sales.

7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.
8. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)
9. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
10. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.
11. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.
12. Write a single Spark application that:
    - Transposes the original Amazon food dataset, obtaining a PairRDD of the type: <user_id> → <list of the product_ids reviewed by user_id>
    - Counts the frequencies of all the pairs of products reviewed together;
    - Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency

Reference Books

1.AlanGates,Programming PigDataflowScriptingwithHadoop,O'ReillyMedia,Inc,2011.
2.Jason Rutherglen, Dean Wampler, Edward Caprialo, Programming Hive, O'ReillyMedia Inc,2012 3.KathleenTing,JarekJarcecCecho,ApacheSqoopCookbook,O'ReillyMediaInc,2013.
4.Dikshant Shahi, Apache Solr: A Practical approach to enterprise search, Apress, 2015.
5.Chuck Lam, Hadoop in Action, Manning Publications,2010. 6.Andrea Gazzarini, Apache Solr Essentials, PACKT Publications, 2015.

P20NWC1XX	EMPLOYABILITY ENHANCEMENT COURSE - I	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

P20DAT204	IMAGE PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objective:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

Course Outcome

After completion of the course, the students will be able to

CO1: Discuss digital image fundamentals. **(K2)**
CO2: Apply image enhancement and restoration techniques.**(K3)**
CO3: Use image compression and segmentation Techniques. **(K3)**
CO4: Represent features of images. **(K2)**
CO5: Design and create practical solutions to a range of common image processing problems and to critically assess the results of their solutions, including shortcomings **(K4)**

UNIT I DIGITAL IMAGE FUNDAMENTALS

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models

UNIT II IMAGE ENHANCEMENT

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters

UNIT III IMAGE RESTORATION AND SEGMENTATION

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation

UNIT IV WAVELETS AND IMAGE COMPRESSION

Wavelets – Subband coding - Multiresolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards

UNIT V IMAGE REPRESENTATION AND RECOGNITION

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Text Book:

- Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.

Reference Books:

- Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
- Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
- Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
- Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

P20DAT205	NEXT GENERATION DATABASES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study issues related to the design and analysis of systems with real-time constraints.
- To explore the concepts of NoSQL Databases.
- To understand and use columnar and distributed database patterns.
- To learn to use various Data models for a variety of databases.
- Understand the architectures and common features of the main types key-value stores, document databases, column-family stores, graph databases

Course Outcomes

After completion of the course, the students will be able to

CO1: Explore the relationship between Big Data and NoSQL databases**(K1)**
CO2: Work with NoSQL databases to analyze the big data for useful business applications.**(K2)**
CO3: Work with different data models to suit various data representation and storage needs.**(K2)**
CO4: Outline Keyvalue architecture and characteristics **(K2)**
CO5: Choose and implement Advanced columnar data model functions for the real time applications **(K4)**

Unit 1 **(9 Hrs)**

INTRODUCTION TO NOSQL CONCEPTS

Data base revolutions: First generation, second generation, third generation, Managing Trans- actions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with database sharding, Brewers CAP theorem.

Unit 1I **(9 Hrs)**

NOSQL DATA ARCHITECTURE PATTERNS

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 1II **(9 Hrs)**

KEY VALUE DATA STORES

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 1V **(9 Hrs)**

DOCUMENT ORIENTED DATABASE

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.

Unit V **(9 Hrs)**

COLUMNAR DATA MODEL

Advanced techniques: Vectorized Processing, Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations, Case Studies DATA MODELING WITH GRAPH: 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

Reference Books:

1. An introduction to Information Retrieval, Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze

2. TheDesignandImplementationofModernColumn-OrientedDatabaseSystems,Daniel Abadi YaleUniversity
3. Next Generation database: NoSQL and big data by GuyHarrison

P20DAT206	DEEP LEARNING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study issues related to the design and analysis of systems with real-time constraints.
- To acquire knowledge on the basics of neural networks.
- To implement neural networks using computational tools for variety of problems.
- To explore various deep learning algorithms.
- Provide overview of machine learning and context for the sub-area of deep learning

Course Outcomes

After completion of the course, the students will be able to

CO1: Develop algorithms simulating human brain. **(K3)**
CO2: Implement Neural Networks in Tensor Flow for solving problems. **(K3)**
CO3: Explore the essentials of Deep Learning and Deep Network architectures. **(K4)**
CO4: Define, train and use a Deep Neural Network for solving real world problems that require artificial Intelligence based solutions. **(K2)**
CO5: Develop recent models from both supervised and unsupervised learning. **(K3)**

UNIT I DEEP LEARNING **(9 Hrs)**

Basics of Deep learning- Deep learning architectures: Convolutional Neural Networks : Neurons in Human Vision-The Shortcomings of Feature Selection-Vanilla Deep Neural Networks Don't Scale-Filters and Feature Maps-Full Description of the Convolutional Layer-Max Pooling-Full Architectural Description of Convolution Networks-Closing the Loop on MNIST with Convolutional Networks-Image Preprocessing Pipelines Enable
More Robust Models-Accelerating Training with Batch Normalization-Building a Convolutional Network for CIFAR-10-Visualizing Learning in Convolutional Networks- Leveraging Convolutional Filters to Replicate Artistic Styles-Learning Convolutional Filters for Other Problem Domains-Training algorithms.

UNIT II MEMORY AUGUMENTED NEURAL NETWORK **(9Hrs)**

Memory Augmented Neural Networks : Neural Turing Machines-Attention-Based Memory Access-NTM Memory Addressing Mechanisms-Differentiable Neural Computers-Interference-Free Writing in DNCs-DNC Memory Reuse-Temporal Linking of DNC Writes-Understanding the DNC Read Head-The DNC Controller Network- Visualizing the DNC in Action-Implementing the DNC in TensorFlow-Teaching a DNC to Read and Comprehend.

UNIT III DEEP REINFORCEMENT LEARNING **(9Hrs)**

Deep Reinforcement Learning: Deep Reinforcement Learning Masters Atari Games- What Is Reinforcement Learning?-Markov Decision Processes (MDP)-Explore Versus Exploit-Policy versus Value Learning-Pole-Cart with Policy Gradients-Q-Learning and Deep Q-Networks-Improving and Moving Beyond DQN.

UNIT IV IMPLEMENTING NEURAL NETWORK IN TENSORFLOW **(9Hrs)**

Implementing Neural Networks in TensorFlow : What Is TensorFlow?-How Does TensorFlow Compare to Alternatives?-Installing TensorFlow-Creating and Manipulating TensorFlow Variables-TensorFlow Operations-Placeholder Tensors-Sessions in TensorFlow-Navigating Variable Scopes and Sharing Variables-Managing Models over the CPU and GPU-Specifying the Logistic Regression Model in TensorFlow-Logging and Training the Logistic Regression Model-Leveraging TensorBoard to Visualize Computation Graphs and Learning-Building a Multilayer Model for MNIST in TensorFlow.

UNIT V APPLICATIONS **(9Hrs)**

Applications: Deep learning for computer vision, Deep Learning Applications at the Enterprise Scale, Deep Learning Models for Healthcare Applications.

Text Books:

1. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly Media, 2017.

Reference Books:

1.Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series", MIT Press, 2017.

2.Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer 2018.
3.Deep Learning with Python, Francois Chollet, Manning 2017.

P20DAT207 INFORMATION RETRIEVAL AND DATA VISUALIZATION

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study issues related to the design and analysis of systems with real-time constraints.
- To visualize the objects in different dimensions.
- To design and process the data for Virtualization.
- To visualize techniques in physical sciences, computer science, applied mathematics and medical sciences.
- To virtualize techniques for research projects

Course Outcomes

After completion of the course, the students will be able to

CO1 - visualize the objects in different dimensions. **(K1,K4)**

CO2: design and process the data for Virtualization. **(K1,K3,S5)**

CO3: apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.**(K1,K3,S5)**

CO4: apply the virtualization techniques for research projects.**(K1,K3)**

UNIT I INTRODUCTION AND DATA FOUNDATION **(9 Hrs)**

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

UNIT II FOUNDATIONS FOR VISUALIZATION **(9 Hrs)**

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables - Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson's Affordance theory – A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES **(9 Hrs)**

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data - Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks .

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES **(9 Hrs)**

Text and Document Visualization: Introduction – Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations - Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space -Data Space -Attribute Space- Data Structure Space - Visualization Structure - Animating Transformations -Interaction Control

UNIT V RESEARCH DIRECTIONS IN VIRTUALIZATIONS **(9 Hrs)**

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications .

Text books:

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Colin Ware, "Information Visualization Perception for Design", 2nd edition, Margon Kaufmann Publishers, 2004.

Reference Books:

1. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2 nd Edition, 2007. 2. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.
2. Information Storage and Retrievalby R. R. Korfhage, published by John Wiley & Sons in 1997. ISBN 0-471-14338-3.

3. Introduction to Information Retrieval by Manning, C.D., Raghavan, P.and Schütze, H., 2008, Cambridge University Press, ISBN-13: 9780521865715.
4. Information Storage and Retrieval SystemsTheory and Implementation,Second Edition.Gerald J. Kowalski,Mark T. Maybury September 2000, Kluwer Academic Publisher, ISBN 0-7923-7924-1

P20DAP203	DEEP LEARNING LAB	L	P	T	C	Hrs
		0	0	4	2	45

Course Objectives

- To study issues related to the design and analysis of systems with real-time constraints.
- To introduce basic machine learning techniques.
- To develop the skills in using recent machine learning software for solving practical problems in high-performance computing environment.
- To develop the skills in applying appropriate supervised, semi-supervised or unsupervised learning algorithms for solving practical problems.
- Helps in learning algorithms on perceptron and apply back propagation learning on Neural Network

Course Outcomes

After completion of the course, the students will be able to to

CO1: Implement and apply machine learning algorithms to solve problems. **(K3)**
CO2: Select appropriate algorithms for solving a of real-world problems. **(K2)**
CO3: Use machine learning techniques in high-performance computing environment to solve real-world problems **(K3)**
CO4: Apply different types of auto encoders with dimensionality reduction and regularization **(K3)**
CO5: Solve sequence learning problem and implement long short term memory and gated recurrent units. **(K4)**

List of Experiments

1. Introduction: Get your first taste of deep learning by applying style transfer to your own images, and gain experience using development tools such as Anaconda and Jupyter notebooks.

2. Neural Networks:

Learn neural networks basics, and build your first network with Python and NumPy. Use the modern deep learning framework PyTorch to build multi-layer neural networks, and analyze real data.

3. Convolutional Neural Networks:

Learn how to build convolutional networks and use them to classify images (faces, melanomas, etc.) based on patterns and objects that appear in them. Use these networks to learn data compression and image denoising.

4. Recurrent Neural Networks:

Build your own recurrent networks and long short-term memory networks with PyTorch; perform sentiment analysis and use recurrent networks to generate new text from TV scripts.

5. Generative Adversarial Networks:

Learn to understand and implement the DCGAN model to simulate realistic images, with Ian Goodfellow, the inventor of GANS (generative adversarial networks).

6. Deploying a Sentiment Analysis Model:

Use deep neural networks to design agents that can learn to take actions in a simulated environment. Apply reinforcement learning to complex control tasks like video games and robotics.

7. SAMPLE PROJECT 1

Predicting Bike-Sharing Patterns
Build and train neural networks from scratch to predict the number of bikeshare users on a given day.

8. SAMPLE PROJECT 2

Dog-Breed Classifier
Design and train a convolutional neural network to analyze images of dogs and correctly identify their breeds. Use transfer learning and well-known architectures to improve this model—this is excellent preparation for more advanced applications.

9. SAMPLE PROJECT 3

Generate TV scripts
Build a recurrent neural network on TensorFlow to process text. Use it to generate new episodes of your favorite TV show, based on old scripts.

Reference Books:

1. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-GenerationMachineIntelligenceAlgorithms",O'ReillyMedia,2017.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning (Adaptive ComputationandMachineLearningseries",MITPress,2017.

Professional Elective - I Offered in Semester - I		
1	P20DAE101	IoT & Edge Computing
2	P20DAE102	AI and Expert system
3	P20DAE103	Block Chain Technolgy
4	P20DAE104	Programming using MATLAB & simulink
5	P20DAE105	Distributed and Cloud Computing

		L	T	P	C	Hrs
P20DAE101	IOT & EDGE COMPUTING	3	0	0	3	45

Course Objectives

- To introduce the basic of IoT and various domains that utilize IoT
- To understand the concepts of management of IOT systems that leads to platform design
- To identify various physical devices , endpoints and servers used in IOT
- To infer the role of Data Analytics & security in IT
- To explore various tools and develop IoT design for certain Applications.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explain the basic concepts of IOT and distinguish between IOT & M2M.**(K2)**

CO2 - Explore IoT system Management leading to platform design. **(K4)**

CO3 - Work with IoT Devices and connect them to cloud servers. **(K3)**

CO4- Illustrate the use of Data analytics and need for security in IoT. **(K2)**

CO5 - Work with IoT tools and explore to create a realtime example **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction :Definition and Characteristics of IoT - Physical Design of IoT - Things in IoT - Logical Design of IoT - IoT Communication Models - IoT Communication APIs - IoT Enabling Technologies .IoT Levels and deployment template. Domain specific IoTs –Iot and M2M - Introduction to M2M - Difference between IoT and M2M - SDN and NFV for IoT - Software Defined Networking.

UNIT II SYSTEM MANAGEMENT AND PLATFORM DESIGN **(9 Hrs)**

Need for IoT Systems Management- SNMP- Network Operator Requirements NETCONF - YANG- IoT System Management with NETCONF-YANG. **IoT Platforms Design Methodology** - Case study on Weather Monitoring.

UNIT III DEVICES END POINTS AND SERVERS **(9 Hrs)**

IoT Physical Devices and Endpoints: Basic building blocks - Exemplary Device: Raspberry Pi and Arduino – interfaces - Programming with python- Python Packages for IOT- other devices: pc Duino –Beagle Bone Black –Cubie board. IoT physical servers and cloud offerings.

UNIT IV DATA ANALYTICS AND SECURITY OF IOT **(9 Hrs)**

Data and Analytics for IoT: An Introduction to Data Analytics for IoT- Big Data Analytics Tools and Technology Edge Streaming Analytics-Network Analytics

Securing IoT- A Brief History of IOT Security - Common Challenges in OT Security - Security Practices and Systems Variation-Formal Risk Analysis Structures: OCTAVE and FAIR-Phased Application of Security in an Operational Environment.

UNIT V TOOLS FOR IOT AND CASE STUDIES **(9 Hrs)**

Tools- CHEF- CHEF Case Study,PUPPET.**Casestudies Illustrating IOT design:** Home Automation Environment – Agriculture - Productivity Application IoT in Industry: Smart and Connected Cities-Transportation-Public Safety.

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 Edition, 2017,ISBN: 978-81-265-5686-1

Reference Books

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, —"Architecting the Internet of Things", Springer, 2011.

2. Donald Norris, —"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", Mc.Graw Hill, 2015.

3. CunoPfister, —"Getting Started with the Internet of Things", O'Reilly Media, Inc.,2011

4. Olivier Hersent, David Boswarthick, Omar Elloumi, —"The Internet of Things,Key applications and Protocols", Wiley, 2012

5. Dieter Uckelmann et.al, —"Architecting the Internet of Things", Springer, 2011.

P20DAE102	AI AND EXPERT SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Study the Concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of Expert Systems and machine Learning.
- To identify problems that is amenable to solve by AI methods.
- To identify appropriate AI methods to solve a given problem.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Use appropriate search algorithms for any AI Problem. **(K3)**
CO2 - Represent a problem propositional and predicate logic **(K2)**
CO3 - Provide the APT agent strategy to solve a given problem **(K3)**
CO4- Use various Planning and Learning strategies to solve a problem **(K4)**
CO5 - Design applications for NLP that uses Artificial Intelligence. **(K2)**

UNIT I INTRODUCTION **(9Hrs)**

Introduction: Introduction to Artificial Intelligence-History of AI- AI Techniques - Data Acquisition and Learning Aspects in AI - Typical Intelligent Agents - General Search algorithm – BFS- A* Search- AO* Search- Memory Bounded Heuristic Search.

UNIT II KNOWLEDGE AND REASONING – I **(9 Hrs)**

Knowledge Representation: Knowledge Representation-Knowledge based Agents - Propositional Logic- Predicate Logic-Unification and Lifting - Forward Chaining-Backward Chaining – Representing Knowledge using Rules-Semantic Networks - Frame Systems

UNIT III KNOWLEDGE AND REASONING – II **(9 Hrs)**

Reasoning Under Uncertainty:Inference - Probabilistic inference - Types of Reasoning- Expectation Maximization - Bayesian networks - Hidden Markov models - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV PLANNING **(9 Hrs)**

Planning and Learning: Planning Problem – Simple Planning agent - Planning as a State space Search - Knowledge based Planning - Blocks world - Execution Monitoring and Re-planning-Continuous Planning- Multi-agent Planning-Job shop Scheduling Problem - Overview of different forms of learning- Learning Decision Trees, Neural Networks.

UNIT V APPLICATIONS **(9 Hrs)**

Applications and Game Playing: Prolog Programming - Natural Language Processing - Speech Recognition – Robot – Hardware – Perception - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games - Case study in AI Applications

Text Books

1.S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2.Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.

Reference Books

1.Bratko, Prolog,"Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
2.David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.
3.Rajendraakerkar, "Introduction to Artificial Intelligence", prentice hall of India, 2005. mentioned in Problem 1.

		L	T	P	C	Hrs
P20DAE103	**BLOCK CHAIN TECHNOLOGY**	3	0	0	3	45

Course Objectives

- To understand the concepts of block chain.
- To learn about Bitcoin, Cryptocurrency.
- To explore the concepts of Ethereum.
- To learn about Hyperledger Fabric model and its architecture.
- To integrate ideas from block chain technology into projects.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of Block Chain Technologies. **(K1)**
CO2- Explain the functional /operational aspects of CryptocurrencyEcosystem. **(K2)**
CO3- Developing application using Ethereum.**(K2)**
CO4- Build models for Block Chain Technology. **(K3)**
CO5- Integrate Blockchain with IoT and track the emerging trends in Blockchain. **(K2)**

UNIT I INTRODUCTION TO BLOCK CHAIN **(9 Hrs)**

Block Chain - History of Block Chain – Types of Block Chain – Consensus – CAP Theorem and Block Chain – Decentralization using Block Chain – Block Chain and full ecosystem decentralization – Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY **(9 Hrs)**

Bitcoin – Digital keys and addresses – Transactions – Mining – Bitcoin Network and Payments – Wallets – Bitcoin Payments Alternative coins – Theoretical Foundations - Bitcoin limitations – Name coin – Lite coin – Prime coin – Zcash – Smart contracts – Ricardian contracts.

UNIT III ETHEREUM **(9 Hrs)**

Introduction – Ethereum network – Components of the Ethereum ecosystem – Programming Languages – Ethereum Development Environment – Development Tools and Frameworks. **Illustrative:** Setup the Ethereum development environment.

UNIT IV WEB3 AND HYPERLEDGER **(9 Hrs)**

Introduction to Web3 – Contract Deployment – Development Frameworks – Hyperledger as a protocol – Reference Architecture – Hyperledger Fabric - Sawtooth Lake – Corda. **Illustrative:** Creating and deploying a business network on Hyperledger Composer Playground, Implementation of business network in Blockchain using Hyperledger Fabric.

UNIT V BLOCK CHAIN APPLICATIONS **(9 Hrs)**

IoT with Block Chain – Block Chain based voting system - Border Control – Medical Record Management System - Alternative Blockchains – Kadena – Ripple – Rootstock – Quorum - Scalability – Privacy – Other Challenges.

Text Books

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016

Reference Books

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas M. Antonopoulos.
2. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, 1st Edition.
3. Building Blockchain Projects by Narayan Prusty, 2017.

P20DAE104	OPEN Stack	L	T	P	C	Hrs
		3	0	0	3	45

Course Objective:

- To learn ubiquitous Open Source Cloud Computing platform
- Learn how to implement, interoperable between deployments
- Learn to meet the needs of users and operators of both public and private clouds
- Understand the concepts of software designed storage.
- Identify the components of an open stack.

Couse Outcome:

CO1: Enable rapid innovation. **(K3)**
CO2: Understands the scalability and resource utilization. **(K1)**
CO3: Understanding networking as a service and software as networking. **(K1)**
CO4: Apply the cloud security in respective platforms. **(K3)**
CO5: Apply the concept of mysql and sqlite in corresponding project. **(K3)**

Unit-1

Introduction to Linux-Linux admin commands-Introduction to Cloud-Comparison with Amazon AWS and RackSpace cloud-Other Cloud frameworks-Introduction to openStack and its components-Virtualization techniques

Unit-II

Compute (Nova)-Openstack-Architecture & features-Control Flow-Building a Platform as a Service using Docker/LXC- OpenStack image service (Glance)- Architecture & features Control flow

Unit-III

Software defined storage (Cinder)-Block Storage properties-Architecture & features Control flow.Software defined storage (Swift)-Object storage properties-Object security, permissions and metadata-Architecture & components-Features Control flow-Building a Content Delivery Network

Unit-IV

Software defined networking-Architecture & features-Control flow-Creating VPN Open vSwitch. Cloud Security-Cloud security groups-Instance access (SSH Keys)-Virtual private clouds - DMZs

Unit-V

Identity & Access Management -RBAC-Users, Roles, Groups, Domains, Projects-OpenStack dashboard (Horizon)-Architecture & features-Control flow Additional components of an OpenStack system- Message serverRabbitMQ and Qpid -Databases Mysql and sqlite

Reference Book

1.OpenStack: Building a Cloud Environment 2016 Author:Alok shrivastwa,Sunil Sarat,Kevin Jackson.
2..OpenStack Operations Guide: Set Up and Manage Your OpenStack Cloud 1st Edition
by Tom Fifield , Diane Fleming , Anne Gentle , Lorin Hochstein , Jonathan Proulx , Everett Toews , Joe Topjia

P20DAE105	DISTRIBUTED AND CLOUD COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand Distributed Systems.
- To be familiar with Distributed Deadlock Detection
- To study cloud computing
- To expose with Cloud Computing Technology and applications
- To understand cloud services

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of Distributed Systems. **(K2)**
CO2 - Explain the Distributed Deadlock Detection. **(K2)**
CO3 - Understand the cloud computing. **(K2)**
CO4 - Understand the Cloud Computing Technology and applications. **(K2)**
CO5 - Analyze the various cloud services. **(K2)**

UNIT I DISTRIBUTED SYSTEMS **(9 Hrs)**

Characterization of Distributed Systems: Introduction - Examples - Issues - System Models: Architectural models - fundamental Models -Limitation of Distributed system - Global clock - Shared memory - Logical clocks - Lampors & vectors logical clocks - global state - Termination detection - Distributed Mutual Exclusion: Classification of distributed mutual exclusion - Requirement of mutual exclusion theorem - Token based and non token based algorithms - Performance metric for distributed mutual exclusion algorithms.

UNIT II DISTRIBUTED DEADLOCK DETECTION **(9 Hrs)**

Distributed Deadlock Detection : Resource Vs communication deadlocks - deadlock prevention - avoidance - detection & resolution - centralized dead lock detection - distributed dead lock detection - path pushing algorithms - edge chasing algorithms - Agreement Protocols: Introduction - System models, classification of Agreement Problem - Interactive consistency Problem - Applications of Agreement algorithms.

UNIT III CLOUD COMPUTING **(9 Hrs)**

Introduction - Shift from distributed computing to cloud computing - principles and characteristics of cloud computing - IaaS, PaaS, SaaS - service oriented computing and cloud environment

UNIT IV CLOUD COMPUTING TECHNOLOGY AND APPLICATIONS **(9 Hrs)**

Cloud Computing Technology - Client systems, Networks, server systems and security from services perspectives; Accessing the cloud with platforms and applications - cloud storage

UNIT V CLOUD SERVICES **(9 Hrs)**

Working with Cloud- Infrastructure as a Service – conceptual model and working- Platform as a Service – conceptual model and functionalities Software as a Service – conceptual model and working Technologies and Trends in Service provisioning with clouds

Text books

1. Mukesh Singhal & Niranjan G Shivaratri ,"Advanced Concepts in Operating Systems",,Tata McGraw Hill,2001.
2. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education ,2006
3. Kai Hwang, Geoffery C.Fox, Jack J.Dongarra ,"Distributed and Cloud Computing" , Elsevier, 2012

Reference Books

1. Anthony T.Velte, Toby J.Velte and Robert E, "Cloud Computing – A Practical Approach", TMH , 2010
2. Michael Miller, "Cloud Computing – Web based Applications", Pearson Publishing, 2011
3. John W. Rittinghouse, James F.Ransome ,"Cloud Computing: Implementation, Management and Security" , CRC Press, ,2012.

P20DAE206	ANALYTICS OF IoT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

1. To study the concept of IOT and M2M.
2. To exposure of IOT architecture and applications in various fields
3. To study the security and privacy issues in IOT
4. To introduce the technology that enables IoT and access data using mobile computing devices.
5. This will serve as foundation for the cyber physical systems, Internet of services leading to Industry changes.

Course Outcomes

After completion of the course, the students will be able to

CO1: Identify the technologies that enables IoT. **(K2)**
CO2: Able to use Hardware and software required to design and build IoT. **(K3)**
CO3: Develop programs for interfacing with sensors and actuators and other IoT devices. **(K3)**
CO4: Set up the servers to upload IoT data to cloud for further analysis. **(K3)**
CO5: Select IoT protocols and software and evaluate the wireless technologies for IoT.**(K4)**

UNIT I Introduction to IoT **(9Hrs)**

IOT Hardware platforms-Overview of IoT supported Hardware Platforms: Raspberry pi, Arduino, Intel Galileo

UNIT II Communication in IOT **(9Hrs)**

Interface protocol, Serial, SPI, I2C, 6LoWPAN, 802.11wifi, 802.15 Bluetooth, 802.15.4 Zigbee, RTLS, GPS, CoAp – Constrained application protocol, RPL – routing protocol for lossy networks.

UNIT III IOT Software development **(9Hrs)**

Linux, Networking configurations in Linux, Accessing Hardware & Device Files interactions, Python packages: JSON, XML, HTTPLib, URLLib, SMTPLib, XMPP, Contiki OS

UNIT IV IOT Physical Servers & Cloud Offerings **(9Hrs)**

Introduction to Cloud Storage Models & Communication APIs, Cloud of things, Xively Cloud for IOT, PHP & MySQL for data processing, WAMP, Designing a RESTful Web API, MQTT,Amazon Web Services for IoT

UNIT V Data Analytics for IoT **(9Hrs)**

Configuring and using Apache Storm for Real-time Data Analysis, casestudy: Smart Home, Smart Parking, weather reporting and monitoring- **Contemporary issues**

Reference books:

1.Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on Approach", University Press, 2015.
2. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things" Wiley, 2014.
3. Nik Bessis, Ciprian Dobre "Big Data and Internet of Things: A Roadmap for Smart Environments", Springer, 2014.
4. Maik Schmidt "Arduino: A Quick-Start Guide", The Pragmatic Bookshelf, 2011.
5. Dirk Slama, Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar "Enterprise IoT: Strategies and Best Practices for Connected Products and Services", O'Reilly Media, 2015.
6. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
7. Quinton Anderson "Storm Real-time Processing Cookbook", PACKT Publishers, 2013.
Onur Dundar,"Home Automation with Intel Galileo", Packt Publishing, 2015

P20DAE207

NATURAL LANGUAGE COMPUTING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To get introduced to language processing technologies for processing the text data.
- To understand the role of Information Retrieval and Information Extraction in Text Analytics.
- To acquire knowledge on text data analytics using language models.
- How key concepts from NLP are used to describe POS tagging and context free grammar for English language ·
- Understanding semantics and pragmatics of English language for processing

Course Outcomes

After completion of the course, the students will be able to

CO1: Process the text data at syntactic and semantic level. **(K4)**
CO2: Extract the key information from Text data. **(K3)**
CO3: Analyze the text content to provide predictions related to a specific domain using language models. **(K4)**
CO4: Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each. **(K2)**
CO5: Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions. **(K3)**

UNIT I Natural Language Processing **(9 hrs)**

Linguistic Background — Mathematical Foundations - Morphological Analysis-Tokenization- Stemming-Lemmatization – Boundary Determination.

UNIT II Reading unstructured data **(9 hrs)**

Representing text data - Part of speech tagging – Syntactic representation - Text similarity - WordNet based similarity- Shallow parsing –Semantic representation.

UNIT III Information retrieval and Information extraction **(9 hrs)**

Information retrieval and Information extraction - Named Entity Recognition – Relation Identification-Template filling.

UNIT IV Language model **(9 hrs)**

Language model - Probabilistic Models - n-gram language models- Hidden Markov Model- Topic Modelling - Graph Models -Feature Selection and classifiers -Rule-based Classifiers - Maximum entropy classifier - Clustering-Word and Phrase-based Clustering.

UNIT V Tools **(9 hrs)**

Natural Language Tool kit, Apache OpenNLP. Applications of Text Analytics - Applications in Social media - Life science - Legal Text-Visualization -Case studies.

Reference books:

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2. Steven Struhl, "Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence", Kogan Page, 2015.
3. Matthew A. Russell, "Mining the Social Web", O'Reilly Media, 2013.
4. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", 1st Edition, O'Reilly Media, 2009.
5. Jurafsky, D., Martin, J. Speech and language processing: An introduction to speech recognition, computational linguistics and natural language processing. – Prentice Hall, 2008.

6. Sarkar, D. Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data. – Apress, 2016.

P20DAE208	ETL METHODOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objective:

- To introduce a wide range of clustering, estimation, prediction, and classification algorithms.
- To introduce mathematical statistics foundations of the Data Mining Algorithms.
- To introduce basic principles, concepts and applications of data warehousing
- Able to describe architecture and methods for storage and provision of enterprise data.
- Develop competency in query development and essential business intelligence reporting.

Course Outcome:

After completion of the course, the students will be able to

CO1: Have a deeper understanding of database systems and their underlying theory **(K1)**
CO2: To be able to improve the decision-making process. **(K2)**
CO3: Understand the technology of data warehousing. **(K2)**
CO4: Understand data mining concepts and techniques. **(K2)**
CO5: Be able to develop applications of higher order database systems. **(K4)**

Unit 1: Requirements, Realities, and Architecture , Data Flow: **(9 hrs)**

Surrounding the Requirements: Requirements- Architecture- The Mission of the Data Warehouse ETL Data Structures. Data Structures in the ETL System- Planning and Design Standards- Extracting Changed Data . Extracting: The Logical Data Map- The Challenge of Extracting from Disparate Platforms

Unit II: Cleaning and Conforming **(9 hrs)**

Design Objectives- Cleaning Deliverables- Screens and Their Measurements- Conforming Deliverables Delivering Dimension Tables: The Basic Structure of a Dimension-- The Grain of a Dimension- Big Dimensions- Dimensions as Sub dimensions of Another Dimension- Degenerate Dimensions- Slowly Changing Dimensions- Late-Arriving Dimension Records and Correcting Bad Data- Bridge Tables.

Unit III: Delivering Fact Tables and Implementation and operations. **(9 hrs)**

The Basic Structure of a Fact Table- Fundamental Grains- Factless Fact Tables- Graceful Modifications- Late Arriving Facts- Aggregations- Delivering Dimensional Data to OLAP Cubes.Development: Current Marketplace ETL Tool Suite Offerings- Time Is of the Essence- Using Database Bulk Loader Utilities to Speed Inserts- Managing Database Features to Improve Performance- Increasing ETL Throughput

Unit IV: Operationsp, Metadata **(9 hrs)**

Scheduling and Support- Migrating to Production- Achieving Optimal ETL Performance- Monitoring the ETL System- ETL System Security. Defining Metadata- Business Metadata- Technical Metadata- ETL-Generated Metadata

Unit V: Responsibilities **(9 hrs)**

Planning and Leadership- Managing the Project, Real Time Streaming ETL Systems: Why Real-Time ETL- Defining Real-Time ETL- Real-Time Data Warehousing Review- Categorizing the Requirement- Real-Time ETL Approaches

Text Books

1. The Data warehouse ETL Tool Kit by Ralph Kimball, Joe Caserta .Published by Wiley Publishing, Inc.
2. Decision Support in the Data Warehouse *by* Paul Gray, Hugh J. Watson - Prentice Hall

Reference

1. Oliveira, Bruno, and Orlando Belo. "ETL standard processes modelling-a novel BPMN approach." *International Conference on Enterprise Information Systems*. Vol. 2. SCITEPRESS, 2013.

2. Golfarelli, M., & Rizzi, S. (2011). Data warehouse testing: A prototype-based methodology. *Information and Software Technology*, *53*(11), 1183-1198.

3. Rainardi, Vincent. *Building a data warehouse: with examples in SQL Server*. John Wiley & Sons, 2008.

		L	T	P	C	Hrs
P20DAE209	**INTELLIGENT INFORMATION RETRIEVAL**	3	0	0	3	45

Course Objective:

To understand the basics of Information Retrieval.

- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.
- To Learn the indexing techniques and models.
- Identify the Intelligent web agents

Course Outcome:

Upon completion of the course, the students will be able to:

- Use an open source search engine framework and explore its capabilities.**(K2)**
- Apply appropriate method of classification or clustering. **(K3)**
- Design and implement innovative features in a search engine. **(K3)**
- Design and implement a recommender system. **(K3)**
- Analyse the text representation and interpret them. **(K4)**

Unit-I **(9 Hrs)**

Overview of IR Systems, Historical Perspectives, Basic Evaluation, Acquiring data, processing text

Unit-II **(9 Hrs)**

Document Representation: Statistical Characteristics of Text, Basic Query Processing, Data Structure and File Organization for IR,

Unit-III **(9 Hrs)**

Automatic Indexing and Indexing Models, Retrieval Models: Similarity Measures and Ranking, Boolean Matching, Vector Space Models, Probabilistic Models,

Unit-IV **(9 Hrs)**

Search and Filtering Techniques: Relevance Feedback, User Profiles, Collaborative Filtering, Document and Term Clustering, Document Categorization,

Unit-V **(9 Hrs)**

IR Systems and the WWW, Heterogeneous Information Sources, Intelligent Web Agents, Web Mining and Its Applications.

References:

1. D. Grossman and O. Frieder,"Information Retrieval: Algorithms and Heuristics", Kluwer Academic Press.
2. Richard K. Belew, "Finding Out About: A Cognitive Perspective on Search Engine Technology and the WWW", Cambridge University Press, 2001.
3. C. J. van Rijsbergen , "Information Retrieval".
4. C. Manning, P. Raghavan, and H. Schutze, Introduction to Information Retrieval, Cambridge University Press, 2008.
5. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
6. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
7. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook, First Edition, 2011.

3. Tanja Falkowski, "Community Analysis in Dynamic Social Networks", (Dissertation),University Magdeburg, 2009.
4. Ladislav Novak, Alan Gibbons, "Hybrid Graph Theory and Network Analysis",Cambridge Tracts in Theoretical Computer Science, 2009.
5. Eric D. Kolaczyk, "Statistical Analysis of Network Data Methods and Models",Springer Series in Statistics, 2009.
6. Akihito Hora, Nobuaki Obata, "Quantum Probability and Spectral Analysis ofGraphs", Springer, 2007.
7. Richard Brath, David Jonker, "Graph Analysis and Visualization: DiscoveringBusiness Opportunity in Linked Data", John Wiley & Sons, 2015.

		L	T	P	C	Hrs
P20DAE210	**Predictive Analytics**	3	0	0	3	45

Course Objectives:

- Learn to identify new product/service opportunities.
- Understand how to Optimize product and improve performance.
- Gain a deeper understanding of customers, reduce cost and risk.
- Learn to address problems before they occur.
- Identify the types of variables and terminology used in predictive modeling.

Course Outcomes :

CO1: Having a clear understanding of the subject related concepts and of contemporary issues **(K1)**

CO2: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified **(K1)**

CO3: Having problem solving ability- solving social issues and engineering problems **(K2)**

CO4: Having an ability to design and conduct experiments, as well as to analyze and interpret data.**(K3)**

CO5: Understand the key principles of constructing graphs **(K1)**

Unit-1 **(9 Hrs)**

Introduction - The Analytics Life Cycle - Introduction to Predictive Analytics - Matrix Notation -Basic Foundations - (B) Model, Method and Feature Selection- R Refresher - Regression Refresher - Covariance, Correlation and ANOVA review-Simple Linear Regression -OLS Model Diagnostics- Multivariate Regression - OLS Assumptions - Weighted Least Squares (WLS) -Generalized Linear Models (GLM)

Unit-II **(9 Hrs)**

Data Pre-Processing - Overview - Variable Types -Introduction to Data Transformations - Data Transformations: Categorical to Dummy Variables -Polynomials -Box-Cox Transformation-Log & Elasticity Models - Logit Transformation-Count Data Models – Centering- Standardization- Rank Transformations - Lagging Data (Causal Models) -Data Reduction

Unit-III **(9 Hrs)**

Machine Learning :Overview -Bias vs. Variance Tradeoff -Error Measures - Cross-Validation-Variable Selection - Dimensionality Issues - Multi-Collinearity - Variable Selection Methods - Step Methods

Unit-IV **(9 Hrs)**

Non-Linear Models - Non-Linearity Overview - Interaction Models - Polynomial Models - Step Models - Piecewise Models - Piecewise Linear Models - Piecewise Polynomial Models - Spline (MARS) Models

Unit-V **(9 Hrs)**

Classification Models -Introduction - Binomial Logistic Regression - Multinomial Logistic Regression - Linear Discriminant Analysis - Quadratic Discriminant Analysis-Decision Trees -Decision Trees -Regression Trees - Growing Trees - Regression Tree Issues -Classification Trees -Pruning Trees -Bootstrap Aggregation (Bagging) - Random Forest Models

Reference Book

1."An Introduction to Statistical Learning: with Applications in R" by James, Witten, Hastie and
2.Tibshirani, Springer, 1st. Edition, 2013.
"R for Everyone: Advanced Analytics and Graphics" by Lander, J., Addison-Wesley Data & Analytics Series, 1 edition, 2013

P20DAE211

HEALTH CARE DATA ANALYTICS

L	T	P	C	Hrs
3	0	0	3	45

Course objectives

- To explore the various forms of electronic health care information.
- To learn the techniques adopted to analyse health care data.
- To understand the predictive models for clinical data
- Describe the process of health care data analytics and the tools used in each step
- Explain how to use health data to improve quality and safety of patient care outcomes

Course Outcomes

After completion of the course, the students will be able to

CO1: Analyze health care data using appropriate analytical techniques. **(K3)**
CO2: Apply analytics for decision making in healthcare services. **(K3)**
CO3: Apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems. **(K3)**
CO4: Evaluate the role of usability in the adoption of electronic health records (EHR). **(K4)**
CO5: Define the core competencies for health informatics and analytics professionals. **(K2)**

UNIT I INTRODUCTION **(9Hrs)**

Introduction to Healthcare Data Analytics- Electronic Health Records–Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting EHRChallenges-Phenotyping Algorithms.

Unit II ANALYSIS **(9Hrs)**

Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.

Unit III ANALYTICS **(9Hrs)**

Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical- Social Media Analytics for Healthcare.

Unit IV ADVANCED DATA ANALYTICS **(9Hrs)**

: Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.

UNIT V APPLICATIONS **(9Hrs)**

Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical ImageAnalysis Systems- Mobile Imaging and Analytics for Biomedical Data.

TextBook:

1. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics" , Taylor & Francis, 2015

References:

1. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016

		L	T	P	C	Hrs
P20DAE212	**LINKED OPEN DATA AND SEMANTIC WEB**	3	0	0	3	45

Objectives:

- To understand the fundamentals of linked open data, its representation and applications.
- To learn the design considerations for linked data and technologies behind in publishing and consuming linked data on applications
- To understand the fundamental concepts, advantages and limitations of the Semantic Web and its related techniques and tools.
- To learn the basics of ontology and use ontology engineering approaches in semantic applications.
- Critically review the potential and challenges of linked open data and related Semantic Web tec hnologies.

Outcomes:

After completion of the course, the students will be able to

CO1: Describe the fundamentals of linked open data, its representation and advantages **(K1)**

CO2: Explain the design considerations for linked data and technologies behind in publishing and consuming linked data on applications. **(K2)**

CO3: Explore fundamental concepts, advantages and limitations of the Semantic Web and its related techniques and use various tools for constricting applications. **(K3)**

CO4: Use ontology engineering approaches in developing semantic applications **(K3)**

CO5: Understanding about Data Web(Linked open data Cloud) **(K1)**

UNIT I Introduction **(9 Hrs)**

Introduction to Linked Data (LD) and the Semantic Web- visions and basic concepts- focusing on linked "entities" on the Web - The Rationale for Linked Data Structure Enables Sophisticated Processing - Hyperlinks Connect Distributed Data -From Data Islands to a Global Data Space - Introducing Big Lynx Productions -Principles of Linked Data - The Principles in a Nutshell - Naming Things with URIs - URIs dereferencable - Providing Useful RDF Information - The RDF Data Model – RDF Serialization Formats - Including Links to other Things - Relationship Links – Identity Links - Vocabulary Links.

UNIT II The Web of Data **(9 Hrs)**

Bootstrapping the Web of Data - Topology of the Web of Data – Cross-Domain Data - Geographic Data - Media Data - Government Data - Libraries andEducation - Life Sciences Data - Retail and Commerce - User Generated Content and Social Media- Linked Data Design Considerations- Using URIs as Names for Things -Describing Things with RDF - Literal Triples and Outgoing Links - Publishing Data about Data - Choosing and Using Vocabularies - Making Links with RDF - Making Links within a Data Set - Making Links with External Data Sources - Setting RDF Links Manually -Auto-generating RDF Links.

UNIT III Publishing Linked Data **(9 Hrs)**

Linked Data Publishing Patterns - The Recipes - Serving Linked Data as Static RDF/XML Files - Serving Linked Data as RDF Embedded in HTML Files -Serving RDF and HTML with Custom Server-Side Scripts - Serving Linked Data from Relational Databases - Serving Linked Data from RDF Triple Stores - Serving Linked Data by Wrapping Existing Application or Web APIs - Linked Data Publishing Checklist- Consuming Linked Data- Deployed Linked Data Applications - Generic Applications - Domain-specific Applications - Developing a Linked Data Mashup - Architecture of Linked Data Applications - Effort Distribution between Publishers- Consumers and Third Parties.

UNIT IV Semantic Web **(9 Hrs)**

Introduction to Semantic Data - Semantic modeling- Modeling for Human Communication- Explanation and Prediction- Mediating Variability- Expressivity in Modeling -RDF The basis of the Semantic Web -

Semantic Web application architecture- RDF Parser/Serializer- RDF Store - Querying the Semantic Web- SPARQLSPARQL-Query Language for RDF- Advanced Features of SPARQL - RDF and inferencing.

UNIT IV RDFS and Ontology **(9 Hrs)**

RDF schema- The RDF Schema Language - RDFS-Plus – Using RDFS-Plus in the wild - SKOS—managing vocabularies with RDFS-Plus - Introduction to Ontology- OWL-Web Ontology Language- Basic OWL- Examples include BIBO- FOAFGood Relations- CIDOC-CRM- DPLA - Counting and sets in OWL - Ontologies on the Web—putting it all together - Ontology Mapping - Good and bad modeling practices - Expert modeling in OWL The future of the Semantic Web.

TextBooks:

1. Tom Heath and Christian Bizer, "Linked Data: Evolving the Web into a Global Data Space - Synthesis Lectures on the Semantic Web: Theory and Technology", 1st Edition, Morgan & Claypool, 2011.
2. Dean Allemang and James Hendle, "Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL", Second Edition, Elsevier, 2011.
3. Bob DuCharme, "Learning SPARQL: Querying and Updating SPARQL 1.1", Second Edition, O'Reilly Media, 2013.
4. Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra, "Semantic Web Primer, Third Edition, MIT Press, 2012.

References:

1. Rajendra Akerkar, "Foundations of the Semantic Web", Narosa Publishing House,New Delhi and Alpha Science Intern, 2009.
2. Leslie Sikos, "Mastering Structured Data on the Semantic Web: From HTML5 Microdata to Linked Open Data ", Apress, 2015

		L	T	P	C	Hrs
P20DAE213	**FINANCIAL RISK ANALYTICS AND MANAGEMENT**	3	0	0	3	45

Objectives:

- To identify the different risks involved in Finance arena.
- To understand and solve the different risks pertaining to stock market and its instruments.
- To analyze the legal issues affecting the business.
- Evaluate and discuss the challenges of issues relating to social responsibility, corporate governance
- Provide a comprehensive understanding of the principles and techniques of financial decision making

Outcomes:

After completion of the course, the students will be able to

CO1: Identify and categorize the various risks faced by an organization.**(K1)**
CO2: Explore the tools and practices needed to assess and evaluate financial risks. **(K3)**
CO3: Explore risk management practices in an industry.**(K3)**
CO4: Identify and solve legal issues that impact financial and other risk affecting business. **(K1)**
CO5: Apply the knowledge and understanding of risk management practices for participants **(K3)**

UNIT I Introduction to Risk **(9 Hrs)**

Understanding Risk- Nature of Risk, Source of Risk, Need for risk management, Benefits of Risk Management, Risk Management approaches. RiskClassification- credit risk, market risk, operational risk and other risk

UNIT II Risk Measurements **(9 Hrs)**

-Measurement of Risk – credit risk measurement, market risk measurement, interest rate risk measurement, Asset liability management, measurement of operational risk

UNIT III Risk Management **(9 Hrs)**

Risk Management- Risk management- Managing credit risk, managing operational risk, managing market risk, insurance

UNIT IV Risk in Instruments **(9 Hrs)**

Tools for risk management – Derivatives, combinations of derivative instruments, Neutral and volatile strategies, credit derivatives, credit ratings, swaps

UNITV Risk Management **(9 Hrs)**

Regulation and Other Issues: Other issues in risk management – Regulatory framework,Basel committee, legal issues, accounting issues, tax issues, MIS and reporting, integrated risk management

Textbooks

1. Dun, Bradstreet, "Financial Risk Management", TMH, 2006.

References

2. John C Hull, "Risk management and Financial Institutions", Pearson, 2015.
3. Aswath Damodharan, "Strategic Risk Taking", Pearson, 2008.

P20DAE214	DATA ACQUISITION AND PRODUCTIZATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To explore the fundamental concepts of data pre-processing, extraction,cleaning, annotation, integration.
- To understand the various information visualization techniques.
- To understand data productization using Internet of things
- Delineate catchments and streams from digital elevation models
- Apply map algebra for spatial planning

Course Outcomes:

After completion of the course, the students will be able to

CO1: Apply of data pre-processing, extraction, cleaning, annotation, integration on data. **(K3)**
CO2: Apply the suitable visualization techniques to output analytical results. **(K3)**
CO3: Explore on applications using Internet of things. **(K3)**
CO4: Analytical and creative thinking, critical questioning, and examination of evidence **(K4)**
CO5: Explain various data transfer techniques and the components of data acquisition system **(K2)**

UNIT I Data Acquisition Introduction to Data Warehouse **(9 Hrs)**

OLTP and OLAP concepts- Introduction to Data Mining- Data Objects and Attribute Types-Basic Statistical Descriptions of Data- Exploratory Data analysis- Measuring Data Similarity and Dissimilarity-Graphical representation of data.

UNIT II Introduction to Data Acquisition **(9 Hrs)**

Applications –Process- Data Extraction- Data Cleaning and Annotation- Data Integration -Data Reduction- Data Transformation –DataDiscretization and Concept Hierarchy Generation.
Visualization-Introduction -Terminology- Basic Charts and Plots- Multivariate

UNIT III Data Visualization **(9 Hrs)**

Data Visualization Techniques– Pixel-Oriented Visualization Techniques- Geometric Projection Visualization Techniques- Icon-Based Visualization Techniques- Hierarchical Visualization Techniques-Visualizing Complex Data and Relations- Data Visualization Tools– Rank Analysis Tools- Trend Analysis Tools- Multivariate Analysis Tools- Distribution Analysis Tools- Correlation Analysis Tools-Geographical Analysis Tool

UNIT IV Data Productization **(9 Hrs)**

IoT Overview- IoT Design methodology- Semantic Web Infrastructure-Intelligence Applications-Programming Framework for IoT- Distributed Data Analysis for IoT- Security and Privacy in IoT- Applied IoT- Cloud Based Smart Facilities Management.

UNIT V Virtualization on Embedded Boards IoT **(9 Hrs)**

Stream Processing in IoT-Internet of Vehicles and Applications - Case study on Data Acquisition using Dashboards, Android and iOS apps.

Text Books:

1. Han, Jiawei, Jian Pei, and Micheline Kamber, "Data mining: concepts and techniques", 3rd Edition, Elsevier, 2011.
2. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2012.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things -A hands-on approach",Universities Press, 2015.
4. Manoel Carlos Ramon, "Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.

References:

1. Karl Pover, "Learning Qlikview Data Visualization", Packt, 2013.
2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2016.

		L	T	P	C	Hrs
P20DAE214	**ESSENTIALS OF HUMAN RESOURCE ANALYTICS**	3	0	0	3	45

Course Objective:

- To provide the knowledge and necessary skills to accomplish personnel roles in the domain of HR.
- To provide knowledge to carry out analytics within the context of business objectives and outcomes.
- Learn to Interpret statistical output involving HR data.
- Understanding the concept of developing effective surveys for use in an organizational setting.
- Develop recommendations for workforce planning (e.g., staffing needs) based on the results of a Markov Analysis.

Course Outcomes:

After completion of the course, the students will be able to

CO1: Identify necessary skills to carry out the personnel roles in the domain of HR. **(K2)**

CO2: Identify and develop metrics to improve employer-employee relationship and improve employee retention. **(K3)**

CO3: Identify skilled personnel and job tasks to achieve mission-critical goals.**(K2)**

CO4: Align organization's mission and goals with key metrics and benchmarks. **(K4)**

CO5: Apply HR analytics to improve organizational performance by providing better insights on human resources data. **(K3)**

UNIT I Introduction to HR Analytics **(9 Hrs)**

Overview of HR Process, HR as an expense, the analytics and prediction Strategic Human capital measures, business analysis and rational action. Benefits of Analytics in Improving HR Process, Intersection of people and profits.Technology Used, SWOT Analysis of HR analytics.

UNIT II Employee Engagement Measurement Process **(9 Hrs)**

Attracting, motivating and retaining people Organization Gap and Alignment Analytics. Process to assess and prioritize organization gaps and identify alignment opportunities. HR Alignment Inventory.Developing performance metrics/Predicting future 'performance' Developing metrics to capture the fallouts of HR Policies.

UNIT III Organization-Wide Alignment Audits **(9 Hrs)**

Assessing the individual components and the holistic system and the best practices, clarifying organizational practices and gaps,Recruitment Analytics and On Boarding Analytics Staffing Analytics Performance & Skill Gap Analytics Compensation & Benefit Analytics Training &Learning Analytics Promotion and Succession Planning Analytics Compliance Analytics Attrition& Retention Analytics, Identification of Key Business Objectives Conducting HR Practice Audits Conducting On-Site Visits Performing Data Triangulation.

UNIT IV Approach to HR Solutions **(9 Hrs)**

Identifying job responsibilities, tasks, and employee attributes needed on different jobs to assure mission-critical goals. Assessing competencies as a consistent foundation for organization/job design, succession and compensation. HR Dashboards Advanced Data Analytics (Forecasting, Predicting and Segmentation etc.) & Business Insights High End Consulting, KPI Catalogue Creation

UNIT V Program Evaluation and Return-On-Investment Analysis **(9 Hrs)**

Applied research for datadriven organization change and improvement using sophisticated HR analysis and metrics. Clarifying HR issues and drive focused, systematic organization change.Evaluating critical HR initiatives and/or business objectives. Make program improvements and shifts.

Textbooks:

1. Jac Fitz-enz, "The New HR Analytics: Predicting the Economic Value of Your Company's Human Capital Investments", American Management Association,2010.

References:

1.. John W. Boudreau," Beyond HR: The New Science of Human Capital", Harvard Business School Press, 2007

P20DAP204	CREATIVE AND INNOVATIVE LAB	L	T	P	C	Hrs
		0	0	4	2	45

This lab intend to develop creative thinking among the students which leads to innovation in the field of their study. The following Components may be included

- Technical seminar in a particular field of interest.
- Participating in workshops / technical seminars leading to acquisition of new knowledge.
- Develop their scientific and technical reading and writing skills that they need to understand and construct research articles.
- To obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas
- Developing innovative applications.

The end semester evaluation of this course is based on the student presentation about the various components they have explored and approached throughout the semester regarding this course