SEMESTER VII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	HS	BA20151	Entrepreneurship Development	3	0	0	3
2.	PC	CI20701	IOT Security	3	0	0	3
3.	PE	CI2035*	Professional Elective Course III	3	0	0	3
4.	PE	CI2045*	Professional Elective Course IV	3	0	0	3
5.	OE	CI2090*	Open Elective II	3	0	0	3
Practical							
6.	PC	CI20702	IOT Security Laboratory	0	0	4	2
7.	EE	CI20703	Mini Project	0	0	6	3
			TOTAL	15	0	8	20

SEMESTER VIII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	PC	CI20801	Industrial IOT	3	0	0	3
2.	PE	CI2055*	Professional Elective Course V	3	0	0	3
3.	PE	CI2065*	Professional Elective Course VI	3	0	0	3
Practical							
4.	EE	CI20802	Project Work	0	0	12	6
			TOTAL	9	0	12	15

PROFESSIONAL ELECTIVE COURSES
(PE-III)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	PE	CI20351	Smart Sensor Technologies	3	0	0	3
2.	PE	CI20352	Web and Internet Technologies	3	0	0	3
3.	PE	CI20353	Cyber Security Essentials	3	0	0	3
4.	PE	CI20354	Augmented Reality and Virtual Reality	3	0	0	3
			TOTAL	12	0	0	12

PROFESSIONAL ELECTIVE COURSES
(PE-IV)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	PE	CI20451	Robotics and Its Applications	3	0	0	3
2.	PE	CI20452	IT Infrastructure Management	3	0	0	3
3.	PE	CI20453	Wireless Sensor Networks	3	0	0	3
4.	PE	CI20454	Cyber Forensics	3	0	0	3
			TOTAL	12	0	0	12

PROFESSIONAL ELECTIVE COURSES
(PE-V)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	PE	CI20551	Mobile Computing	3	0	0	3
2.	PE	CI20552	Software Defined Networks	3	0	0	3
3.	PE	CI20553	Information Retrieval	3	0	0	3
4.	PE	CI20554	Mobile Adhoc Networks	3	0	0	3
			TOTAL	12	0	0	12

PROFESSIONAL ELECTIVE COURSES
(PE-VI)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	PE	CI20651	Natural Language Processing	3	0	0	3
2.	PE	CI20652	Deep Learning	3	0	0	3
3.	PE	CI20653	Information Visualization	3	0	0	3
4.	PE	CI20654	Service Oriented Architecture	3	0	0	3
			TOTAL	12	0	0	12

OPEN ELECTIVE COURSES (OE-II)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	OE	CI20903	Human Computer Interaction	3	0	0	3
2.	OE	CI20904	Android Application Development	3	0	0	3
			TOTAL	6	0	0	6

SUMMARY

S.NO.	CATEGORY	CREDITS AS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HS	3	4	1	-	-	-	3	-	11
2	BS	11	8	4	4	-	-	-	-	27
3	ES	7	5	5	6	-	-	-	-	23
4	PC	-	4	12	11	19	16	5	3	70
5	PE	-	-	-	-	3	3	6	6	18
6	OE	-	-	-	-	-	3	3	-	6
7	EE	-	-	-	0	1	1	3	6	12
8	MC	-	0	0	-	-	-	-	-	0
	TOTAL	21	21	23	21	23	23	20	15	167

BA20151	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the Management principles.
2	build the entrepreneurial competencies & analyse the support rendered by government and other agencies in entrepreneurship development.
3	understand the business opportunities & to prepare a Feasibility Report.
4	propose a business plan.
5	appraise & comprehend the various factors to be considered for launching a small business.

UNIT I	BASICS OF MANAGEMENT	9

Management: Meaning, Definition; Nature & Importance – Roles of management - Functions of Management - Levels of Management - Functional areas of Management: Marketing, Finance, Production, HRM, IT, R &D. The Evolution & Development of Management Thought: Classical, Neo - classical; System and Contingency Approaches - An Overview.

UNIT II	ENTREPRENEURIAL COMPETENCE & ENVIRONMENT	9

Entrepreneurial Competence: Entrepreneurship - Definition, Role and expectations - Entrepreneurial styles and types - Characteristics of the Entrepreneur - Entrepreneurial Competencies - Functions of an Entrepreneur. Entrepreneurial Environment: Role of Socio-Cultural, Economic and Political Environment - Institutional Support for small entrepreneurs; Assistance Programme for Small Scale Units - Institutional Framework, Central and State Government Industrial Policies and Regulations.

UNIT III	ENTREPRENEURIAL DEVELOPMENT	9

Ownership Structures - Proprietorship, Partnership, Company, Co-operative, Franchise. Identification of Business Opportunity - Preparation of Feasibility Report - Financial and TechnicalEvaluation - Project Formulation - Common Errors in Project Formulation - Specimen Project Report. Entrepreneurial Development Programs - Role of SSI Sector in the Economy - SSI Units - Failure, Causes and Preventive Measures - Turnaround Strategies.

UNIT IV	BUSINESS PLAN PREPARATION, FINANCING VENTURES	9

Business Plan: Business opportunities - SWOT, Business plan process, Feasibility Study, Functional plan- Marketing plan, Operational plan, Organizational plan, financial plan, Evaluation Criteria. Financing ventures: sources of raising capital, seed funding, venture capital funding, funding opportunities for startups in India.

UNIT V	WOMEN ENTREPRENEURSHIP & ENTREPRENEURSHIP IN VARIOUS SECTORS	9

Women Entrepreneurship: Growth of women Entrepreneurship - Problems faced by Women Entrepreneurs Development of women Entrepreneurship. Entrepreneurship in Informal Sector: Rural Entrepreneurship - Entrepreneurship in Sectors like Agriculture, Tourism, Health care, Transport and allied services.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES	BT MAPPED
	At the end of this course, the students will be able to	(Highest Level)
CO1	Implement the necessary managerial skills to become an entrepreneur.	Applying (K3)
CO2	take up self-employment having been exposed to entrepreneurial environment.	Applying (K3)
CO3	select a best business idea by using appropriate methods to assess its viability.	Analysing (K4)
CO4	formulate a business plan & deploy the resources for sustainable growth.	Applying (K3)
CO5	analyses channels and means of launching a small business in any sector.	Analysing (K4)

TEXT BOOKS

1. Khanka S.S, Entrepreneurial Development, S. Chand & Company Limited, New Delhi, 2016.
2. Saravanavel. P, Entrepreneurial Development, Ess Pee Kay Publishing House, Chennai, 2013.

REFERENCES

1. Donald L. Sexton & Raymond W.Smilor, "The Art and Science of Entrepreneurship", Ballinger Publishing Company, 2008.

2. Clifford M.Baumback & Joseph R.Mancuso, "Entrepreneurship and Venture Management", Prentice Hall, 1975.

3. Gifford Pinchot, "Intrapreneuring" Harper & Row Publishers, New York, 2005.

4. Mathew Manimala, "Entrepreneurship Theory at the Crossroads", Paradigms & Praxis, Biztrantra, 2nd Edition, 2015.

5. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation and Reviews", Tata McGraw-Hill, 2013.

6. P.C.Jain, "Handbook for New Entrepreneurs", EDII, Oxford University Press, New Delhi, 2012.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

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

CI20701		IOT SECURITY	3	0	0	3

COURSE OBJECTIVES	

To enable the students to

1	learn IOT and cyber physical system security
2	know the perspective of IOT secure design based on available technology.
3	study about role of cryptography for IOT.
4	find the available authentication credentials and privacy concerns.
5	acquire the knowledge of exploring cloud services and security for IoT.

UNIT I	INTRODUCTION	9

Cyber security versus IoT security and cyber physical - systems vulnerabilities, attacks, and countermeasures - Primer on threats, vulnerability, and risks (TVR) - Primer on attacks and countermeasures -Today's IoT attacks - Threat modeling an IoT system.

UNIT II	SECURITY ENGINEERING FOR IOT DEVELOPMENT	9

Building security in to design and development, secure design, technology selection – security products and services; The IoT security lifecycle – implementation and integration, operation and maintenance, dispose.

UNIT III	CRYPTOGRAPHIC FUNDAMENTALS FOR IOT SECURITY ENGINEERING	9

Cryptography and its role in securing the IoT - Cryptographic module principles - Cryptographic key management fundamentals - Examining cryptographic controls for IoT protocols - Future directions of the IoT and cryptography.

UNIT IV	IDENTITY AND ACCESS MANAGEMENT SOLUTIONS	9

An introduction to identity and access management, Authentication credentials, IoT IAM infrastructure, Authorization and access control; Mitigating IoT Privacy Concerns - Privacy challenges introduced by the IoT, Guide to performing an IoT PIA.

UNIT V	CLOUD SECURITY FOR THE IOT	9

Cloud services and the IoT - Exploring cloud service provider IoT offerings - Cloud IoT security controls - Tailoring an enterprise IoT cloud security architecture - New directions in cloud-enabled IoT computing; IoT Incident Response - Threats both to safety and security - Planning and executing an IoT incident response.

	TOTAL PERIODS	45

COURSE OUTCOMES	

COs	At the end of this course, students will be able to	BT MAPPED (Highest Level)
CO 1	understand the IOT attacks, threats, vulnerabilities and its countermeasures.	Understanding (K2)
CO 2	aware of the IOT existing products and security implementations.	Understanding (K2)
CO 3	recognize cryptographic protocols for IoT.	Applying (K3)
CO 4	identify the state of art access control technologies.	Analyzing (K4)
CO 5	realize the cloud architecture and cloud computing for IoT.	Applying (K3)

TEXT BOOKS

1.	Brian Russell and Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2nd edition, 2018.
2.	Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms,and Implementations", CRC Press (Taylor & Francis Group), 2016.

REFERENCES

1.	David Etter, "IoT Security: Practical guide book", Create Space, 1st Edition, 2016.
2.	Sean Smith, "The Internet of Risky Things", O'Reilly Media, 1st Edition, 2017.
3.	Sridipta Misra, Muthucumaru Maheswaran, Salman Hashmi, "Security Challenges and Approaches in Internet of Things", Springer, 2016.
4.	Ollie White house, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome

(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	1	1	1	-	-	-	1	-	-	-	2	1
CO2	3	3	3	1	3	-	-	-	1	-	-	1	2	1
CO3	3	3	3	1	3	-	-	-	1	-	1	2	2	1
CO4	3	3	3	1	3	-	-	-	1	-	2	3	2	1
CO5	3	3	3	1	3	-	-	-	1	-	2	3	2	1

CI20702	IOT SECURITY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1	learn the state of art open source hardware in IoT
2	study about role of security for IOT security.
3	find the method of upload and analyze the data in IoT using cloud.
4	acquire the knowledge of amazon web service in IoT.

LIST OF EXPERIMENTS

1. To detect unauthorized tampering using a accelerometer and trigger an alert system.

2. Identify security vulnerabilities on a common IoT device using an open source scanner.

3. Monitor and analyze the data traffic of an IoT device to identify possible privacy leaks.

4. Implement a basic block cipher algorithm to understand how encryption secures data in IoT devices.

5. Implement basic Burglar alarm security system with the help of sensor and buzzer.

6. Set up an IoT device (like a Raspberry Pi) and identify potential security vulnerabilities. .

7. Set up different IoT networking protocols and analyze their security features.

8. Conduct experiments to read RFID tags, and discuss security implications.

9. Write a program on Arduino/Raspberry Pi to upload data (temperature and humidity) to thing speak cloud.

10. Explore the working of AWS IoT Device Defender.

		TOTAL PERIODS	60

Cos	COURSE OUTCOMES At the end of this course, students will be able to	BT MAPPED (Highest Level)
CO1	analyze the IOT open source processing module.	Analyzing (K4)
CO2	apply the IOT security concept with symmetric and asymmetric cryptography.	Applying (K3)
CO3	analyze cloud data flow from connected IoT devices.	Analyzing (K4)
CO4	apply AWS IoT Core to connect and monitor edge devices.	Applying (K3)

CO-PO MAPPING:

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

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CI20703		MINI PROJECT			0	0	6	3

COURSE OBJECTIVES

To enable the students to

1	recognize the significance of scope and the problems of project
2	understand the strategic plans, project prioritization methods and projects
3	analyze the importance of scheduling / allocating resources to a project
4	understand the importance of project management as it effects strategy and business success

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 3 members for a project.

2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of the beginning of 7th semester.

3. The group has to identify and select the problem to be addressed as their project work and study literature survey to finalize a comprehensive aim and scope of their work.

4. A project report has to be submitted by each student group for their project work.

5. Three reviews have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

	TOTAL PERIODS	90

COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	formulate a real world problem, identify the requirement and develop the design solutions.	Applying (K3)
CO2	identify technical ideas, strategies and methodologies.	Understanding (K2)
CO3	utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.	Analysing (K4)
CO4	test and validate through conformance of the developed prototype and analysis the cost effectiveness	Applying (K3)

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

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

CI20801	INDUSTRIAL IOT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	learn iot fundamental computations and evolutions of industry 4.0.
2	know the perspective of industrial iot process.
3	study about iiot reference architectures and offsite technologies.
4	find the available on site reality and communication technologies.
5	acquire the knowledge of industrial data acquisition and its applications.

UNIT I	OVERVIEW OF INDUSTRIAL IOT	9

IOT architecture, application based IOT protocol, cloud computing, fog computing, sensor cloud, big data; industry 4.0 – industrial revolution, Evolution of industry 4.0, environmental impacts, industrial internet, applications – IIoT – Basics of CPS, CPS and IIoT.

UNIT II	INDUSTRY 4.0 BASICS	9

Design requirements, drivers of industry 4.0, sustainability assessment of industry, smart business perspective, cybersecurity, impacts of industry 4.0 – Industrial IoT – Industrial internet systems, industrial sensing, industrial process.

UNIT III	IIOT REFERENCE ARCHITECTURE	9

Business models – definition, business for IoT and IIoT, reference architecture of IoT and IIoT, IIRA; Offsite Technologies – cloud computing and fog computing for IIoT.

UNIT IV	ON SITE TECHNOLOGIES	9

Need for industry 4.0 - Augmented reality - virtual reality - big data and advanced analytics - smart factories – lean manufacturing system; industrial data transmission – foundation field bus, profibus, HART, inter bus, bit bus, CC-link, mod bus, Digital STROM, CAN, Lonworks, ISA 100.11a, wireless HART, LoRa, LoRaWAN.

UNIT V	CASE STUDIES OF IIOT SYSTEMS	9

Industrial data acquisition – DCS, PLC, SCADA – IIOT analytics – Machine learning and data science in industries – plant safety and security; case studies – manufacturing industry - automotive industry - mining industry, Introduction to Industry 5.0.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the revolution in industrial data processing techniques.	Understanding (K2)
CO2	aware the design requirements, security and internet system for iiot.	Understanding (K2)
CO3	recognize architectural and computing strategies of iiot.	Analysing (K4)
CO4	identify the state of art technologies for industrial data communication.	Applying (K3)
CO5	realize the industrial data acquisition methods with real time examples.	Applying (K3)

	TEXT BOOKS
1.	Sudip Misra, chandana Roy, Anandarup Mukharjee, "Introduction to Industrial Internet of Tings and Industry 4.0", CRC Press, Taylor & Francis Group, 2021.
2.	Ismail Butun, "Industrial IoT: Challenges, Design Principles, Applications, and Security", Springer Nature, 2020.

	REFERENCES
1.	Jiafu Wan, Iztok Humar, Daqiang Zhang, "Industrial IoT Technologies and Applications", Springer, 2016.
2.	R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman Subhas Chandra Mukhopadhyay, Gourab Sen Gupta, "Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance", John Wiley & Sons, 2022.
3.	Anand Sharma, Sunil Kumar Jangir, Manish Kumar, Dilip Kumar Choubey, Tarun Shrivastava, S. Balamurugan, "Industrial Internet of Things Technologies and Research Directions", CRC Press, 2020.
4.	Sudan Jha, Usman Tariq, Gyanendra Prasad Joshi, Vijender Kumar Solanki, "Industrial Internet of Things Technologies, Design, and Applications", CRC Press, 2022.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1indicatesstrengthofcorrelation)3-Strong,2-Medium,1-Weak

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

| CI20802 | | PROJECT WORK | | | | | | | 0 | 0 | 12 | 6 |

COURSE OBJECTIVES

To enable the students to

1	recognize the significance of scope and the problems of project
2	understand the strategic plans, project prioritization methods and projects
3	understand the importance of scheduling / allocating resources to a project
4	develop strategies for developing and reinforcing high performanceteams

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 3 members for a project.

2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of the beginning of 8th semester.

3. The group has to identify and select the problem to be addressed as their project work and studyliterature survey to finalize a comprehensive aim and scope of their work.

4. A project report has to be submitted by each student group for their project work.

5. Three reviews have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of faculty team (for monitoring the progress of projectplanning and implementation).

	TOTAL PERIODS	**180**

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	prepare a literature survey in a specific domain as a team/ individual to motivate lifelong learning	Applying (K3)
CO2	identify theproblem by applying acquired knowledge	Understanding(K2)
CO3	choose efficient tools for designing project modules	Applying (K3)
CO4	design engineering solutions to complex problems utilizing a systems approach and combine all themodules for efficient testing	Analysing (K4)

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1- Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2	2	1	1	1	-	-	1	1	1	2	3	2
CO2	3	2	2	1	1	1	-	-	1	1	1	2	3	2
CO3	3	2	2	1	1	1	-	-	1	1	1	2	3	2
CO4	3	2	2	1	1	1	-	-	1	1	1	2	3	2

CI20351	SMART SENSOR TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	learn smart sensor fundamentals, its characteristics and in capabilities.
2	know the concepts of communication control strategies for smart sensors.
3	study about RF sensing and semiconductor sensor packaging approaches.
4	find the smart sensor standards to extend the system to the network.
5	acquire the knowledge of next phase of sensing system.

UNIT I	INTRODUCTION TO SMART SENSOR	9

Smart sensor basics – sensor output characteristics, other sensing technologies, digital output sensors - Using MCU to increase sensor IQ: MCU control, MCUs for sensor interface, techniques and system considerations, software, tools and support, sensor integration.

UNIT II	COMMUNICATIONS AND CONTROL FOR SMART SENSORS	9

Definitions and Background - definitions and background, office/building automation, home automation, other aspects of network communications; control techniques - state machines, fuzzy logic, neural networks, combined fuzzy logic and neural networks, adaptive control, other control areas, the impact of artificial intelligence.

UNIT III	TRANSCEIVERS, TRANSPONDERS, AND TELEMETRY	9

Introduction - Wireless data and communications, RF sensing, telemetry, RF MEMS; MEMS beyond sensors- micro machined actuators, other micro machined structures; Packaging – semiconductor packaging applied sensor, hybrid packaging, packaging for monolithic sensor, reliability implications, testing smart sensors.

UNIT IV	MECHATRONICS AND SENSING SYSTEMS	9

Introduction - smart-power ICs, embedded sensing, sensing arrays, other system aspects; standards for smart sensing - introduction, setting the standards for smart sensors and systems - IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, extending the system to the network.

UNIT V	THE IMPLICATIONS OF SMART SENSOR STANDARDS	9

Sensor-plug and-play – communicating sensor data via existing wiring – automated/remote sensing and the web – process control over the internet – alternative standards; The next phase of sensing systems – future semiconductor capabilities, future system requirements, Not-so-futuristic system – software, sensing and the system, alternative views of smart sensing, the smart loop.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the characteristics of sensors and fundamentals MCU for sensor IQ.	Understanding (K2)
CO2	identify the automation, communication and control strategies.	Applying (K3)

CO3	recognize the implementation of RF sensor networks and semiconductor sensor packaging.	Applying (K3)
CO4	know about the smart sensor standards.	Understanding (K2)
CO5	comprehend the remote sensing and future system using smart sensors.	Analysing (K4)

TEXT BOOKS

1.	Randy Frank, "Understanding Smart Sensors", ARTECH HOUSE, INC., 2000.
2.	Youn-Long Lin, Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu, "Smart Sensors and Systems", Springer International Publisihing, 2015.

REFERENCES
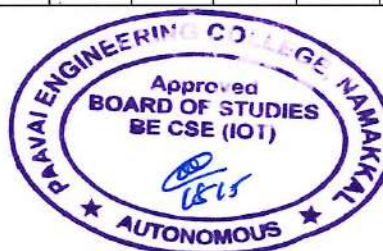
1.	Peter Brida, Ondrej Krejcar, Ali Selamat, Attila Kertesz , " Smart Sensor Technologies for IoT", MDPI, 2021.
2.	Subhas Chandra Mukhopadhyay, Gourab Sen Gupta, "Smart Sensors and Sensing Technology ", Springer, 2008.
3.	Gerard Meijer, "Smart Sensor Systems", Wiley-Interscience, 2008.
4.	Daniel E Suarez, "Smart sensors & Sensing Technologies", Nova Science Publishers Inc 2011.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	2	1
CO2	3	2	2	1	1	-	-	-	-	-	-	2	2	1
CO3	3	2	2	1	1	-	-	-	-	-	-	2	2	1
CO4	3	2	2	1	1	-	-	-	-	-	-	2	2	1
CO5	3	2	2	1	1	-	-	-	-	-	-	2	2	1

CI20352	WEB AND INTERNET TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	analyze the basic concepts of web programming and internet protocols.
2	know how to design interactive web pages using Scripting languages.
3	learn server-side programming using servlets.
4	develop web pages using XML/XSLT.
5	develop application using recent environment like Node JS

UNIT I	WEB SITE BASICS AND WEB DESIGNING	9

Web Essentials - Clients, Servers, and Communication; The Internet - Basic Internet Protocols, The World Wide Web, HTTP request message, response message, Web Clients Web Servers; Markup Languages - XHTML; An Introduction to HTML History - Versions, Basic XHTML Syntax and Semantics; Some Fundamental HTML Elements - Relative URLs , Lists-tables, Frames-Forms.

UNIT II	CLIENT SIDE PROCESSING AND SCRIPTING	9

Client-Side Processing - The JavaScript Language, History and Versions; Introduction - JavaScript in Perspective, Basic Syntax, Variables and Data Types; Statements - Operators, Literals, Functions, Objects Arrays, Built-in Objects, JavaScript Debuggers.

UNIT III	SERVER SIDE PROCESSING AND SCRIPTING	9

Separating programming and presentation - JSP Technology, introduction JSP and servlets, Running JSP; Applications - Basic JSP, JavaBeans Classes and JSP, tag libraries and files, support for the model view - Controller Paradigm; Representing Web Data - XML Documents and Vocabularies, Versions and Declaration, Namespaces; DOM based XML processing - Event oriented parsing; SAX - Transforming XML documents - Selecting XML Data; XPATH - Template based transformations; XSLT - Displaying XML documents in browsers.

UNIT IV	JSP AND XML	9

Introduction - smart-power ICs, embedded sensing, sensing arrays, other system aspects; standards for smart sensing - introduction, setting the standards for smart sensors and systems - IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, extending the system to the network.

UNIT V	APPLICATION DEVELOPMENT USING NODE JS	9

Introduction to Node.js - Installing node.js, using events, listeners, timers, callbacks in node.js; introduction to mongoDB, accessing mongoDB from node.js.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design simple web pages using markup languages like html and xhtml.	Applying (K3)
CO2	create dynamic web pages using java script that is easy to navigate and use.	Applying (K3)

CO3	program server-side web pages that have to process request from client-side web pages.	Analysing (K4)
CO4	represent web data using xml and develop web pages using jsp.	Analysing (K4)
CO5	create web and internet application using nodejs.	Applying (K3)

TEXT BOOKS

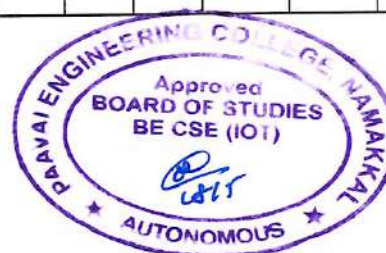| 1.	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2.	Brad Dayley, Brendan Dayley, and Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Pearson Education, 2018.

REFERENCES

1.	Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.
2.	Deitel, Goldberg, "Internet & World Wide Web How ToProgram", Third Edition, Pearson Education, 2006.
3.	Marty Hall and Larry Brow, "Core Web Programming", Second Edition, Volume I and II, Pearson Education, 2001, Bates, ·Developing Web Applicationsl, Wiley, 2006.
4.	Ethan Brown , "Web Development with node and express", Orelly Education, 2014.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20353	CYBER SECURITY ESSENTIALS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	interpret the threats and vulnerabilities in computer systems.
2	infer the need for security in operating systems and networks.
3	understand the security counter measures- firewalls and intrusion detection system.
4	know about privacy principles and policies.
5	analyze the typical threats, security planning and know about cyber laws.

UNIT I	INTRODUCTION TO CYBER SECURITY	9

Introduction - computer security, threats, harm, vulnerabilities, controls, authentication; Access control and cryptography - web, user side, browser attacks, web attacks targeting users, obtaining user or website data, email attacks.

UNIT II	SECURITY IN OPERATING SYSTEM & NETWORKS	9

Security in Operating Systems - security in the design of operating systems, rootkit, network security attack, threats to network communications; wireless network security - denial of service, distributed denial of service.

UNIT III	DEFENCES: SECURITY COUNTERMEASURES	9

Cryptography in Network Security - firewalls, intrusion detection and prevention systems, network management, databases, security requirements of databases, reliability and integrity, database disclosure, data mining and big data.

UNIT IV	PRIVACY IN CYBER SPACE	9

Privacy Concepts - privacy principles and policies, authentication and privacy, data mining, privacy on the web; email security - privacy impacts of emerging technologies, where the field is headed.

UNIT V	MANAGEMENT AND INCIDENTS	9

Security Planning - business continuity planning, handling incidents, risk analysis, dealing with disaster; Emerging technologies - internet of things; economics; electronic voting, cyber warfare - cyberspace and the law, international laws, cybercrime, cyber warfare and homeland security.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	explain the threats and vulnerabilities in computer systems.	Understanding (K2)
CO2	describe the need for security in operating systems and networks.	Understanding (K2)`
CO3	discuss the principles of firewalls and intrusion detection system.	Analysing (K4)
CO4	summarize the privacy principles and policies.	Analysing (K4)
CO5	demonstrate the typical threats and describe security planning, cyber laws	Applying (K3)

TEXT BOOKS	
1.	Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies, "Security in Computing", 5th Edition, Pearson Education, 2015.
2.	George K. Kostopoulous, "Cyber Space and Cyber Security", CRC Press, 2013.

REFERENCES	
1.	Martti Lehto, Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland 2015.
2.	Nelson Phillips and Enfinger Steuart, - "Computer Forensics and Investigationsl", Cengage Learning, New Delhi, 2009.
3.	AllanFriedman and P. W. Singer, "Cybersecurity and Cyberwar: What Everyone Needs to Know"
4.	Erdal Ozkaya, "Cybersecurity: the beginner's guide: a comprehensive guide to getting started in cyber security"

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20354	AUGMENTED REALITY AND VIRTUAL REALITY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	impart the fundamental aspects and principles of AR/VR technologies
2	know the internals of the hardware and software components involved in the development of AR/VR enabled applications
3	learn about the graphical processing units and their architectures
4	gain knowledge about AR/VR application development
5	know the technologies involved in the development of AR/VR based applications

UNIT I	INTRODUCTION	9

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II	VR MODELING	9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III	VR PROGRAMMING	9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV	APPLICATIONS	9

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education

UNIT V	AUGMENTED REALITY	9

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the basic concepts of AR and VR.	Understanding (K2)
CO2	understand the tools and technologies related to AR/ VR.	Understanding (K2)
CO3	know the working principle of AR/VR related sensor devices.	Understanding (K2)
CO4	design of various models using modeling techniques.	Applying (K3)
CO5	develop AR/ VR applications in different domains.	Applying (K3)

TEXT BOOKS

1.	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2.	Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016

REFERENCES

1.	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003
2.	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1indicatesstrengthofcorrelation)3-Strong,2-Medium,1-Weak

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

CI20451	ROBOTICS AND ITS APPLICATIONS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn the basics of robotics and their applications
2	study the need for various sensors and drives in robotics
3	gain thorough knowledge about the robot kinematics
4	knowledge on path planning and different trajectories
5	apply the programming of robots in contemporary use

UNIT I	INTRODUCTION TO ROBOTICS	9

Introduction - Automation and robotics - Robotics in science fiction - Types - Mobility - Terrain - Components classification and performance characteristics, Automation

UNIT II	WORKING COMPONENTS FOR ROBOTS	9

Drives - Electric - Hydraulic and Pneumatic Drives - Tactile sensors - Proximity and Range Sensors - Acoustic Sensors - Vision Sensor Systems - Image Processing and Analysis - Image Data Reduction - Segmentation - Feature Extraction - Object Recognition

UNIT III	ROBOT KINEMATICS AND DYNAMICS	9

Kinematics of Manipulators - Rotational - Translation and transformation - Homogeneous transformations - Denavat Hartenberg Representation - Inverse kinematics - Linearization of robot dynamics, state variable continuous and discrete models.

UNIT IV	PATH PLANNING	9

Types of Trajectories - Trajectory Planning and Avoidance of Obstacles - Path Planning - Skew Motion - Joint Integrated Motion and Straight Line Motion.

UNIT V	APPLICATION OF ROBOTS	9

Industrial Automation - Robots for Nuclear - Thermal and Chemical Plants - Remote Controlled Robots - Typical Examples of Automated Industries.

TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the necessity and basics of robotics in real time applications	Understanding (K2)
CO2	explain the components and working principle in robots	Understanding (K2)
CO3	apply the use of image processing, obstacle detection and path planning in robotic applications.	Applying (K3)
CO4	demonstrate the mathematical model of robotic systems	Applying (K3)
CO5	apply mathematical modeling in kinematic behavior	Applying (K3)`

TEXT BOOKS

1	Mikell P. Groover, "Industrial Robotics: Technology, Programming and nd Applications", 2 Edition, McGraw-Hill Publishers. .
2	John J. Craig, "Introduction to Robotics, Mechanics and Control", 2010, 3 Edition, Pearson Education

REFERENCES

1	M.W. Spong and M. Vidyasagar, "Robot Dynamics and Control," 2 Edition, John Wiley & Sons, New York, 2012.
2	Lorenzo Sciavicco Bruno Siciliano, "Modelling and Control of Robot st Manipulators", 1 Edition, Springer Science & Business Media, Berlin, 2012
3	Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.
4	M.W. Spong and M. Vidyasagar, "Robot Dynamics and Control," 2 Edition, John Wiley & Sons, New York, 2012.
5	Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice Hall of India Pvt. Ltd., 1994.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20452	IT INFRASTRUCTURE MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the basics of it infrastructure.
2	understand the basics of data center and its performance metrics.
3	acquire the basics of compute and storage services provided in cloud.
4	learn the basics of cloud platforms and technologies.
5	study the security issues associated with cloud infrastructure.

UNIT I	INTRODUCTION TO INFRASTRUCTURE	9

Introduction to IT Building Blocks – Infrastructure, Nonfunctional Attributes, Calculating Availability, Availability Percentages and Intervals, Mean Time Between Failures (MTBR), Mean Time to Repair (MTTR), Sources of Unavailability, Availability Patterns; Performance concepts – Introduction to Performance, Performance During Infrastructure Design, Performance of a Running System, Performance Patterns.

UNIT II	DATA CENTERS	9

Introduction, Datacenter Building Blocks – Datacenter Categories, Location of the Datacenter, Physical Structure, Power Supply, Cooling, Fire Prevention, Detection, And Suppression, Equipment Racks, Datacenter Cabling and Patching, Datacenter Energy Efficiency; Datacenter Availability –Availability Tiers, Redundant Datacenters, Datacenter Performance, Datacenter Security.

UNIT III	COMPUTE AND STORAGE	9

Introduction, Compute Building Blocks, Memory, Interfaces, Compute Virtualization, Container Technology, Mainframes, Midrange Systems, X86 Servers, Supercomputers; Compute Availability – Compute Performance; Compute Security; Popular Operating Systems, Operating System Availability, Operating System Performance, Operating System Security; Storage - Storage Building Blocks, DAS, NAS, SAN, Software Defined Storage, Storage Availability, Storage Performance, Storage Security.

UNIT IV	INFRASTRUCTURE DEPLOYMENTS	9

Introduction, Hosting Options, Enterprise Infrastructure Deployment, Converged Infrastructure, Cloud Computing At A Glance, Cloud Computing Platforms And Technologies, Cloud Reference Model, Types of Cloud, Economics of Cloud, Open Challenges, Cloud Platforms in Industry, Amazon Web Service, Google App Engine, Microsoft Azure.

UNIT V	INFRASTRUCTURE SECURITY	9

Introduction, Risk Management, Risk Response, Exploits, Security Controls, Attack Vectors, Identity and Access Management, Segregation of Duties and Least Privilege, Layered Security, Cryptography, Monitoring; Vulnerability Patching, Go Live Process/Checklist, Decommissioning a Service/Device.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES	BT MAPPED
	At the end of this course, the students will be able to	(Highest Level)
CO1	design the fundamentals of IT Infrastructure.	Applying (K3)
CO2	implement the data center infrastructure and its associated performance metrics.	Applying (K3)
CO3	desire knowledge on infrastructure services (IaaS) provided by different vendors.	Understanding (K2)
CO4	identify various Cloud platforms and associated technologies.	Applying (K3)
CO5	understand various security issues associated with data centers and cloud applications.	Understanding (K2)

TEXT BOOKS

1.	SJaak Laan, "IT Infrastructure Architecture – Infrastructure Building Blocks and Concepts", ThirdEdition, Lulu Press Inc, 2017.
2.	Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Prentice Hall, 2013.

REFERENCES

1.	IBM, "Introduction to Storage Area Networks and System Networking", Redbooks. 2012, https://www.redbooks.ibm.com/Redbooks.nsf/domains/san?Open&start=46.
2.	Ray J. Rafael, "Cloud Computing: From Beginning to End", Second Edition, Wiley, 2018.
3.	Matthew Portnoy, "Virtualization Essentials", John Wiley, 2012.
4.	Lee Brotherson, Amanda Berlin, "Defensive Security Handbook: Best Practices for securingInfrastructure", O'Reilly, 2017.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

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

CI20453	WIRELESS SENSOR NETWORKS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the overview of wireless sensor networks.
2	describe the design methodology for transmission and wireless sensor network.
3	know about the mac protocols features and wireless sensor technology.
4	understand the use of routing protocol and transport control protocol.
5	analyze the characteristics of middleware and network management.

UNIT I	INTRODUCTION	9

Introduction- Basic overview of the technology; Applications of Wireless Sensor networks; Background- Range of applications - Examples of category 2 WSN Applications - Examples of category 1 WSN applications- Another taxonomy of WSN technology.

UNIT II	BASICS, TRANSMISSION TECHNOLOGY AND SYSTEMS	9

Sensor Node Technology- Sensor Taxonomy- WN Operating Environment - WN Trends - Radio Technology Primer - Available Wireless Technologies.

UNIT III	MAC PROTOCOLS	9

Background- Fundamentals of MAC Protocols - MAC Protocols for WSNs - Sensor-MAC Case Study – IEEE 802.15.4 LR - WPANs Standard Case Study.

UNIT IV	ROUTING PROTOCOLS AND TRANSPORT CONTROL PROTOCOLS	9

Background - Data Dissemination and gathering - Routing challenges and design issues in wireless sensor networks- Routing strategies in wireless sensor networks; Traditional transport control protocols - Transport protocol design Issues - Examples of existing transport control protocols - Performance of transport control protocols.

UNIT V	MIDDLEWARE AND NETWORK MANAGEMENT	9

WSN Middleware Principles - Middleware architecture - Existing middleware; Network management; Network management requirements - Traditional network management models- Network management design issues- Example of management architecture - WSN design issues - Performance modeling of WSNs.

		TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the basics of Wireless Sensor Networks.	Understanding (K2)
CO2	study about the basics and systems of wireless sensor networks.	Applying (K3)
CO3	analyses Medium Access Control Protocol.	Analysing (K4)
CO4	know about the routing protocols and transport control protocol for WSN	Understanding (K2)
CO5	apply the network management and the middleware.	Applying (K3)

TEXT BOOKS

| 1. | Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks: Technology, Protocols and Applications", John Wiley and sons, 2007. |

REFERENCES

1.	Holger Karl, Andreas Willing, "Protocols and Architectures for Wireless Sensor Networks", JohnWiley & Sons, 2005.
2.	Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufmann, 2004.
3.	WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications ,2011.
4.	Anna Hac, "Wireless Sensor Network Designs", John Wiley 2003.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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

CI20454	CYBER FORENSICS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn digital forensics.
2	become familiar with forensics tools.
3	know and identify crime and dos.
4	acquire about the tools and graphics.
5	understand the data hiding and virtual machine.

UNIT I	INTRODUCTION TO DIGITAL FORENSICS	9

Overview of Digital Forensics, Preparing for Digital Investigations, Digital Forensics Investigations, Private sector High - Tech Investigations, Data recovery workstations, Conducting an Investigation.

UNIT II	INVESTIGATOR AND DATA ACQUISITION	9

Investigator Office - Understanding Forensics Lab Accreditation Requirements, Determining the Physical Requirements for a Digital Forensics, Selecting a Basic Forensic Workstation; Data Acquisition - Understanding Storage Formats for Digital Evidence, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Using Remote Network Acquisition Tools, Using OtherForensics Acquisition Tools.

UNIT III	PROCESSING CRIME AND SYSTEMS	9

Processing Crime and Incident Scenes - Identifying Digital Evidence, Preparing for a Search - Seizing DigitalEvidence at the Scene, Storing Digital Evidence, Reviewing a Case; Working with Windows and DOS Systems, Understanding File Systems, Examining NTFS Disks, Understanding Whole Disk Encryption, Windows Registry, Microsoft Startup Tasks, Virtual Machines.

UNIT IV	TOOLS AND GRAPHICS FILES	9

Computer Forensics Tools - Software/ Hardware Tools, Validating and Testing Forensics Software; Linux and Macintosh File Systems - Examining Linux File Structures, Understanding Macintosh File Structures, Recovering Graphics Files, Recognizing a Graphics File, Locating and Recovering Graphics Files, Identifying Unknown File Formats.

UNIT V	ANALYSIS AND VALIDATION	9

Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding techniques; An Overview of Virtual Machine Forensics, Performing Live Acquisitions, Network ForensicsOverview; E-mail Crimes and Violations.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the basics of digital forensics.	Understanding (K2)
CO2	apply a number of different computer forensic tools to a given scenario.	Applying (K3)
CO3	analyze and identify the crime and virtual machine in forensics data.	Analysing (K4)
CO4	identify the tools given in a given graphics file.	Applying (K3)
CO5	implement data hiding and network forensics using virtual machine.	Applying (K3)

	TEXT BOOKS
1.	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, "Computer Forensics and Investigations", Cengage Learning, India Edition, 2016.
2.	"CEH official Certfied Ethical Hacking Review Guide", Wiley India Edition, 2015.

	REFERENCES
1.	John R.Vacca, "Computer Forensics", Cengage Learning, 2005
2.	MarjieT.Britz, "Computer Forensics and Cyber Crimel: An Introduction", 3rd Edition, Prentice Hall, 2013.
3.	AnkitFadia ,"Ethical Hacking", Second Edition, Macmillan India Ltd, 2006
4.	Kenneth C.Brancik,"Insider Computer Fraud",Auerbach Publications Taylor & FrancisGroup– 2008

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium ,1-Weak

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

PROFESSIONAL ELECTIVE COURSES - V

CI20551	MOBILE COMPUTING	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	understand the basic concepts of mobile computing.
2	learn the basics of mobile telecommunication system.
3	understand the basic functions of mobile internet protocol and transport layer.
4	identify the characteristics of wireless ad hoc networks and state the design issues in routing protocols.
5	gain knowledge about different mobile device operating systems and security issues.

UNIT I	INTRODUCTION	9

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 TELECOMMUNICATION SYSTEM	9

Global System for Mobile Communication (GSM) - General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS), Cellular Mobile Communication Networks.

UNIT III	MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER	9

Overview of Mobile IP - Features of Mobile IP, Key Mechanism in Mobile IP, route Improvement Optimization; Overview of TCP/IP - Architecture of TCP/IP, Adaptation of TCP Window, Improvement in TCP Performance.

UNIT IV	WIRELESS AD-HOC NETWORKS	9

Introduction - Ad-Hoc Basic Concepts, Characteristics, Applications, Design Issues; Routing - Essential of Traditional Routing Protocols, Popular Routing Protocols; Vehicular Ad Hoc networks (VANET), MANET Vs VANET, Security issues in MANET.

UNIT V	MOBILE PLATFORMS AND APPLICATIONS	9

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

		TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	discuss the basic concepts of mobile computing.	Analyze (K4)
CO2	outline the fundamentals of mobile telecommunication system.	Understand (K2)
CO3	describe the functions of mobile internet protocol and transport layer.	Understand (K2)

CO4	state the characteristics of wireless ad hoc networks and state the design issues in routing protocols.	Apply (K3)
CO5	select the OS for the application of different mobile device and the security issues.	Analyze (K4)

TEXT BOOKS

1.	Prashant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt, Ltd. New Delhi, 2012.
2.	Alan Colman, Jun Han, and Muhammad Ashad Kabir, "Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications", Springer, 2016.

REFERENCES

1.	Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2010.
2.	William.C.Y.Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition, TataMcGraw Hill Edition, 2006.
3.	Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
4.	UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20552	SOFTWARE DEFINED NETWORKS	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	know about the working of software defined networks.
2	study about the SDN controllers.
3	learn the fundamentals of software defined networks protocols.
4	understand the SDN programming concepts.
5	gain knowledge about the juniper SDN framework.

UNIT I	INTRODUCTION	9

History of Software Defined Networking (SDN) - Modern Data Center, Traditional Switch Architecture, Why SDN, Evolution of SDN, How SDN Works, Centralized and Distributed Control and Date Planes.

UNIT II	OPEN FLOW & SDN CONTROLLERS	9

Open Flow Specification - Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor; 111 Based Overlays; SDN via Opening up the Device; SDN Controllers; General Concepts.

UNIT III	SDN PROTOCOLS	9

SDN Protocol specifications, Border Gateway Protocol (BGP); Cisco Application Centric Infrastructure (ACI); OpenFlow - OpenFlow versions, Components of an OpenFlow Switch, Flow and group tables, Rule matching, Action handling, Table misses, Counters, metering and metadata.

UNIT IV	SDN PROGRAMMING	9

Programming SDNs - Northbound Application Programming Interface, Current Languages and Tools; Composition of SDNs ; Network Functions Virtualization (NFV) and Software Defined Networks - Concepts Implementation and Applications.

UNIT V	JUNIPER SDN FRAMEWORK	9

Juniper SDN Framework; IETF SDN Framework; Open Daylight Controller; Floodlight Controller; Bandwidth Calendaring; Data Center Orchestration.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	describe the working of software defined networks.	Applying (K3)
CO2	state the working of sdn controllers.	Understanding (K2)
CO3	discuss on software defined networks protocols.	Analysing (K4)
CO4	illustrate the sdn programming concepts.	Analysing (K4)
CO5	explain about the juniper sdn framework.	Understanding (K2)

TEXT BOOKS

1.	Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", First Edition, Morgan Kaufmann, 2014.
2.	Thomas D. Nadeau, Ken Gray, "Software Defined Networks", O'Reilly Media, 2013.

REFERENCES

1.	Siamak Azodolmolky, -Software Defined Networking with Open Flow, Packet Publishing, 2013.
2.	Harvey M. Deital, "Operating Systems", Third Edition, Pearson Education, 2007. Vivek Tiwari, SDN and Open Flow for Beginnersl, Amazon Digital Services, Inc., 2013.
3.	Fei Hu, Editor, -Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20553	INFORMATION RETRIEVAL	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	acquire knowledge about information retrieval systems.
2	write code for text construction and compression.
3	learn to evaluate information retrieval systems and language models.
4	understand the concepts of Text Classification and Text clustering.
5	know about search engine and information extraction.

UNIT I	INTRODUCTION TO INFORMATION RETRIEV	9

Boolean retrieval model; The term vocabulary and postings lists; Dictionary and tolerant retrieval

UNIT II	INDEXING AND COMPRESSION	9

Blocked sort - based indexing, single pass in memory indexing, distributed indexing, dynamic indexing, other types of indexes; Statistical properties of terms in information retrieval; Dictionary compression - Postings file compression.

UNIT III	EVALUATION, PROBABILISTIC AND LANGUAGE MODELS	9

Evaluation in information retrieval - XML retrieval, Probabilistic information retrieval, Language models for information retrieval.

UNIT IV	TEXT CLASSIFICATION & TEXT CLUSTERING	9

The text classification problem - Naive Bayes text classification, K- nearest neighbors; Support vector Machine; Feature Selection; Vector-space clustering - K-means algorithm, Hierarchical clustering.

UNIT V	WEB SEARCH BASICS, CRAWLING, INDEXES, LINK ANALYSIS	9

Web Characteristic - Search user experience, Index size and estimation, near duplicates and shingling; Crawling; Distributing indexes; Connectivity servers - Web As a graph, Page Rank, Hubs and Authorities. IR applications - Information extraction, Question answering, Opinion summarization, Social Network.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	discuss about information retrieval systems.	Understanding (K2)
CO2	summarize the different types of indexing and compression techniques.	Understanding (K2)
CO3	evaluate information retrieval systems and language models.	Applying (K3)
CO4	describe about text classification and clustering.	Applying (K3)
CO5	elaborate web search engine, crawling and information extraction.	Analysing (K4)

TEXT BOOKS

1.	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press. 2008.
2.	ChengXiang Zhai, "Statistical Language Models for Information Retrieval", (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008.

REFERENCES

1.	Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2010.
2.	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", Second Edition, ACM Press Books, 2011.
3.	Stefan Buettcher, Charles L. A. Clarke and Gordon, V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010.
4.	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, " Modern Information Retrieval", Addison Wesley, 1999.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20554	MOBILE ADHOC NETWORKS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire the different types of mac protocols.
2	familiarize with different types of adhoc routing protocols.
3	know the TCP issues in adhoc networks.
4	understand the architecture and protocols of ad-hoc networks.
5	know about the various quality wireless networks.

UNIT I	INTRODUCTION	9

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum, Radio Propagation Mechanisms, Characteristics of the Wireless Channel; Mobile Ad-Hoc Networks (MANETs) and Wireless Sensor Networks (WSNs)- Concepts and Architectures, Applications of Ad-Hoc and Sensor Networks, Design Challenges in Ad- Hoc and Sensor Networks.

UNIT II	MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS	9

Issues in designing a MAC Protocol - Classification of MAC Protocols; Contention based Protocols- Contention based Protocols with Reservation Mechanisms, Contention based Protocols with Scheduling Mechanisms; Channel MAC-IEEE 802.11.

UNIT III	NETWORK PROTOCOLS	9

Addressing issues in AD-HOC Network; Routing Protocols- Design issues, Goals and Classification ,Proactive vs. Reactive Routing, Unicast Routing Algorithms, Multicast Routing Algorithms, Hybrid Routing Algorithm, Power/ Energy aware Routing Algorithm, Hierarchical Routing, QOS aware Routing.

UNIT IV	END -TO - END DELIVERY AND SECURITY	9

Transport Layer- Issues in Designing- Transport Layer Classification, ADHOC Transport Protocols; Security Issues in ADHOC Networks- Issues and Challenges, Network Security Attacks,Secure Routing Protocols.

UNIT V	CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G	9

Cross Layer Design- Need for Cross Layer Design, Cross Layer Optimization, Parameter Optimization Techniques, Cross Layer Cautionary Perspective; Co-operative Networks- Architecture, Methods of Co-operation, Co-operative Antennas; Integration of Ad-Hoc Network with other Wired and Wireless Networks.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	implements the concepts, network architectures and applications of ad hoc and wireless sensornetworks.	Applying (K3)
CO2	create the unique issues in ad-hoc/sensor networks.	Applying (K3)
CO3	identify the protocol design issues of ad hoc and sensor networks.	Analyze (K4)
CO4	understand routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues.	Understanding (K2)
CO5	apply the quos related performance measurements of ad hoc and sensor networks.	Applying (K3)

TEXT BOOKS

1.	C. Siva Ram Murthy, and B. S. Manoj, -"Ad Hoc Wireless Networks: Architectures and Protocols" -Prentice Hall Professional Technical Reference, 2008.
2.	Carlos De Morais Cordeiro, Dharma Prakash Agrawal –"Ad Hoc & Sensor Networks:Theory and

REFERENCES

1.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivanstoj menovic, "Mobile adhoc networking", Wiley-IEEE press, 2004.
2.	Feng Zhao and LeonidesGuibas, -"Wireless Sensor Networks", Elsevier Publication – 2002.
3.	Holger Karl and Andreas Willig –"Protocols and Architectures for Wireless Sensor Networks",Wiley,2005.
4.	Department of English and Foreign Languages SRM University, Rhythm of Lifel, SRM

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium ,1-weak

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

CI20651	NATURAL LANGUAGE PROCESSING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	learn the fundamentals of natural language processing.
2	understand the use of components in nlp.
3	gain knowledge on parsing and methodologies.
4	grasp the role of semantics and pragmatics.
5	acquire the nlp techniques to the applications.

PRE-REQUISITES: Artificial Intelligence, Probability and Statistics

UNIT I	INTRODUCTION	9

Words - Regular Expressions and Automata, Words and Transducers, N-grams, Part-of-Speech, Tagging; Hidden Markov and Maximum Entropy Models.

UNIT II	SPEECH	9

Speech Phonetics - Speech Synthesis, Automatic Speech Recognition, Speech Recognition; Advanced Topics, Computational Phonology.

UNIT III	SYNTAX	9

Formal Grammars of English - Syntactic Parsing, Statistical Parsing, Features and Unification, Language and Complexity.

UNIT IV	SEMANTICS AND PRAGMATICS	9

The Representation of Meaning - Computational Semantics, Lexical Semantics, Computational Lexical Semantics, Computational Discourse.

UNIT V	APPLICATIONS	9

Information Extraction - Question Answering and Summarization, Dialogue and Conversational Agents; Machine Translation - Language similarities and differences, The transfer metaphor, The interlingual idea; Using meaning, Direct translation, Using statistical techniques, Usability and system development.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	describe the fundamentals of natural language processing.	Understanding (K2)
CO2	demonstrate the use of components in NLP.	Applying (K3)
CO3	differentiate on parsing and methodologies.	Analysing (K4)
CO4	discuss the role of semantics and pragmatics.	Analysing (K4)
CO5	identify the applications of the natural language processing.	Applying (K3)

TEXT BOOKS	
1.	Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
2.	Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, O'Reilly Media, 2009.

REFERENCES	
1.	Breck Baldwin, "Language Processing with Java and Ling Pipe Cookbook", Atlantic Publisher, 2015.
2.	Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
3.	Nitin Indurkhya and Fred J. Damerau, " Handbook of Natural Language Processing ", Second Edition, Chapman and Hall/CRC Press, 2010.
4.	Siddiqui T., Tiwary U. S , "Natural language processing and Information retrieval", OUP, 2008

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

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

CI20652	DEEP LEARNING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the basic ideas and principles of neural networks.
2	understand the basic principles of deep learning.
3	familiarize with image processing facilities.
4	understand and implement deep learning architectures.
5	learn the applications of deep learning

PRE-REQUISITES: Artificial Intelligence, Probability and Statistics

UNIT I	DEEP NETWORKS	9

Basic Concept of Neurons - Perceptron Algorithm; Deep Feed forward Networks - Learning XOR;Gradient Based Learning - Hidden Units, Architecture Design; Back-Propagation and Other Differentiation Algorithms.

UNIT II	REGULARIZATION FOR DEEP LEARNING	9

Regularization for Deep Learning - Parameter Norm Penalties, Norm Penalties as Constrained Optimization; Regularization and Under-Constrained Problems; Dataset Augmentation; Noise Robustness; Semi -Supervised Learning; Multitask Learning; Early Stopping; Parameter Tying andParameter Sharing; Sparse Representations - Bagging and Other Ensemble Methods Dropout; Adversarial Training –Tangent Distance, Tangent Prop and Manifold Tangent Classifier.

UNIT III	CONVOLUTIONAL NETWORKS	9

The Convolution Operation - Motivation, Pooling; Convolution and Pooling as an Infinitely StrongPrior - Variants of the Basic Convolution Function; Structured Outputs; Data Types - Efficient Convolution Algorithms; Random or Unsupervised Features; The Neuroscientific Basis for Convolutional Networks.

UNIT IV	RECURRENT AND RECURSIVE NETS	9

Unfolding Computational Graphs; Recurrent Neural Networks; Bidirectional RNNs; Encoder- Decoder Sequence-to-Sequence; Architectures; Deep Recurrent Networks; Recursive Neural Networks; The Challenge of Long-Term Dependencies-Echo State Networks.

UNIT V	APPLICATIONS	9

Images segmentation - Object Detection, Automatic Image Captioning, Image generation with Generative adversarial networks; Video to Text with LSTM models - Attention models forcomputer Vision, Case Study: Named Entity Recognition - Opinion Mining using Recurrent Neural Networks - Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the role of deep learning in machine learning applications.	Understanding (K2)

CO2	design and implement deep learning applications.	Applying (K3)
CO3	critically analyze different deep learning models in image related projects.	Analysing (K4)
CO4	understand and implement deep learning architectures.	Understanding (K2)
CO5	know the various nlp and image processing applications that utilizes deep learning methods.	Analysing (K4)

TEXT BOOKS

1.	Ian Goodfellow , Yoshua Bengio , Aaron Courville , "Deep Learning", MIT Press,2017.
2.	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.

REFERENCES

1.	Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and ArtificialIntelligence", Apress, 2017.
2.	Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRCPress, 2018.
3.	Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
4.	Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicatesstrength of correlation) 3-Strong, 2-Medium , 1-Weak

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

CI20653	INFORMATION VISUALIZATION	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the data types and information, analysis
2	understand the concepts and significance of data visualization.
3	learn the visualization idioms and map data attributes to graphical attributes.
4	evaluate the effectiveness of visualization designs.
5	comprehend the considerations in information dashboard design.

PRE-REQUISITES: Artificial Intelligence, Probability and Statistics

UNIT I	INTRODUCTION	9

Visualization Definition and Need - Data Abstraction, Data Semantics and Types, Data Types, Dataset, Types(DL); Attribute Types - Semantics, Task Abstraction, Analyze tasks abstractly, Actions, Targets, Analyzing and Deriving

UNIT II	ANALYSIS	9

Four levels for Validation - Reasons to Validate, Four levels of Design, Angles of Attack; Threats to Validity - Validation Approaches, Validation Examples; Marks and Channels - Defining Marks and Channels, Using Marks and Channels, Channel Effectiveness; Relative versus Absolute Judgements - Rules of Thumb to be followed, No unjustified 3D, No unjustified 2D, Eyes beat memory; Resolution over Immersion - Overview, Zoom, Filter, Details on demand; Responsiveness is required - Get it Right in Black and White.

UNIT III	TABLES AND SPATIAL DATA	9

Arrange by Keys and Values - Express; Quantitative Values - Separate, Order, and Align; Categorical Regions - Matrix Alignment; Two Keys - Volumetric Grid; Three Keys - Recursive Subdivision; Multiple Keys - Spatial Axis Orientation, Spatial Layout Density, Arrange Spatial data, Geometry, Scalar Fields; One Value - Vector Fields; Multiple Values - Tensor Fields; Many Values.

UNIT IV	NETWORKS, TREES, MAP COLOR	9

Connection; Link Marks - Matrix Views, Connection versus Matrix, Containment; Hierarchy Marks - Map Color and Other Channels, Color Theory, Color maps, Other Channels, Reduce items and attributes, Reasons to Reduce, Filter, Aggregate, Manipulate View; Reasons for Change - Change View over Time, Select Elements, Navigate; Changing Viewpoint - Reducing Attributes.

UNIT V	INFORMATION DASHBOARD DESIGN	9

Clarifying the Vision - Variations in Dashboard Uses and Data, Common Mistakes in Dashboard Design, Fundamental considerations in dashboard design; Power of Visual Perception - Key Goals in the Visual Design process, Dashboard Display Media. Comparing simple plot formats for polling data using R, Exploring and making visual comparisons for football dataset using R.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	describe the data abstraction and data visualization	Understanding (K2)
CO2	design and create data visualizations.	Applying (K3)
CO3	apply data transformations such as aggregation and filtering for visualization.	Applying (K3)
CO4	evaluate choice of colour and visual encoding suitable for visualization.	Applying (K3)
CO5	use knowledge of perception and cognition to design information dashboards.	Applying (K3)

TEXT BOOKS

1.	Tamara Munzner, "Visualization Analysis and Design", CRC Press, 2014.
2.	Stephen Few, "Information Dashboard Design: Displaying Data for At-a-glance Monitoring", analytics Press, Second Edition, 2013.

REFERENCES

	Alexander Telea, "Data Visualization Principles and Practice", CRC Press, Second Edition, 2014.
	Andy Kirk, "Data Visualization: A Successful Design Process", PACKT Publishing, 2012.
	Karl Pover, "Leaning Qlik View Data Visualization", PACKT, 2013.
	Stephen Few, "Show Me the Numbers: Designing Tables and Graphs to Enlighten", Analytics Press, Second Edition, June 2012.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	3	1	1	1	-	-	-	-	-	-	-	2	2	2
CO3	3	1	1	1	-	-	-	-	-	-	-	2	2	2
CO4	3	1	1	1	-	-	-	-	-	-	-	2	2	2
CO5	3	1	1	1	-	-	-	-	-	-	-	2	2	2

CI20654	SERVICE ORIENTED ARCHITECTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	gain understanding of the basic principles of service orientation.
2	understand web service oriented analysis.
3	learn technology underlying the service design.
4	familiarize advanced concepts such as top down and bottom up strategy.
5	to know about various ws -specification standards.

PRE-REQUISITES: Artificial Intelligence, Probability and Statistics

UNIT I	BASICS OF SOA	9

Fundamental SOA, Evolution and Characteristics of SOA, SOA Timeline, ROOTS of SOA - Comparing SOA to past Architectures, SOA vs. Client server architecture, SOA vs. Distributed internet architecture, and SOA vs. Hybrid web service architecture, service orientation and object orientation.

UNIT II	WEB SERVICES	9

Web services —Web services framework, Services, Service descriptions, Messaging with SOAP; Web Services and Contemporary SOA - Message exchange Patterns, Service Activity, Coordination, Atomic Transactions, Business activities, Orchestration, Choreography.

UNIT III	PRINCIPLES OF SERVICE-ORIENTATION	9

Introduction - Service-orientation and the enterprise, Anatomy, Principles of service-orientation; Service Layers- Service layer abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Service layer configuration scenarios.

UNIT IV	PLANNING AND ANALYSIS	9

SOA Delivery Strategies - SOA delivery lifecycle phases, The top-down strategy, The bottom-up strategy, The agile strategy; Service Modeling.

UNIT V	BUILDING SOA-BASED APPLICATIONS	9

WS-BPEL basics —Process elements, partner Links and partner Links elements, partner Link Type element, variable element, get variable Property, sequence element, invoke element, receive element, reply element, reply element, Switch case and otherwise elements, assign, copy, from and to elements, WS- Coordination overview; SOA Platforms.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design the basics of SOA.	Applying (K3)
CO2	desire about the service layers of web services.	Understanding (K2)
CO3	understand and discuss service and design in SOA.	Understanding (K2)
CO4	demonstrate the basic Modelling of SOA.	Applying (K3)
CO5	describe the various applications of SOA.	Understanding (K2)

TEXT BOOKS

1.	Thomas Erl—"Service -Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2008.
2.	Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004.

REFERENCES

1.	Thomas Erl, "SOA Principles of Service Design —(The Prentice Hall Service –Oriented Computing Series from Thomas Erl)", 2005.
2.	Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education,2005.
3.	Ron Schmelzer et al. " XML and Web Services", Pearson Education, 2002.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1- Weak

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

CI20903	HUMAN COMPUTER INTERACTION			3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	learn the foundations of human computer interaction.
2	familiar with the design technologies for individuals and persons with disabilities
3	understand the concept of mobile hci
4	learn the guidelines for user interface
5	understand the wen interfaces

PRE-REQUISITES: Artificial Intelligence, Probability and Statistics

UNIT I	FOUNDATIONS OF HCI	9

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies

UNIT II	DESIGN AND SOFTWARE PROCESS	9

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT III	MODELS AND THEORIES	9

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW

UNIT IV	MOBILE HCI	9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

UNIT V	WEB INTERFACE DESIGN	9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design effective dialog for HCI	Applying (K3)
CO2	design effective HCI for individuals and persons with disabilities	Applying (K3)

CO3	assess the importance of user feedback.	Applying (K3)
CO4	explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites	Analysing (K4)
CO5	develop meaningful user interface.	Applying (K3)

TEXT BOOKS

1.	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2.	Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
3.	Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009. (UNIT-V)

REFERENCES

1.	Alan Cooper, RobertReimann, David Cronin, Christopher Noessel,"About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014
2.	Ben Shneiderman, Catherine Plaisant, Maxine Cohen,Steven Jacobs,NiklasElmqvist"Designing the User Interface: Strategies for Effective HumanComputer Interaction", Sixth Edition, Pearson Education, 2016.
3.	Jenny Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human Computer Interaction", Wiley Student Edition, 4th Edition, Wiley, 2015

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1- Weak

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

CI20904	ANDROID APPLICATION DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand android SDK.
2	gain a basic understanding of android application development.
3	know about android studio development tool.
4	acquire knowledge of android application design.
5	learn to test and publish android applications.

UNIT I	FOUNDATIONS OF HCI	9

Introduction to Android - The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application.

UNIT II	ANDROID APPLICATION	9

Application Using the Android Manifest File; Master the Android Development Tools; Designing Compatible application.

UNIT III	ANDROID USER INTERFACE DESIGN ESSENTIALS	9

Android User Interface Design Essentials - User Interface Screen elements, Designing User Interfaces with Layouts - Working with Dialogs.

UNIT IV	ANDROID APPLICATION DESIGN ESSENTIALS	9

Working with Fragments; Using Android Preferences; working with files and directories; Managing Application resources - Working with different types of resources.

UNIT V	TESTING AND PUBLISHING ANDROID APPLICATION	9

Testing Android application - Testing mobile application, Testing Environment; Leveraging Android Tools and Application; Publishing Android application - Distribution model, application for publication, Publishing on the Android Market.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	identify various concepts of android development.	Applying (K3)
CO2	outline design a simple android application.	Applying (K3)
CO3	utilize rapid prototyping techniques to design user interface.	Applying (K3)
CO4	program mobile applications for the android operating system that use basic and advanced phone features.	Analysing (K4)
CO5	deploy applications to the android marketplace for distribution.	Applying (K3)

	TEXT BOOKS
1.	T.Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson
2.	Education, 3rd ed. (2012).

REFERENCES

1.	Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd.
2.	Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.
3.	Wallace Jackson, "Android Apps for Absolute Beginners", Press, 2012.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1- Weak

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