JSS SCIENCE AND TECHNOLOGY UNIVERSITY
MYSURU

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HANDBOOK

M.Tech. in Networking and Internet Engineering

JSS TECHNICAL INSTITUTIONS CAMPUS

MYSORE - 570 006

Dean Academic
JSS STU, Mysuru

2022-2024

Dean (Engg. & Tech.)
JSS Science & Technology University
MYSURU-570 006

Registrar
JSS Science & Technology University
JSS Technical Institutions' Campus
Mysuru 570 006, Karnataka

About JSS Science and Technology University

JSS Science and Technology University is one of the recent additions to the institutions administered by JSS Mahavidyapeetha, and is the second University being established besides a Medical University at Mysuru. India's higher education system is on the verge of major reforms and JSS Science and Technology University has been established envisioning creating a bright future and a desired learner centric eco-system and transforming into a futuristic global University. The Availability of skilled human resources and trained technical manpower in engineering and technology is a major reason for growing investments in the state. In this context higher education system has a key role and more particularly JSS S&T U with an objective of transforming the students at all levels of higher education including research and innovation with measures to improve quality of workforce.

National Focus: We'll orient our efforts towards overall development of students', aligning our investments with our strategic priorities to cater to the Nations' Vision. We'll streamline our systems and processes to make the most of our resources, and minimise bureaucracy.

Global reach: We'll broaden our efforts to meet the global needs of the larger world community with focused priorities including a multi-cultural community of students and staff and become a truly international university. We'll prepare students for diversified technological environments worldwide, and develop international alliances and partnerships.

Multi-disciplinary approaches: We'll strategically provide encouragement to multi-disciplinary approaches by supporting and developing networks of students, faculty and researchers worldwide. We'll create world leading, multi-disciplinary, learning centers, research institutes that meet our Industries and funders' strategic needs.

The vision of JSS Science and Technology University is to be an effective instrument in enhancement of knowledge in the Society and thus the social transformation.

Our Strategic priority includes:

1. Prominent National Status
2. Quality Teaching & Learning
3. Research of International Repute
4. State of the art infrastructure of International Standard:
5. Open access to knowledge through Distance Education
6. Collaborations & MOU

JSS Science and Technology University strategies to utilize the very best of education technology, optimize teaching methods, and encourage new inter-disciplinary research programmes that help connect teaching and research, including applied and action research projects.

Vision of JSS Science and Technology University

1. Advancing JSS S&T University as a leader in education, research and technology on the international arena.
2. To provide the students a universal platform to launch their careers, vesting the industry and research community with skilled and professional workforce.
3. Accomplishing JSS S&T University as an epicentre for innovation, centre of excellence for research with state of the art lab facilities.
4. Fostering an erudite, professional forum for researchers and industrialist to coexist and to work cohesively for the growth and development of science and technology for betterment of society.

Mission of JSS Science and Technology University

1. Education, research and social outreach are the core doctrines of JSS S&T University that are responsible for accomplishment of in-depth knowledge base, professional skill and innovative technologies required to improve the socio economic conditions of the country.
2. Our mission is to develop JSS S&T University as a global destination for cohesive learning of engineering, science and management which are strongly supported with interdisciplinary research and academia.
3. JSS S&T University is committed to provide world class amenities, infrastructural and technical support to the students, staff, researchers and industrial partners to promote and protect innovations and technologies through patents and to enrich entrepreneurial endeavors.
4. JSS S&T University core mission is to create knowledge led economy through appropriate technologies, and to resolve societal problems by educational empowerment and ethics for better living.

Vision of Sri Jayachamarajendra College of Engineering

Be an international leader in engineering education, research and application of knowledge to benefit society globally.

Mission of Sri Jayachamarajendra College of Engineering

1. To synergistically develop high-quality manpower and continue to stay competitive in tomorrow's world.
2. To foster and maintain mutually beneficial partnerships with our alumni, industry, state and central governments through public services assistance and collaborative research.
3. To create empower individuals with sense of identity.

Vision of the Department of Electronics and Communication Engineering

Be a leader in providing globally acceptable education in electronics and communication engineering with emphasis on fundamentals-to-applications, creative-thinking, research and career-building.

Mission of the Department of Electronics and Communication Engineering

1. To provide best infrastructure and up-to-date curriculum with a conducive learning environment.
2. To enable students to keep pace with emerging trends in Electronics and Communication Engineering.
3. To establish strong industry participation and encourage student entrepreneurship.
4. To promote socially relevant eco-friendly technologies and inculcate inclusive innovation activities.

ABOUT THE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

The department of Electronics and Communication Engineering was established in 1968.The department offers an undergraduate program in Electronics and Communication Engineering, three PG programs namely M.Tech in Industrial Electronics, M.Tech in Network and Internet Engineering and M.Tech in Automotive Electronics. In addition to these, it also offers M.Sc. Engineering by research and Ph.D. programs which provide a platform for bright graduates and postgraduates to conduct research in state-of-the-art technologies. The department is composed of well qualified teaching and technical staff with good retention.

The Department is also a recognized Center under the Quality Improvement Program (QIP) of the Government of India. The well-designed curriculum lays a strong foundation in both the analytical and technological aspects of Electronics and Communication Engineering. It also provides ample opportunities to students to work on mini-projects, develop communication skills, explore internship opportunities in industry and take part in national and international design contests like PACE, Aero-JC, cultural and sports activities etc.

The BE degree in Electronics and Communication Engineering at SJCE, JSSSTU is one of the most sought-after programs in the state and attracts top ranking students. It has a very good placement record and almost 100 % of the eligible students get placement in top companies with a very good package. Department also encourages students to pursue higher studies and to become entrepreneurs. The department has a very active IEEE student chapter which organises National level paper presentation competitions and other events such as Vacation Project Mania, Latex workshops and mini project competitions, etc.

Apart from teaching, the department also guides UG and PG students for getting Internships at renowned Industries and premier Institutes like IISc, IIT's and NIT's, organizes Industrial visits, conducts expert lectures and workshops. The department also has special labs namely Nano Dielectric and devices lab, Visual TCAD and research lab and e-yantra lab which provides space for researchers to carry out experimental investigations and UG and PG students to implement project ideas.

Programmes offered

UG Programme:

1. Bachelor of Engineering in Electronics and Communication Engineering: 4 years duration

PG Programme:

1. Master of Technology in Industrial Electronics: 2 Years duration
2. Master of Technology in Networking and Internet Engineering: 2 Years duration
3. Master of Technology in Automotive Electronics: 2 Years duration

Research Programme:

1. Doctoral Program
2. M.Sc. (Engineering) by research.

Department Faculty Details

Sl. No.	Faculty Name	Qualification	Designation.	Email Id
1	Dr. Shankaraiah	Ph.D.	Professor	shankaraiah@jssstuniv.in shankaraiah@sjce.ac.in
2	Dr. Mahadevaswamy U B	Ph.D.	Professor & Head	mahadevaswamy@jssstuniv.in mahadevaswamy@sjce.ac.in
3	Dr. Gayathri S	Ph.D.	Associate Professor	sgmurthy_65@jssstuniv.in sgmurthy_65@sjce.ac.in
4	Prof. Thyagaraja Murthy A	M. Tech	Associate Professor	thyagarajamurthy@jssstuniv.in thyagarajamurthy@sjce.ac.in
5	Prof. Sujathakumari B A	M. Tech	Associate Professor	sujathakumari@jssstuniv.in sujathakumari@sjce.ac.in
6	Prof. Renuka B S	M. Tech	Associate Professor	renuka@jssstuniv.in renuka@sjce.ac.in
7	Dr. Rudraswamy S B	Ph.D.	Assistant Professor	rudra.swamy@jssstuniv.in rudra.swamy@sjce.ac.in
8	Prof. Halesh M R	M. Tech	Assistant Professor	haleshmr@jssstuniv.in haleshmr@sjce.ac.in
9	Dr. Sudharshan Patil Kulkarni	Ph.D.	Professor	sudarshan_pk@jssstuniv.in sudharshan_pk@sjce.ac.in
10	Dr. Veena M G	Ph.D.	Professor	veenamg@jssstuniv.in veenamg@sjce.ac.in
11	Dr. Gayitri H M	Ph.D.	Associate Professor	gayitrikumar@jssstuniv.in gayitrikumar@sjce.ac.in
12	Prof. Anitha S Prasad	M. Tech	Assistant Professor	anith.sp@jssstuniv.in anith.sp@sjce.ac.in
13	Prof. Pavithra D R	M. Tech	Assistant Professor	pavithra@jssstuniv.in pavithra@sjce.ac.in

14	Prof. Shivaprasad N	M. Tech	Assistant Professor	shivaprasad_n@jssstuniv.in shivaprasad_n@sjce.ac.in
15	Prof. Supreetha M	M. Tech	Assistant Professor	supreetha.manjanna@jssstuniv.in supreetha.manjanna@sjce.ac.in
16	Prof. Puneeth K M	M. Tech	Assistant Professor	kmpuneeth@jssstuniv.in kmpuneeth@sjce.ac.in
17	Prof. Eshwari A Madappa	M. Tech	Assistant Professor	eshwarinaveen@jssstuniv.in eshwarinaveen@sjce.ac.in
18	Prof. Yashwanth S D	M. Tech	Assistant Professor	yashwanth@jssstuniv.in yashwanth@sjce.ac.in
19	Prof. Vinay Prasad M S	M. Tech	Assistant Professor	vpms1408@jssstuniv.in vpms1408@sjce.ac.in
20	Prof. Kavyashree M K	M. Tech	Assistant Professor	kavyashreemk@jsstuniv.in kavyashreemk@sjce.ac.in
21	Dr. Shashidhar R	Ph.D.	Assistant Professor	shashidhar.r@jsstuniv.in shashidhar.r@sjce.ac.in
22	Prof. Chandrashekar Murthy B N	M. Tech	Assistant Professor	chandrashekar@jssstuniv.in chandrashekar@sjce.ac.in
23	Prof. Praveen Kumar M S	M. Tech	Assistant Professor	ms_praveenkumar@jssstuniv.in ms_praveenkumar@sjce.ac.in
24	Prof. Anupama	M.Tech	Assistant Professor	anupama@jssstuniv.in
25	Prof. Madhu Sudan M P	M.Tech	Assistant Professor	madhusudan.mp@jssstuniv.in
26	Prof. Megha K M	M.Tech	Assistant Professor	meghakm@jssstuniv.in
27	Prof. Rakesh M D	M.Tech	Assistant Professor	rakeshmd@jssstuniv.in
28	Prof. Rohith M N	M.Tech, MBA	Assistant Professor	rohithmn@jssstuniv.in
29	Prof. Priyanka D S	M.Tech	Assistant Professor	priyankads@jssstuniv.in
30	Prof. Roopa M	M.Tech	Assistant Professor	roopam@jssstuniv.in
31	Dr. Rakshith B	M.Tech	Assistant Professor	rakshithec@jssstuniv.in

Laboratory facilities:

Sl No	Name of the Lab	Major facility
1	**E-Yantra Lab**	FireBird-V3 Robot, Robotics Atmega - 16A platform, Robotics Atmega - 2600 platform, Servo motor-based gripper kit, programmable 32-bit ARM 9 Robotic platform, Robotic arm, depth sensor camera with adapter.
2	**Networking and Simulation Lab**	Computers, switches, routers, WIFI access, Exata simulator
3	**Automotive Controls Lab**	dSpace, computers, Power Supplies, CRO.
4	**Power Electronics Lab**	CRO, Power supplies, multimeters, motors, Choppers, Inverters.
5	**Communication Lab**	CRO, LCR meter, Spectrum Analyzer, Power Supplies breadboards, Active and Passive Components Digital Storage Oscilloscopes.
6	**VLSI and DSP Lab**	Computers, Cadence, TCAD software, ARM, MSP, FPGA/CPLD, DSP boards.
7	**Nano dielectrics & Devices Lab**	Spin coater, Megohmmeter, Electrospinning Espinnano, HV tester, analytical balance, inclined plane tracking, Vacuum Oven, Contact angle meter.
8	Data Sciences and Machine Learning facility (Central Computing facility)	10 High end client systems, 1 PARAM-SHAVAK C-DAC Server. Systems preloaded with software for deep learning and high-performance computing.

Networking Lab

Communication Lab

E-Yantra Lab - Robotics and Embedded Systems Labs

Structure of Board of Studies:

Structure of Board of Studies:				
Sl. No.	**Category**	**Designation**	**Name of the Person**	
1.	The Dean(s) of the Faculties	Ex-Officio Members	Dr. S B Kivade Principal, SJCE Mysore.	
2.	Dean (Academics)	Ex-Officio Members	Dr. B Manoj Kumar Professor, Dept of Environmental, Dean (Academics), JSS STU	
2.	Head of the Department	Chairperson	Dr. U B Mahadevaswamy Professor and Head, Department of E&C, SJCE-JSSSTU, Mysuru	
3.	All Professors of the Department	Members	1.	Dr.Shankaraiah N
			2.	Dr.Sudarshan Patil Kulkarni
			3.	Dr. M G Veena
4.	Two Senior Associate Professors of the concerned Department by Rotation	Members	1.	Dr S. Gayathri
			2.	Renuka B S
5.	One Senior Assistant Professor of the concerned Department by Rotation	Member	1.	Dr.Rudraswamy S B
6.	One external Subject Expert from any reputed academic/Research Institution/other universities Nominated by the Academic council	Members	1.	Dr. Hariprasad S A. Designation. Director - Faculty of Engineering and Technology Jain (Deemed-to-be University), Bengaluru-560069
			2.	Dr Ravish Aradya H V, Professor & Head, Department of Electronics and Communication Engineering, RVCE, Bengaluru - 560059
7.	One external Subject Expert from any reputed academic/Research Institution/other universities Nominated by the vice Chancellor upon recommendation by theDean of Respective Faculty	Members	1.	Dr. Sushil Kumar Pandey Assistant Professor, Department of ECE, NITK, Surathkal - 575 025
			2.	Dr. P.C.Srikanth Professor & Head, Dean Planning &Development, MCE Hassan-573202.
8.	Two external Members From Concerned Industry/Government Departments/Public sectors	Members	1.	Mr. Raghavendra B R Domain Manager, Intel, Bengaluru - 560103

	undertakings/allied area relating to placement, nominated by the academic council upon recommendation by the Dean of respective faculty		2.	Mr. Venkatasubramanian B Senior Systems Architect, Distinguished Member of Technical Staff (DMTS) at Nokia, Bengaluru - 560045
			3.	Dr. T Shreekanth Project Manager - Automotive, L&T Technology Services, Mysore.
9.	One postgraduate meritorious alumnus, to be nominated by the Head of the Department	Member	1.	Dr. Parameshwara S. Associate Professor & HoD, Dept. of Electronics & Communication Engineering, National Institute of Engineering, Mysuru. 570008
10.	The chairperson, Board of studies, may with the approval of the vice chancellor, co-opt as members: a) One external Subject Expert from reputed academic/Research Institution/other universities/industry/Government Departments/Public Sector undertakings, whenever special Courses of studies or to be formulated. b) Two other members of faculty of the concerned department.	Members	1.	Dr. Basavaraj Talawar Assistant Professors, Dept of CSE, NITK, Surathkal - 575 025
			2.	Dr. Suresh K V Professor, Dept. of Electronics & Communication Engineering Siddaganga Institute of Technology, Tumkur– 572103
			3.	B.A.Sujatha Kumari Associate Professor E&C Dept.SJCE-JSSSTU
			4.	A.Thyagaraja Murthy Associate Professor E&C Dept.SJCE-JSSSTU

M. Tech. Program Structure 2022-23

Scheme of Teaching and Examination for I to IV semester

Semester	Credits
I	27
II	27
III	10
IV	16
TOTAL	**80**

Credit Pattern

Semester	Type of Course	Number	Credits
I	Professional Core Professional Elective Professional Core Laboratory Mini Project with Seminar/ Lab	04 02 01 01	16 credits 08 credits 1.5 credits 1.5 credits **Sub Total = 27 credits**
II	Professional Core Professional Elective Open Elective Research Methodology and IPR Professional Core Laboratory	03 02 01 01 01	12 credits 08 credits 04 credits 1.5 credits 1.5 credits **Sub Total = 27 credits**
III	Internship/ Industrial Training Project work (Phase 1)	01 01	04 credits 06 credits **Sub Total = 10 credits**
IV	Project work (Phase 2)	01	**16 credits**
TOTAL			**80 credits**

- **Program Overview**

Semester Wise Credits

Semester	Credits	Total Marks
I	27	700
II	27	700
III	10	100
IV	16	300
Total	**80**	**1800**

Grading System

Marks	Grade
90 – 100	**S**
75 – 89	**A**
66 – 74	**B**
56 – 65	**C**
50 – 55	**D**
45 – 49	**E**
< 45	**F**

Notation in the Scheme

CIE	**Continuous Internal Evaluation**
SEE	**Semester End Examination**
L	**Lecture**
T	**Tutorial**
P	**Practical**

Program Outcomes

PO1: Research skills: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Presentation Skills: An ability to write and present a substantial technical report/ document.

PO3: Domain-specific knowledge: An ability to demonstrate a degree of mastery in the field of Networking and communication.

PO4: Engineering solution: Analyze the problem, design, and demonstrate solutions in the area of networking and Communication.

PO5: Modern tools usage: Investigate real-time communication problems and provide solutions using modern tools.

PO6: Life-long learning: Create an ability to address multidisciplinary research challenges and develop skills for management and entrepreneurship, adhering to ethics.

Program Educational Objectives

PEO 1: To empower graduates to formulate, analyze, design and provide innovative solutions in the field of internetworking and communication for real life problems.

PEO2: To ensure that graduates have adequate exposure to research and emerging technologies through industry interaction.

PEO3: To enable graduates to pursue successful professional career with ethics and social responsibilities of the engineering profession.

QUALITY POLICY

The Department of **Electronics and communication engineering** is committed to provide highest quality education and training.

1. To inculcate moral and ethical values among the students and the staff.
2. To provide a sound academic and research environment to students for a complete learning experience.
3. To develop strong Industry-Institute –Interaction to enrich the teaching learning process and exploring career opportunities for students.
4. To train and develop faculty members for imparting quality education, to satisfy the industrial and societal needs of the aspirants
5. Implementation of feedback responses from the stakeholders on quality related processes in curriculum enhancement.
6. Enhancing skillset in the identified thrust areas of the department.

M. Tech (Networking and Internet Engineering) PROGRAM

SEMESTER I

Sl. No.	Code	Course Title	Course	Teaching Hours per Week				Credits	Examination			
				L	T	P	Total Contact Hours		CIE	SEE	Total Marks	Duration in Hours
1	22PNI110	Advanced Communication Networks	PCC 1	**3**	**2**	**0**	5	4	40	60	100	3
2	22PNI120	Cryptography and Network security	PCC 2	**3**	**2**	**0**	5	4	40	60	100	3
3	22PNI130	Object oriented Programming using Java	PCC 3	**3**	**2**	**0**	5	4	40	60	100	3
4	22PNI140	Network programming	PCC 4	**3**	**2**	**0**	5	4	40	60	100	3
5	22PNI15Y	Professional Elective Course - 1	PEC 1	**4**	**0**	**0**	4	4	40	60	100	3
6	22PNI16Y	Professional Elective Course -2	PEC 2	**4**	**0**	**0**	4	4	40	60	100	3
7	22PNI170L	Networking Lab -1	PCCL	**0**	**0**	**3**	3	1.5	50	-	50	-
8	22PNI180	Design and Implementation Lab	Mini Project with Seminar (MPS)/ Lab (PCCL)	**0**	**0**	**3**	3	1.5	50	-	50	-
TOTAL							**34**	**27**	**340**	**360**	**700**	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; S: Seminar; SDA: Skill Development Activities
PCC: Professional Core Course; PEC: Professional Elective Course; PCCL: Professional Core Course Laboratory; MPS: Mini Project with Seminar

Professional Elective 1	
Course Code	**Course Title**
22PNI151	Wireless Networks
22PNI152	Big Data and Analytics
22PNI153	Advances in Operating systems

Professional Elective 2	
Course Code	**Course Title**
22PNI161	Cloud computing and virtualization
22PNI162	Cyber forensics and information security
22PNI163	Social Network Analysis

M. Tech. (Networking and Internet Engineering) PROGRAM

SEMESTER II

Sl. No.	Code	Course Title	Course	Teaching Hours per Week				Credits	Examination			
				L	T	P	Total Contact Hours		CIE	SEE	Total Marks	Duration in hours
1	22PNI210	Mobile computing	PCC 5	**3**	**2**	**0**	**5**	4	40	60	100	3
2	22PNI220	Protocol engineering	PCC 6	**3**	**2**	**0**	**5**	4	40	60	100	3
3	22PNI230	Web services	PCC 7	**3**	**2**	**0**	**5**	4	40	60	100	3
4	22PNI24Y	Professional Elective Course - 3	PEC 3	**4**	**0**	**0**	**4**	4	40	60	100	3
5	22PNI25Y	Professional Elective Course - 4	PEC 4	**4**	**0**	**0**	**4**	4	40	60	100	3
6	22PXX26OE	Open Elective Course	OEC	**4**	**0**	**0**	**4**	4	40	60	100	3
7	22PNI270	Research Methodology and IPR	MC	2	0	0	2	1.5	50	-	50	-
8	22PNI280L	Networking Lab -2	PCCL	0	0	3	3	1.5	50	-	50	-
TOTAL							**32**	**27**	**340**	**360**	**700**	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; S: Seminar; SDA: Skill Development Activities
PCC: Professional Core Course; PEC: Professional Elective Course; OEC: Open Elective Course; MC: Mandatory Course; PCCL: Professional Core Course Laboratory

Professional Elective 3	
Course Code	**Course Title**
22PNI241	IOT and Applications
22PNI242	Ubiquitous Computing
22PNI243	Software Defined Networks

Professional Elective 4	
Course Code	**Course Title**
22PNI251	5G technologies
22PNI252	Advances in Storage area Networks
22PNI253	Artificial Intelligence and Machine Learning

Open Elective Course	
Course Code	**Course Title**
22PAE26OE	Nano dielectrics
22PIE26OE	Deep Learning for Speech Processing
22PNI26OE	Advanced wireless technology

SEMESTER III

Sl. No.	Code	Course Title	Course	Teaching Hours				Credits	Examination			
				L	T	P	Total Contact Hours		CIE	SEE	Total Marks	Duration in hours
1	22PNI310P	Internship/ Industrial Training	INT	Minimum 08 weeks commencing from intervening vacation of II and III semesters			8 weeks*	4	50	-	50	-
2	22PNI320P	Project Work (Phase-1)	PROJ	-	-	12 weeks	12 Weeks**	6	50	-	50	-
TOTAL								**10**	**100**		**100**	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; S: Seminar; SDA: Skill Development Activities
INT: Internship/ Industrial Training; PROJ: Project Work

*8 weeks = (40 hours / week in Industry + 2 hours / week in college)

**12 Weeks: 40 Hours / week.

SEMESTER IV

Sl. No.	Code	Course Title	Contact hours	Total credits	CIE	SEE	Total Marks	Exam Duration in hours
1	22PNI410P	Project Work (Phase-2)	22 weeks***	16	100	200	300	3
Total				**16**				

***22 Weeks: 40 Hours / week

I Semester

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 110**	*Total Credits*	**4**	*Course Type*	Professional Core Course		
Course Title	**Advanced Communication Networks**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Fundamental of Communication Networks

COURSE OBJECTIVE:

1. To understand the basic concepts of data communication, layered model, protocols and interworking between computers.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the concepts of layered network models, Protocols and devices.	L2
CO2	Examine the functionalities of data link layer, network layer Protocol and its design issues.	L4
CO3	Analyze various Transmission Protocols and Queuing Techniques.	L4
CO4	Evaluate the transmission of real time signals on multimedia network	L4
CO5	Function individually to implement various network configurations using modern tool and prepare document adhering to standard practices	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Packet Switched Networks:** Basic Definition, Types, Packet size and Optimization. **Foundations of Networking Protocols:** TCP/IP model, OSI Model, Internet protocols and addressing.	**7**	**5**

	Networking Devices: Switching and routing devices, Router structure **Data Link and Transmission:** Data links, Wired links and Transmission, Error detection and correction and link level flow controls.		
2	**Networks of LAN:** Basic Topologies, LAN Protocols, MAC and IP Addresses, Classification of MAC Protocols, Contention Access and Round Robin access MAC, Networks of LAN. **Routing and internetworking:** Network layer routing, least cost path algorithms, non-least cost algorithms, Intra domain routing protocols, inter domain routing protocols, Congestion control in network layer.	**8**	**5**
3	**Transport and End to End protocols**: Transport layer, TCP, UDP, Mobile transport protocols, TCP Congestion control. **Applications and Network management:** Overview, DNS, Remote Login Protocols, Email, FTP, HTTP and Network Management.	**8**	**5**
4	**Packet Queues and Delay Analysis**: Little's Theorem, Birth-Death Process, Queuing disciplines, Markovian systems, non-Markovian systems, Networks in Queues, **Basics of QoS and Resource allocation**: Overview, Integrated Service QoS, Differentiated Service QoS, Resource Allocation: Management, Classification and Fairness in Resource Allocation.	**8**	**5**
5	**VPNs, Tunneling and Overlay networks:** VPN, MPLS, P2P networks. **Basics of VOIP and Multimedia Networking:** Overview, VoIP Signaling Protocol, RTCP, Distributed Multimedia Networking. **Mobile adhoc networks:** Overview, Routing and Routing Protocols**.**	**8**	**6**

Text Books:

1. **Nader Mir,**" Computer *and communication networks*", Pearson Education, Second Edition, 2015.

Reference Books:

1. **Wayne Tomasi**," Introduction to data communications and networking", Pearson Education, Third Edition, 2007
2. **Kurose and Ross**," Computer *Networking*", Pearson Education, Third Edition, 2007
3. **Leon Garcia and Indra Widjaja**," *Communication Networks*", TMH Second Edition, 2004

SWAYAM/NPTEL:

1. https://onlinecourses.nptel.ac.in/noc22_ee61
2. https://archive.nptel.ac.in/courses/106/105/106105183/

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open-Source Tool	Programming

Self-Learning Exercises:

1. Mini Projects (Simulation)

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	3		
CO3			3	3		
CO4			3	3		
CO5	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 120**	*Total Credits*	**4**	*Course Type*	Professional Core Course		
Course Title	**Cryptography and Network security**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Computer Networks

COURSE OBJECTIVE:

1. To understand network security concepts
2. To learn various cryptographic algorithms.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain Cryptographic principles and Network Security architecture, mechanism and standards	L2
CO2	Analyze the various Cryptographic Algorithms.	L3
CO3	Examine network security procedures using tools.	L4
CO4	Function individually to implement various cryptographic algorithms using modern tool and prepare document adhering to standard practices.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Overview:** Services, Mechanisms and attacks, OSI security architecture, Model for network security. Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transportation techniques, Rooter machine, Steganography, Problems.	**8**	**5**
2	**Block Ciphers** and DES (Data Encryption Standards): Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes operation, AES Problems.	**8**	**5**
3	**Public Key Cryptography and RSA:** Principles of public key cryptosystems, RSA algorithm, Problems. Other Public Key Crypto Systems and Key Management: Key management, DiffieHellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems.	**8**	**5**

4	**Message Authentication and Hash Functions:** Authentication requirements, Authentication functions, Message authentication codes, Hah Functions, Security od Hash functions and MAC's, Problems. Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard. Authentication Applications: Kerberos, X.509 authentication services, Authentication protocols, Digital Signature standard. **Application Layer security:** Electronic Mail Security: Pretty good privacy, S/MINE	**8**	**5**
5	**Security at transport and Network layers:** Overview, IP security architecture, Authentication header, Security associations, Key management, Problems. **Firewalls:** Firewall design principles, trusted systems, System viruses Problems and new research and advanced topics.	**7**	**6**

Text Books:

1. **William Stallings,** "Cryptography and network Security – principles and practice",7th edition, Pearson India. Prentie Hall of India, 2019.
2. **Behrouz A Forouzan, Debdeep Mukhopadhyay,** "Cryptography and Network Security" 3rd Edition, McGraw-Hill, 2015.

Reference Books:

1. **Cryptography and Network security**", 3 rd Ed, McGraw-Hill Education,2013.

Web/Digital resources:

1. https://www.cs.vsb.cz/ochodkova/courses/kpb/cryptography-and-network-security_-principles-and-practice-7th-global-edition.pdf

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/106105162
2. https://archive.nptel.ac.in/courses/106/105/106105031/

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Writing codes to practice cryptographic principles	c/c++/ java	Coding
2	Packet sniffing tool	wireshark	Usage

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	3		
CO3			3	3	2	
CO4	3	3	2	3	2	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI130**	*Total Credits*	*4*	*Course Type*	Professional Core Course		
Course Title	***Object oriented programming using Java***						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

Course Prerequisite: Basic Knowledge of any Programming Language.

COURSE OBJECTIVE:

1. To understand the basic concepts and fundamentals of platform independent object-oriented language.
2. To learn the programming skills using exception handling, collections, networking and database connectivity.

COURSE OUTCOMES (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Develop programs on object-oriented concepts.	L3
CO2	Apply the concepts of I/O streams and exception handling to develop efficient and error free programs	L3
CO3	Design the Java applications using threads and networking.	L4
CO4	Demonstrate the Java programming skills in the analysis and simulation using various IDE tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction to Java**, The Java Programming Environment, Fundamental Programming Structures, Datatypes, operators, String handling, Wrapper classes, Control statements.	8	5
2	**Introducing Classes**, Inheritance, Polymorphism, Inner Classes, Packages and Interfaces.	8	6
3	**Exception Handling -** Fundamentals, Exception Types, Java's Built-in Exceptions, User Defined exceptions. **I/O Streams:** Byte stream, character stream, object serialization, object externalization.	8	5
4	**Multithreading**–Java Thread model, Creating a Threads, Creating Multiple Threads, Thread life cycle, Thread Priorities, Thread Synchronization, Inter-thread Communication.	8	5
5	**Collections-** Collections Overview ,The Collection Interfaces, The Collection Classes, Accessing a Collection via an Iterator, Sets, Lists, Maps, Vector Class **JDBC**- JDBC Driver Types, JDBC Packages, Database Connection, Statement Objects; ResultSets	7	5

Text Books:

1. Herbert Schildt, *Java: The Complete Reference***,** Mcgraw-Hill Education,2019.
2. E Balagurusamy. *Programming with Java*, 2019

Reference Books:

1. Cay S Horstmann, *Core Java Volume I--Fundamentals ,9th Edition, Core Series,* Prentice Hall, 2012.
2. Cay S Horstmann, *Core Java, Volume II--Advanced Features (9th Edition) (Core Series***)** , Prentice Hall, 2013.

Web/Digital resources:

1. https://fr.coursera.org/lecture/distributed-programming-in-java/2-1-introduction-to-sockets-XiZXU

SWAYAM/NPTEL:

1. http://nptel.ac.in/courses/106106147/3
2. https://onlinecourses.nptel.ac.in/noc19_cs07/preview
3. https://nptel.ac.in/courses/106105084/28

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	ExpectedSkill /Ability
1	**RMI:** Remote Method Invocation, Servlets programming, Networking	programming using IDE	Java programming

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2	3		3	3		
CO3			3	3	2	2
CO4	3	2	3	3	2	2

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 140**	*Total Credits*	*4*	*Course Type*	Professional Elective Course		
Course Title	**Network programming**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE:

Principles of Data *Communications* Networks and *System* Development in the UNIX/LINUX Environment.

COURSE OBJECTIVE:

1. To learn Sockets Programming and Network Security concepts.
2. To gain knowledge on Client/Server Programming and network architecture.
3. To learn Application layer protocols.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic networking concept with communication modules and processes using Unix/Linux.	L2
CO2	Develop program for client server model for various networking applications.	L3
CO3	Analyze the real-world problems using sockets-based programming.	L4
CO4	Examine the design considerations in building network applications considering multitasking and interoperability	L5
CO5	Take part individually to implement assigned tasks using modern tool and document the work adhering to standard practices.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	Introduction: History, Layering, OSI Model, Processes, a Simplified Model, Client-Server Model. The UNIX Model: Introduction, Basic Definitions, Input and Output, Signals, Process Control, Daemon Processes	**8**	**5**
2	Interprocess Communication: Introduction, File and Record Locking, A Simple Client-Server Example, Pipes, FIFOs, Streams and Messages, Name Spaces, System V IPC: Message Queues, Semaphores, Shared Memory, Sun RPC.	**8**	**5**

3	Introduction Transport Layer Sockets Introduction Elementary TCP Sockets TCP Client/Server Example Elementary SCTP Sockets SCTP Client/Server Example Name and Address Conversions	**8**	**5**
4	IPv4 and IPv6 Interoperability, Daemon Processes and the inetd Super server, Advanced I/O Functions Unix Domain Protocols, Non-blocking I/O, ioctl Operations	**8**	**5**
5	Routing Sockets, Key Management Sockets, Broadcasting, Multicasting, Advanced UDP Sockets, Advanced SCTP Sockets, Out-at-Band Data, Signal-Driven I/O, Threads, IP Options, Raw Sockets, Data link Access, Client/Server Design Alternatives.	**7**	**6**

Text Books:

1. **Richard Stevens**, "UNIX Network Programming", 3 rd edition, Prentice Hall, 2014.
2. **Richard Stevens**: "UNIX Network Programming", Volume 1, Second Edition: Networking APIs: Sockets and XTI, Prentice Hall, 1998.
3. **Richard Stevens**: "UNIX Network Programming", Volume 2, Second Edition: Inter-process Communications, Prentice Hall, 1999.

Reference Books:

1. **David Reilly and Michael Reilly**, *Java Network Programming and Distributed Computing*, Addison-Wesley (ISBN: 0-201-71037-4).
2. **W. Richard Stevens**, *TCP/IP Illustrated, Volume 1: The Protocols*, Addison-Wesley, 1994 (ISBN: 0201633469).
3. **W. Richard Stevens, Bill Fenner & Andrew M. Ruddof**, *Unix Network Programming*, **Volume** *The Sockets Networking API* ; 3rd. edition, Addison-Wesley 2004.

Web/Digital resources:

1. **https://www.youtube.com/watch?v=fhWFTckyHuA**
2. **https://www.youtube.com/watch?v=vU4ejtRc-vk**

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/117106113

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill /Ability
1	Client and server programs, Definition socket and socket programming	C /Python programming	IPC
2	Server programming, process to process communication	Python programming	IPC

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4			3	3	3	
CO5	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 151**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -1		
Course Title	**Wireless Networks**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Fundamentals of communication Systems.

COURSE OBJECTIVE:

1. To understand the concept of Wireless networks, protocol stack and standards.
2. To study fundamentals of 3G Services, its protocols and applications.
3. To learn evolution of 4G Networks, its architecture and applications.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamentals of wireless communications.	L2
CO2	Apply knowledge of TCP/IP extensions for mobile and wireless networking.	L3
CO3	Analyze characteristics features of advanced wireless technologies.	L4
CO4	Design and implement wireless network environment for various application using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Wireless LAN:** Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security – IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX.	**12**	**0**
2	**Mobile Network Layer:** Introduction – Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-	**10**	**0**

	Network layer in the internet- Mobile IP session initiation protocol – mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing.		
3	**Mobile Transport Layer**: TCP enhancements for wireless protocols – Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility – Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP – TCP over 3G wireless networks.	**10**	**0**
4	**Wireless Wide Area Network:** Overview of UTMS Terrestrial Radio access network-UMTS Core Network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High Speed Downlink packet access (HSDPA)- LTE network architecture and protocol.	**10**	**0**
5	**Advanced Wireless Technologies:** Introduction – 4G vision – 4G features and challenges – Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio, 5G Networks.	**10**	**0**

Text Books:

1. **Jochen Schiller**," *Mobile Communications*", Second Edition, Pearson Education 2012.
2. **Vijay Garg**, "*Wireless Communications and networking*", First Edition, Elsevier 2007.

Reference Books:

1. **Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming**, "*3G Evolution HSPA and LTE for Mobile Broadband*, Second Edition, Academic Press, 2008.
2. **Anurag Kumar, D.Manjunath, Joy kuri,** "*Wireless Networking*", First Edition, Elsevier 2011.
3. **Simon Haykin, Michael Moher, David Koilpillai**, "*Modern Wireless Communications*", First Edition, Pearson Education 2013.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open-Source Tool	Programming

Self-Learning Exercises:

1. Mini Projects (Simulation)

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3			
CO3			3			
CO4	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 152**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -1		
Course Title	**Big Data and Analytics**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Basic knowledge of any programming language and databases.

COURSE OBJECTIVE:

1. To learn an overview of Apache Hadoop, HDFS Concepts
2. To Understand Hadoop Eco System and Map Reduce Techniques.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain different techniques in big data analytics.	L2
CO2	Solve statistical and mathematical problems related to large data sets	L3
CO3	Apply HADOOP framework and Map Reduce technique for different datasets.	L3
CO4	Apply tools to analyze and compare structured and unstructured data used different Datasets.	L4
CO5	Survey advances in the Big Data by engaging in self-study and give an effective presentation with proper documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Introduction to Big Data Platform:** Challenges of Conventional Systems -Intelligent data analysis – Nature of Data -Analytic Processes and Tools -Analysis vs Reporting -Modern Data Analytic Tools -Statistical Concepts: Sampling Distributions -Re-Sampling - Statistical Inference Prediction Error	**10**	**0**
2	**Mining Data Streams**: 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	**10**	**0**

	Studies -Real Time Sentiment Analysis, Stock Market Predictions.		
3	**Hadoop:** History of Hadoop-The Hadoop Distributed File System – Components of Hadoop Analyzing the Data with Hadoop-Scaling Out-Hadoop Streaming-Design of HDFS-Java interfaces to HDFS Basics-Developing a Map Reduce Application-How Map Reduce Works- Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort –Task execution - Map Reduce Types and Formats-Map Reduce Features.	**10**	**0**
4	**Hadoop Environment:** Setting up a Hadoop Cluster -Cluster specification -Cluster Setup and Installation –Hadoop Configuration-Security in Hadoop -Administering Hadoop –HDFS - Monitoring-Maintenance- Hadoop Benchmarks-Hadoop in the cloud.	**10**	**0**
5	**Frameworks:** 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 Info Sphere Big Insights and Streams. Visualizations -Visual data analysis techniques, interaction techniques; Systems and applications.	**12**	**0**

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.

Reference Books:

1. **Zikopoulos, Paul, Chris Eaton**, "*Understanding Big Data: Analytics for Enterprise Class Hadoop an d Streaming Data*", Tata McGraw Hill Publications, 2011.

SWAYAM/NPTEL:

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

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Demonstrating HADOOP and Map Reduce techniques using appropriate tools	Linux	

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3			
CO3			3	3		
CO4			3	3	3	
CO5	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI153**	*Total Credits*	*4*	*Course Type*	Professional Elective Course - 1		
Course Title	**Advances in Operating Systems**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Fundamental of Operating Systems

COURSE OBJECTIVE:

1. To learn distributed operating system concepts
2. To Study distributed resource management components.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the Concept of Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system	L2
CO2	Illustrate the various resource management techniques for distributed systems.	L2
CO3	Identify the different features of real time and mobile operating system	L3
CO4	Modify existing open-source kernels in terms of functionality using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Operating System Overview, Process description & Control**: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems, Process, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues.	**10**	**0**
2	**Threads, SMP, and Microkernel, Virtual Memory:** Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating	**10**	**0**

	System Software, UNIX Memory Management, Windows Vista Memory Management, Summary		
3	**Multiprocessor and Real-Time Scheduling:** Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSl) Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock	**10**	**0**
4	**Embedded Operating Systems:** Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits.	**10**	**0**
5	**Kernel Organization:** Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine, Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management, Running Process Manager, Creating a new Task, IPC and Synchronization, The Scheduler, Memory Manager, The Virtual Address Space, The Page Fault Handler, File Management. The windows NT/2000/XP kernel: Introduction, The NT kernel, Objects, Threads, Multiplication Synchronization, Traps, Interrupts and Exceptions, The NT executive, Object Manager, Process and Thread Manager, Virtual Memory Manager, I/o Manager, The cache Manager Kernel local procedure calls and IPC, The native API, subsystems.	**12**	**0**

Text Books:

1. **William Stallings**: "*Operating Systems: Internals and Design Principles*", 6th Edition, Prentice Hall, 2013.
2. **Gary Nutt**, "Operating *Systems*", 3rd Edition, Pearson, 2014

Reference Books:

1. **Silberschatz, Galvin, Gagne,** "Operating System Concepts", 8th Edition, Wiley, 2008
2. **Andrew S. Tanenbaum, Albert S. Woodhull**, "Operating Systems, Design and Implementation", 3rd Edition, Prentice Hall, 2006.
3. **Pradeep K Sinha**, "Distribute Operating Systems, Concept and Design", PHI, 2007

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/106108101

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open-Source Tool	Programming

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**20PNI 161**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -2		
Course Title	**Cloud Computing and Virtualization**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Basic Knowledge of any Programming Language and computers networks

COURSE OBJECTIVE:

1. To understand the fundamentals and essentials of Cloud Computing.
2. To learn the principles of virtualization technologies and cloud computing

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Identify the architecture, infrastructure and delivery models of Cloud Computing.	L3
CO2	Summarize the key technologies, strengths, and limitation of cloud computing.	L2
CO3	Explain the virtualization and its implementation.	L2
CO4	Apply the various cloud resource management and scheduling algorithms to cloud Computing Scenarios.	L3
CO5	Function individually to implement various Cloud computing applications using modern tool and prepare document adhering to standard practices.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	Introduction, Cloud Infrastructure Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.	**10**	**0**
2	**Cloud Computing Application Paradigms:** Challenges of cloud	**10**	**0**

	computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study on different areas and applications.		
3	**Cloud Resource Virtualization:** Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization.	**10**	**0**
4	**Cloud Resource Management and Scheduling**: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling.	**10**	**0**
5	**Cloud Security, Cloud Application Development:** Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2.	**12**	**0**

Text Books:

1. **Dan C Marinescu**: "*Cloud Computing Theory and Practice*". Elsevier (MK) 2013.

Reference Books:

1. **Rajkumar Buyya , James Broberg, Andrzej Goscinski**: "*Cloud Computing Principles and Paradigms*", Willey 2014.
2. **John W Rittinghouse, James F Ransome**: "*Cloud Computing Implementation, Management and Security*", CRC Press 2013.

Web/Digital resources:

1. https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/212-Cloud-Computing-Theory-and-Practice-Dan-C.-Marinescu-Edisi-2-2017.pdf
2. https://textbooks.elsevier.com/manualsprotectedtextbooks/9780124046276/cloud_computing_solutions.pdf

SWAYAM/NPTEL:

1. https://archive.nptel.ac.in/courses/106/105/106105167/

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Deploy an application in cloud platform	AWS/GCP/Azure	Programming

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4			3	3		
CO5	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 162**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -2		
Course Title	**Cyber forensics and information security**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Cryptography and Network security

COURSE OBJECTIVE:

1. To understand the threats in networks and security concepts.
2. To learn authentication applications in different networks.

COURSE OUTCOMES (COs): After the completion of the course, the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the cyber security needs of an organization.	L2
CO2	Analyze software vulnerabilities and security solutions.	L3
CO3	Design operational and strategic cyber security strategies and policies.	L3
CO4	Simplify the cyber security solutions using security forensics software tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**NETWORK LAYER SECURITY & TRANSPORT LAYER SECURITY** - IPsec Protocol - IP Authentication Header - IP ESP - Key Management Protocol for IPsec. Transport layer Security: SSL protocol, Cryptographic Computations – TLS Protocol.	**10**	**0**
2	**E-MAIL SECURITY & FIREWALLS** - PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.	**10**	**0**
3	**INTRODUCTION TO COMPUTER FORENSICS** - Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. Forensics Technology and Systems - Understanding Computer	**10**	**0**

	Investigation – Data Acquisition.		
4	**EVIDENCE COLLECTION AND FORENSICS TOOLS** - Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.	**10**	**0**
5	**ANALYSIS AND VALIDATION** - Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.	**12**	**0**

Text Books:

1. **Man, Young Rhee**, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
2. **Nelson, Phillips, Enfinger, Steuart,** "Computer Forensics and Investigations", Cengage Learning, India Edition, 2008.
3. **Marjie T.Britz,** "Computer Forensics and Cyber Crime": An Introduction", 3 rd Edition, Prentice Hall, 2013.

Reference Books:

1. **John R.Vacca,** "Computer Forensics", Cengage Learning, 2005.
2. **Richard E.Smith,** "Internet Cryptography", 3 rd Edition Pearson Education, 2008.

SWAYAM/NPTEL:

1. **https://onlinecourses.swayam2.ac.in/cec21_ge10/preview**
2. **https://onlinecourses.swayam2.ac.in/cec20_lb06/preview**

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Perform some Ethical hacking to understand the threats and vulnerability.	Any open-source tools	Programming

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4		3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI163**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -2		
Course Title	**Social Network Analysis**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Probability and statistics.

COURSE OBJECTIVE:

1. **To** apply theoretical foundations of various strategies for modeling social network dynamics.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamental concept and terminologies used in social network.	L2
CO2	Demonstrate, summarize and compare different social networks.	L2
CO3	Explain basic principles behind network analysis algorithms.	L2
CO4	Analyze the real-world social network issues using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Introduction to social network analysis and Descriptive network analysis:** Introduction to new science of networks. Networks examples. Graph theory basics. Statistical network properties. Degree distribution, clustering coefficient. Frequent patterns. Network motifs. Cliques and k-cores.	**10**	**0**
2	**Network structure, Node centralities and ranking on network:** Nodes and edges, network diameter and average path length. Node centrality metrics: degree, closeness and betweenness centrality. Eigenvector centrality and PageRank. Algorithm HITS.	**10**	**0**
3	**Network communities and Affiliation networks:** Networks communities. Graph partitioning and cut metrics. Edge betweenness. Modularity clustering. Affiliation network and bipartite graphs. 1-mode projections. Recommendation systems.	**10**	**0**

4	**Information and influence propagation on networks and Network visualization:** Social Diffusion. Basic cascade model. Influence maximization. Most influential nodes in network. Network visualization and graph layouts. Graph sampling. Low -dimensional projections	**10**	**0**
5	**Social media mining and SNA in real world: FB/VK and Twitter analysis:** Natural language processing and sentiment mining. Properties of large social networks: friends, connections, likes, re-tweets.	**12**	**0**

Text Books:

1. **David Easley and John Kleinberg**, "*Networks, Crowds, and Markets: Reasoning About a Highly Connected World*" Cambridge Publisher, 2010.
2. **Eric Kolaczyk, Gabor Csardi**, "*Statistical Analysis of Network Data with R*" Springer, 2014.

Reference Books:

1. **Stanley Wasserman and Katherine Faust**, "*Social Network Analysis. Methods and Applications*", Cambridge University Press, 1994.

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/106106169

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Modern tools	

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3					
CO2	3	3				3
CO3	2	3	3			
CO4	3	3	3			

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22PNI 170L	Total Credits	1.5	Course Type	Professional Core Course Laboratory		
Course Title	Networking Lab- 1						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	100 %	-	100 %
	Practical	39	1.5	Maximum Marks	50 Marks	-	50 Marks
	Total	39	1.5	Minimum Marks	25 marks	-	25* Marks

COURSE PREREQUISITE: Fundamentals of Computer Networks.

COURSEOBJECTIVE:

1. To conduct computer communication network simulations.
2. To Design various network configuration using Cisco Packet Tracer/Exata simulation/emulation software's.

COURSE OUTCOMES (COs): After completing this course, students should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Demonstrate practically the significance of computer network principles, and techniques.	L2
CO2	Design and Analyze Various Routing protocols and addressing schemes by creating various network configurations.	L4
CO3	Take part individually, complete the task adhering to schedule and communicate effectively in written and oral Presentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool. **Using CISCO packet Tracer, perform the following experiments** a. Configure a basic Network topology. b. HTTP, DNS, Ping and Trace. c. Investigate Unicast, Broadcast and Multicast Traffic.	3
2	**Using CISCO Packet Tracer, Perform the following experiments.** a. Subnetting – FLSM (Fixed Length Subnet Mask) b. Subnetting – VLSM (Variable Length Subnet Mask)	3

3	**Using CISCO Packet Tracer, Perform the following experiments** a. Skills Integration challenge-planning subnets and configuring IP addresses. b. Observing the effects of collision in a shared media environment. c. Static routing and default routing.	3
4	**Using CISCO Packet Tracer, Perform the following experiments** a. Configure the given Network Topology b. Configure them by using RIP Routing Protocol. c. Study the different RIP Timer used in RIP	3
5	**Using CISCO Packet Tracer, Perform the following experiments** a. Configure the given Network Topology b. Configure them by using OSPF Routing Protocol. c. Study the OSPF Process and its States.	3
6	**Using CISCO Packet Tracer, Perform the following experiments** a. Configure the given Network Topology b. Network Address Translation (NAT) c. Access Control List (ACLs)	3
7	**1) Using CISCO Packet Tracer, Perform the following experiments** a) Configure the given Network Topology and basic switching configuration. b) Configure VLAN and Inter-VLAN routing for a Network. **2) Using Wireshark Tool, Perform the following exercises** i) Packet Capture using Wireshark ii) Viewing captured Traffic and analysis of packet	3
8	1) Write a program for Bellman ford's algorithm to find shortest path for a given network graph. 2) Write a program for Dijkstra's algorithm to compute shortest path for a given network graph.	3
9	1) Write a program for minimum spanning tree using kruskal's/Prim's algorithm. 2) Write a program for the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for WITH and WITHOUT error. Given DATA: "WELCOME TO JSSSTU"	3
10	1) Write a socket programming for Client-Server Model. 2) Write a client/server program in which client sends three numbers to the server in a single message. Server returns sum, difference and product as a result single message. Client program should print the results appropriately	3
11	Emulation Test-Bed for video streaming over IP Network using EXATA	3
12	Emulation Test-Bed for VoIP Call using Softphones in EXATA.	3
13	Laboratory Test	3

Text Books:

1. **Todd Lammle, "**CCNA Routing and switching complete study Guide", SYBEX, 2nd Edition 2013.

Web/Digital resources:

1. https://www.udemy.com/course/ip-adressing-and-subnetting/
2. https://www.udemy.com/course/ccna-complete/

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3	3	
CO2			3	3	3	
CO3			3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22PNI 180	Total Credits	1.5	Course Type	Mini-Project with Seminar (MPS)		
Course Title	Design and Implementation Lab						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	100 %	-	100 %
	Practical	39	1.5	Maximum Marks	50 Marks	-	50 Marks
	Total	39	1.5	Minimum Marks	25 marks	-	25* Marks

COURSE PREREQUISITE:

To be enthusiastic to work in groups, identifying new problems and proposing solutions by exploring new tools.

COURSE OBJECTIVE:

1. To generate innovative domain specific /interdisciplinary ideas
2. To design a method to realize the ideas and build the prototype.
3. To carry out tests, prepare report and write article

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Survey the literature, identify gaps and innovatively give a renewed solution.	L4
CO2	Construct prototype, verify the results, prepare report and publish article adhering to standards.	L6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Idea generation	3
2	Literature survey	3
3	Literature survey, Problem statement	3
4	Synopsis preparation and presentation	3

5	Design and implementation	3
6	Design and implementation	3
7	Mid phase evaluation	3
8	Develop and implement solution	3
9	Integrate designed modules/circuits	3
10	Test, verify and validate the results	3
11	Report and articles preparation	3
12	Final Demo	3
13	Laboratory Test	

Reference Books:

1. Web resources
2. Company websites and white papers

Journals/Magazines:

1. IEEE Publications
2. Journals and Magazines

Web Resources:

1. https://github.com/
2. https://www.interaction-design.org/literature/toipics/desgn-thinking

Course Articulation:

COURSE OUTCOMES↓	**PROGRAM OUTCOMES**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	2		
CO2	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

Semester - II

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 210**	*Total Credits*	*4*	*Course Type*	Professional Core Course		
Course Title	**Mobile Computing**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Basics of Mobile and Wireless Communication.

COURSE OBJECTIVE:

1. To understand the basic concepts of mobile computing.
2. To get acquainted with protocols and Ad-Hoc networks.
3. To gain knowledge on different mobile platforms.

COURSE OUTCOMES (COs): After completing the course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic concepts of mobile Computing and identify the challenges of mobile computing.	L2
CO2	Demonstrate the knowledge on various operating systems used in mobile computing environment.	L2
CO3	Analyze the Ad hoc networks concepts and routing protocols.	L4
CO4	Examine the importance of WAP and Bluetooth for mobile computing	L4
CO5	Develop solutions to mobile computing problems.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to mobile computing, Cellular systems, 4G & 5G, GSM, architecture, Hand off, network signaling, SS7 Signaling	**8**	**6**
2	Challenges in mobile computing, Operating systems for mobile applications, Android, iOS, WinCE, Symbian and Palm OS.	**8**	**5**
3	Mobile devices, PDA, CDPD, Smart phones, GPRS, VOIP, Mobile	**8**	**5**

	IP,Ipv6, WLL		
4	Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs	**8**	**5**
5	WAP, WML, XML,UML, Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME	**7**	**5**

Text Books:

1. **Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal**, " Mobile Computing", McGraw Hill, 2nd Edition,2010
2. **Raj Kamal**, " Mobile Computing" Oxford University Press,2nd edition,2012
3. **Yi-Bang Lin**, "Wireless and Mobile Network Architectures", Wiley India,2012

Reference Books:

1. **John Schiller**,"Mobile Communications",Addison-Wiley second edition, 2008.
2. **William Stalling**, "Wireless Communication and Networking", Pearson Education Asia, 2002
3. **Uwe Hansmann, Lothar Merk, Mertin S Nickloue and Thomas Stober**: "Principles of Mobile Computing" Second Edition, Springer International Edition, Springer Professional Computing, 2003.

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4			3	3		
CO5		3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	*ELECTRONICS AND COMMUNICATION ENGINEERING*						
Course Code	**22PNI220**	*Total Credits*	*3*	*Course Type*	*Professional Core Course*		
Course Title	**Protocol Engineering**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 Marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Fundamentals of Computer Networks.

COURSE OBJECTIVE:

1. To learn various fundamental and emerging protocols of all network layers.
2. To design communication Protocol using SDL according to the given specification.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamental terminologies, Specifications and working operation of communication protocol.	L2
CO2	Design and simulate protocol using formal and informal approaches.	L3
CO3	Experiment with protocol testing methods and validate errors.	L3
CO4	Analyze different communication protocols using SDL tool.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction:** Communication Model, Communication Software, Communication Subsystems, Communication Protocol, Communication Protocol Development Methods, Protocol Engineering Process. Layered Architecture, Network Services and	**8**	**6**

	Interfaces, Protocol Function, OSI Model, TCP/IP Protocol Suite, Application Protocols, Protocol Specification: Components of Protocol to be Specified, Communication Service Specification, Protocol Entity Specification, Interface Specifications, Multimedia Protocol Specifications, Internet Protocol Specifications: Examples		
2	**SDL**: Examples of SDL Based Protocol Specifications Introduction to Other Protocol Specification Languages.	**8**	**5**
3	**Protocol Verification/Validation:** Protocol Verification, Verification of a Protocol Using Finite State Machines, Protocol Validation, Protocol Design Errors, Protocol Validation Approaches, and SDL based Protocol Verification, SDL based Protocol Validation	**8**	**5**
4	**Protocol Conformance Testing:** Conformance Testing, Conformance Testing Methodology and Framework, Conformance Test Architectures, Test Sequence Generation Methods, Distributed Architecture by Local Methods, Conformance Testing with TTCN, Conformance Testing in Systems with Semi-controllable Interfaces, Conformance Testing of RIP, Multimedia Applications Testing, SDL Based Tools for Conformance Testing, SDL Based Conformance Testing of MPLS.	**8**	**5**
5	**Protocol testing:** Types, performance testing, Interoperability testing, scalability testing. Protocol synthesis, protocol implementation requirements and methods.	**7**	**5**

Text Books:

1. **Pallapa Venkataram, Sunil Kumar S Manvi, B. SathishBabu**," Communication Protocol Engineering", PHI, Learning, Second Edition,2014.

Reference Books:

1. **Miroslav Popovic**, "Communication Protocol Engineering", CRC Press, 2006
2. **Mohammed G. Gouda** "*Elements of Protocol Design*", Wiley Student Edition, 2004.

SWAYAM/NPTEL:

1. https://archive.nptel.ac.in/courses/106/105/106105183/

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	SDL	Programming

Self-Learning Exercises:

1. Mini Projects (Simulation)

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	3		
CO3			3	3		
CO4	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 230**	*Total Credits*	**4**	*Course Type*	Professional Core Course		
Course Title	**Web Services**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**39**	**3**		**CIE**	**SEE**	**Total**
	Tutorial	**26**	**1**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**65**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: HTTP request, HTTP response and basics of network programming.

COURSE OBJECTIVE:

1. To understand web services, WSDL specification, APIs and SOA architecture.
2. To learn UDDI specification, registry and its interaction.
3. To study step-by-step examples of program writing for Web services using Java.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic concepts of service-oriented architectures and SOAP.	L2
CO2	Develop various JAVA based web applications using different tools.	L3
CO3	Experiment with registration and recovery techniques for web services from a business perspective.	L3
CO4	Examine recent techniques, tools and standards for web service architecture.	L4
CO5	Function individually to implement web services using modern tool and prepare document adhering to standard practices	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Introduction:** Web Services Overview: Definition, History Web Services Technology, Other Concerns, Java and Web Services, Application Scenarios, Implementation Scenarios, Benefits of Web Services, Standards, Service-Oriented Architecture, SOA Entities, SOA Characteristics, Component-Based Service Development, Development Lifecycle, Design, Verification and Validation, Maintenance	**8**	**5**
2	**Technologies**: SOAP, The Case for SOAP, Define SOAP, SOAP Message Structure, SOAP Message Elements, SOAP Processing	**8**	**5**

	Model, SOAP Encoding, WSDL, Describing a Web Service, Describing Functional Characteristics of Services of WSDL, UDDI Discovering Web Services, Categorizing Services, Identifiers, Business Entity Relationships, UDDI's SOAP Interfaces, UDDI and SOAP/WSDL Relationships, Publishing WSDL Service Interfaces in UDDI, Internationalization and Multiple Languages, Extending a UDDI Registry, UDDI- Private UDDI Registries, ebXML, Architectural Overview of ebXML.		
3	Java Web Service Developer, Pack JAXP, JAXP Architecture, SAX, DOM, When to Use SAX, When to Use DOM, When Not to Use Either JAXP and XML Schemes, XSLT, XSLTc, JDOM, JAXP, RI JAX-RPC, JAX-RPC Service Model, Data Types and Serialization, JAX-RPC Development, Advanced JAX-RPC, JAX-RPC Interoperability, JAX-RPC and J2EE, JAXM Messaging and MOM Messaging and Web Services Messaging in Java,	**8**	**5**
4	JAXM Architecture, Designing with JAXM, Developing with JAXM, JAXR Registries and Repositories, JAXR Architecture, The JAXR Information Model, The JAXR, API, JAXR to UDDI Mapping, JAXR and ebXML Registry, JAXB, The Need for Binding and JAXB, When to Use JAXB, JAXB Architecture, Developing with JAXB, XML-to-Java Mapping, The JAXBAPI Validation with]AXB Customizing JAXB, When to Use Custom Declarations	**8**	**5**
5	**Advanced Topics**: Transaction Management Concepts, A Transaction Model for Web Services, New Transaction Specifications, JSRs for Web Service Transaction Support Security, Security Considerations for Web Services, Web Services Security Initiatives, Canonical XML, XML Digital Signatures, Apache XML Security, XML Encryption Security Assertions, Markup Language Web Services Security Assertions, XML Access Control Markup Language, XML Key Management Specification, WS-I Specifications, Java Cryptography Extensions, Implementation Scenarios WEB 2.0.	**7**	**6**

Text Books:

1) **James McGovern, Sameer Tyagi, Michael E. Stevens, Sunil Mathew**: "Java Web Services Architecture", Morgan Kaufmann – 2003
2) **Richard Monsol-Haefel**, "J2EE Web Services", Pearson 2003.
3) **Steven Graham, Dong Davis**, "Building Web Services with Java", 2nd Edition, Pearson-2005.

Reference Books:

1. **Ramesh nagappan, Robert S and Rima patel Sriganesh**: "*Developing Java Web Services*" by John Wiley & Sons, 2004
2. **Robert J. Brunner, Frank Cohen**, " Java Web Services Unleashed", -- **Sams Publishing, 2002**

Web/Digital resources:

1. https://www.youtube.com/watch?v=iqNiINZ4Sxg
2. https://www.youtube.com/watch?v=oTzNRv6X51o
3. https://www.youtube.com/watch?v=iB3NNW1zl44
4. https://www.youtube.com/watch?v=e3bz4dxoUII
5. https://www.youtube.com/watch?v=oHajBmhk05c

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Bank transaction creation and execution (Prototype)	XML and XTML	programming

Self-Learning Exercises:

1. **Case Study projects on banking example.**
2. **Mini Projects on web page creation HTML.**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4			3	3	3	
CO5	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI241**	*Total Credits*	**4**	*Course Type*	Professional Elective Course-3		
Course Title	**IOT and Applications**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Embedded systems, Basics of Networking.

COURSE OBJECTIVE:

1. To understand the concept of Internet of Things and interfacing of various sensors with Arduino/Raspberry Pi.
2. To study data acquisition methods and data storage mechanism using SQL queries.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.	L2
CO2	Analyze and differentiate the protocols employed at each layer of the IoT stack.	L2
CO3	Differentiate between the levels of the IoT stack and be familiar with the key technologies.	L3
CO4	Apply the concept of embedded systems, data analytics and supporting services to IoT environment.	L3
CO5	Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**FUNDAMENTALS OF IoT:** Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.	**12**	**0**
2	**IoT PROTOCOLS:** IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Zigbee, RFID and NFC. Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for	**10**	**0**

	IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP, MQTT, AMQP and XMPP.		
3	**DESIGN AND DEVELOPMENT**: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.	**10**	**0**
4	**DATA ANALYTICS AND SUPPORTING SERVICES**: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.	**10**	**0**
5	**CASE STUDIES/INDUSTRIAL APPLICATIONS**: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.	**10**	**0**

Text Books:

1. **David Hanes, Gonzalo Salgueiro**, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017
2. **Arshdeep Bahga and Vijay Madisetti**, "Internet of Things: A Hands-on Approach", 1st edition, January 2015.

Reference Books:

1. **Raj Kamal**, "Internet of Things: Architecture and Design Principles", McGraw Hill Education, 2nd Edition, June 7, 2022.
2. **David Boswarthick,** "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. **Jan Ho¨ ller, VlasiosTsiatsis,** "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
4. **Dieter Uckelmann**, "Architecting the Internet of Things", Springer,2011.

Journals/Magazines:

1. https://www.iotjournal.com/
2. https://www.rfidjournal.com/
3. www.iot-j.ieee.org, IEEE Internet of Things Journal, Joint Publications of IEEE Sensors Council, IEEE Communications Society, IEEE Computer Society, IEE Signal Processing Society
4. https://www.journals.elsevier.com/journal-of-network-and-computer-applications/Elsevier Journal of Network and Computer Applications

Web/Digital resources:

1. https://www.techtarget.com/iotagenda/
2. https://www.hackster.io/projects/tags/internet+of+things
3. https://blog.bosch-si.com/
4. https://blog.arduino.cc/
5. https://www.postscapes.com/

SWAYAM/NPTEL:

1. https://www.edx.org/learn/iot-internet-of-things
2. https://www.mygreatlearning.com/iot/free-courses
3. https://www.simplilearn.com/learn-iot-basics-skillup
4. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Practice Based Learning:

No.	Topics to be covered	Tools and Techniques	Expected Skill /Ability
1.	Building an IoT Eco system	Raspberry Pi, Arduino Board	Programming
2.	Simulation of an IoT Eco system	Any Simulator	Logical Thinking

Self-Learning Exercises:

1. **Mini Project – Long Term Event will be conducted.**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2			
CO2			2			
CO3			2	2		
CO4			3	3		
CO5	3	3	3	3	3	

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 242**	*Total Credits*	**4**	*Course Type*	Professional Elective Course-3		
Course Title	**Ubiquitous Computing**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Wireless Communication basics

COURSE OBJECTIVE:

1. To learn the key concepts of information technologies used to implement the ubiquitous environment.
2. To understand communication technologies used in ubiquitous computing environment.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the Concepts of ubiquitous Computing and its features.	L2
CO2	Articulate the working of smart environment and smart devices.	L2
CO3	Apply the working of Human Computer Interaction in context of Pervasive Computing.	L3
CO4	Analyze the management of smart devices in context of Pervasive Computing.	L4
CO5	Function individually to implement ubiquitous computing designs using modern tool and prepare document adhering to standard practices.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Introduction to Pervasive Computing:** Concept of Pervasive Computing, Modeling the Key Ubiquitous/Pervasive Computing Properties, Mobile Adaptive Computing, Mobility Management and Caching.	**10**	**0**
2	**Pervasive Computing Devices Smart Environment:** CPI and CCI, Smart Devices: Application and Requirements, Ubiquitous Networks	**10**	**0**

	of Devices: CCI, Human to Human Interaction (HHI) Applications.		
3	Human Computer Interaction Explicit HCI, Implicit HCI, User Interface and Interaction for four hand-held widely used devices, Hidden UI via basic smart devices, Hidden UI via wearable and Implanted devices, Human centered design, user models.	**10**	**0**
4	Management of Smart Devices Managing Smart Devices in Virtual Environments, Process and Application Management, Network Oriented Management, Monitoring and Accounting, Configuration Management, Fault Management, Performance Management, Service Oriented Computer Management, Managing Smart Devices in Physical Environments.	**10**	**0**
5	Middleware for Pervasive Adaptive middleware, Context aware middleware, Mobile middleware, Service Discovery, Mobile Agents. Challenges and Outlook Overview of challenges, smart devices, Smart Interaction, Smart physical environment device interaction, Smart human-device interaction, Human Intelligence versus machine intelligence, social issues	**12**	**0**

Text Books:

1. **Stefan Poslad**, "*Ubiquitous Computing, Smart devices, environment and interaction*", Wiley.
2. **Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert**, "*Fundamentals of Mobile and Pervasive Computing*", Tata McGraw Hills.

Reference Books

1. **Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff, Thomas Schaeck**, "*Pervasive Computing*", Pearson, Eighteenth Impression, 2014.

Web Resources:

1. **https://www.youtube.com/watch?v=bS6XqjBO99Q**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3			
CO2			3	3		
CO3			3	3		
CO4			3	3		
CO5	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 243**	*Total Credits*	*4*	*Course Type*	Professional Elective Course-3		
Course Title	**Software Defined Networks**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Fundamentals of Computer networks.

COURSE OBJECTIVE:

1. To learn the basic concepts of software defined networking.
2. To Understand the concepts of security, maintenance and management.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamentals of SDN and make use of open flow tool.	L2
CO2	Outline the concepts of data center and NFV.	L2
CO3	Illustrate the perceptions of controllers and network programmability.	L3
CO4	Simulate the SDN network framework for traffic monitoring and scheduling using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	Introduction, Centralized and Distributed Control and Data Planes, OpenFlow.	**10**	**0**
2	SDN Controllers: Introduction, General Concept, Layer 3 Centric, Plexxi, Cisco onePK. Network Programmability: Introduction, The management Interface, The Application – Network Divide, Modern programmatic Interface, I2Rs, and modern orchestration.	**10**	**0**
3	Data Centre Concepts and Constructs, Network Function Virtualization.	**10**	**0**
4	Network Topology and Topological Information Abstraction, Building an SDN Framework.	**10**	**0**

5	Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions	**12**	**0**

Text Books:

1. **Ken Gray, Thomas D. Nadeau,** "*SDN: Software Defined Networks*", O'Reilly, 2013.

Reference Books:

1. **Paul Goransson Chuck Black Timothy Culver**, "*Software Defined Networks*", Elsevier, 2nd Edition 2016.

Web Resources (e-resources):

Text Book 1: https://ridhanegara.staff.telkomuniversity.ac.id/files/2017/04/Thomas-D.-Nadeau-Ken-Gray-SDN-Software-Defined-Networks-O_039_Reilly-Media-2013.pdf

Self-Learning Exercises:

1. **Case Study projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4	2	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 251**	*Total Credits*	**4**	*Course Type*	Professional Elective Course -4		
Course Title	**5G Technologies**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Basics of Mobile Communications.

COURSE OBJECTIVE:

1. To understand requirements for advanced communication technologies in 5G
2. To develop and implement algorithm using MATLAB/OCTAVE
3. To understand various architectures for 5G network communication and NR standards

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain factors influencing advanced developments in mobile radio communication and new frequency band allocation.	L2
CO2	Analyze various candidate technologies for 5G mobile radio.	L4
CO3	Develop simulation codes for various physical layer communication techniques used in 5G wireless networks.	L3
CO4	Demonstrate various methods /techniques, by working in groups/individual, adhering to standard ethical practices	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction - over view of new technologies for 5G systems:** Radio frequency allocation for 5G, various bands, specifications for 5G, wireless channel comparison of 3G/4G standards, 5G technical specifications and standards, and NR standards, 5G network	**10**	**0**

	architecture, candidate technologies		
2	**Communication network architecture for 5G systems:** Cloud Radio access networks (CRAN), Mobile edge computing, Radio resource Management (RRM), fronthaul and backhaul design for CRAN.	**10**	**0**
3	**Physical layer communication techniques:** Orthogonal Frequency division Multiplexing (OFDM), Non-Orthogonal Multiple Access (NOMA), Multi-input and Multi-output (MIMO) systems, MmWave (mmW) systems, Full duplex systems (FD), visible light communication (VLC).	**10**	**0**
4	**Network protocols and algorithms:** Resource scheduling, Data off loading and management (case/scenario based), Access control	**10**	**0**
5	**5G cellular access for Massive IOT:** 5G Access for IoT (article 17.1 to 17.8), M2M Communication (article 18.1 to 18.3), SDN & NFV for 5G systems.	**12**	**0**

Text Books:

1. **Vincent w s wong, Robert schober et.al**., - "*Key Technologies for 5G wireless systems*" , Cambridge university press.

Reference Books:

1. **Rath Vannithamby, shilpa Talwar** - "Towards *5G Applications, requirements and Candidate Technologies*", WIELY Publishers.
2. **Harikrishna Venkataraman, Ramona Trestian**, - "*5G Radio Access Networks*", -CRC press.

Web/Digital resources:

1. http://www.techplayon.com/5g-nr-radio-protocol-stack-layer-2-layer-3/
2. https://www.is-wireless.com/academy/4g-5g-courses/lte-radio-network-design-workshop/
3. https://livetrafficfeed.com/
4. https://itectec.com/spec/5g-ng-ran-layer-2

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/108105134

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Design and model 5G Wireless network and simulate using MATLAB	MATLAB	Programming
2	Advanced digital modulation Techniques	simulation	coding
3	Implementation of algorithms	coding	coding

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3			3	3	3	
CO4	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 252**	*Total Credits*	*4*	*Course Type*	Professional Elective Course -4		
Course Title	**Advances in Storage area Networks**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Computer Networks

COURSE OBJECTIVE:

1. To Understands storage architectures, backup, recovery, disaster recovery
2. To learn emerging technologies including IP-SAN, Fibre Channel.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Summarize the performance evaluation and the metrices used for storage centric IT architecture.	L2
CO2	Apply the backup techniques used for datacenter maintenance	L3
CO3	Demonstrate the storage virtualization concepts using modern tools	L4
CO4	Demonstrate various methods /techniques, by working in groups/individual, adhering to standard ethical practices	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**Introduction:** Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.	**10**	**0**
2	**I/O Techniques:** The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS	**10**	**0**

	hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.		
3	**Storage Virtualization:** Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.	**10**	**0**
4	**SAN Architecture and Hardware devices**: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.	**10**	**0**
5	**Management of Storage Network:** System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks.	**12**	**0**

Text Books:

1. **Ulf Troppens, Rainer Erkens and Wolfgang Muller**, "*Storage Networks Explained*", Wiley India, 2013.
2. **Robert Spalding**, "*Storage Networks: The Complete Reference*", Tata McGraw Hil, 2011

Reference Books:

1. **Marc Farley**, "*Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems*", Cisco Press, 2005.
2. **Richard Barker and Paul Massiglia**, "S*torage Area Network Essentials A Complete Guide to understanding and Implementing SANs*", Wiley India, 2006.

Web/Digital resources:

1. http://rsmt.it.fmi.uni-sofia.bg/HPstorage/Storage%20Networks%20Explained%202nd%20Edition.pdf

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/106108058
2. https://nptel.ac.in/courses/106103183

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Create virtual disk and interface using modern tools. Create and demonstrate the different RAID Techniques.	Modern tools	Programming

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3			3	3	3	
CO4	2	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI253**	*Total Credits*	**4**	*Course Type*	Professional Elective Course -4		
Course Title	**Artificial Intelligence and Machine Learning**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**52**	**4**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60 %*	*100 %*
	Practical	**0**	**0**	*Maximum Marks*	*40 Marks*	*60 Marks*	*100 Marks*
	Total	**52**	**4**	*Minimum Marks*	*20 marks*	*25 marks*	*45 Marks*

COURSE PREREQUISITE: Random Variable and Stochastic process.

COURSE OBJECTIVE:

1. To understand and apply various Learning and classification techniques.

COURSE OUTCOMES (COs): At the Completion of the course, student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the various learning and classification techniques	L2
CO2	Choose neural networks and genetic algorithms for ML based applications.	L3
CO3	Apply Bayesian techniques and derive learning rules.	L3
CO4	Examine various reinforcement and analytical learning techniques using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	**Tutorial**
1	**INTRODUCTION, CONCEPT LEARNING AND DECISION TREES:** Introduction to artificial intelligence, Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.	**10**	**0**
2	**NEURAL NETWORKS AND GENETIC ALGORITHMS**: Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.	**10**	**0**
3	**BAYESIAN AND COMPUTATIONAL LEARNING:** Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and	**10**	**0**

	Infinite Hypothesis Spaces – Mistake Bound Model		
4	**INSTANT BASED LEARNING AND LEARNING SET OF RULES**: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions –Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution	**10**	**0**
5	**ANALYTICAL LEARNING AND REINFORCED LEARNING:** Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.	**12**	**0**

Text Books:

1. **Tom M**, "*Machine Learning*", Mitchell, McGraw-Hill ,2013

Reference books:

1. **Ethem Alpaydin**, "Introduction to Machine Learning" PHI Learning Pvt. Ltd 2nd Ed., 2013.
2. **T. Hastie, R. Tibshirani, J. H. Friedman**, "*The Elements of Statistical Learning*", Springer 1st edition, 2001.

Web resources:

- https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/video_galleries/video-lectures/

SWAYAM/NPTEL:

- https://nptel.ac.in/courses/106105184

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Design and develop a machine learning model – use cases.	Any programming language/ tools.	Programming

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	3		
CO2			3	3		
CO3			3	3		
CO4	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22PAE26OE	Total Credits	4	Course Type	Open Elective Course		
Course Title	*Nano dielectrics*						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

Course Prerequisite: Fundamentals concepts of dielectric materials used in capacitors.

COURSE OBJECTIVE:

1. To familiarize on the characteristics, testing and measurement of insulation materials and equipments.
2. To gain knowledge on the advanced computer simulation techniques.

COURSE OUTCOMES (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamentals of nanodielectrics in various applications.	L2
CO2	Apply the different methods to study the structural behavior of nanocomposites.	L4
CO3	Analyze the performance of nanocomposites.	L3
CO4	Demonstrate the skill sets using various tools for experimental/simulation of composite films towards research.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Introduction**: Dielectrics and nanodielectrics, structure, preparation, and characterization of nanodielectrics, attractiveness of polymer nanocomposites.	10	0

2	**Preparation and structure:** Methods of mixing a quasi-spherical nanofillers into a polymer, surface modification of nanoparticles and its effects. Changes in the movement and structure of atoms and molecules represented by the dielectric properties, Structure of polymer/nanofiller interfaces.	**11**	**0**
3	**Compatibility with other engineering performances:** Electrical conductivity contrast between nanofillers and polymer matrix, electronic conduction effect on polymer/metallic nanoparticles, effect on dielectric breakdown strength, need of high-k and low-k materials, thermal and mechanical characteristics.	**11**	**0**
4	**Computer simulation methods:** Quantum mechanics with electronic states, molecular dynamics and Monte Carlo simulation with the collective motion of atoms and molecules, finite element method and statistical thermodynamics calculation with bulk materials, and phase-field method.	**10**	**0**
5	**Epilogue:** Nanodielectrics research challenges, environmental concerns and future prospects.	**10**	**0**

Text Books:

1. **Tanaka, T., & Imai, T**., "*Advanced nanodielectrics: fundamentals and applications*," Pan Stanford Publishing, 2017.
2. **Murthy, B. S., Shankar, P., Raj, B., Rath, B. B., & Murday, J**., "*Textbook of Nanoscience and Nanotechnology*," Springer Science & Business Media, 2013.

Reference Books:

1. **Kulkarni, S. K**., "*Nanotechnology: Principles and Practices,"* Springer, 2019.

Journals/Magazines:

1. **https://www.springer.com/journal/12274**
2. **https://onlinelibrary.wiley.com/journal/21983844**
3. **https://ietresearch.onlinelibrary.wiley.com/journal/25143255**

Web/Digital resources:

1. https://bajkulcollegeonlinestudy.in/StudyMaterialFinal/Chemistry/6th%20sem-DSE3 Nano%20structure%20%20-%20Dr.%20Sunirban%20Das.pdf

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/118102003

PRACTICE BASED LEARNING:

No	Topics to be covered
1	Nano dielectrics in energy storage
2	Nano dielectrics in power sectors
3	Aging behavior of Nano dielectrics

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2	3		3	3		
CO3	3		3	3		
CO4	3	2	3	3	3	2

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22PIE26OE	Total Credits	4	Course Type	Open Elective Course		
Course Title	Deep Learning for Speech Processing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic mathematics and signal processing.

COURSE OBJECTIVE:

1. To understand the fundamental concepts of speech processing and deep learning
2. To learn about feature extraction and classification techniques using deep learning algorithms.

COURSE OUTCOMES (COs): After completing this course, students will be able to

CO #	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the theoretical concepts of speech processing and deep learning.	L2
CO2	Analyze speech feature extraction and recognition techniques.	L4
CO3	Apply deep learning and CNN Architecture algorithms for Speech recognition.	L3
CO4	Analyze neural network and machine learning algorithms for speech applications.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**Phonetics:** Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Phonological Categories, and Pronunciation variation,	11	0

	Acoustic Phonetics, and Signals, Phonetic Resources, Advanced: Articulatory and Gestural Phonology, Text Normalization, Phonetic Analysis, Prosodic Analysis, Diphone Waveform Synthesis, Unit Selection Synthesis.		
2	**Automatic Speech Recognition:** Speech Recognition Architecture, The Hidden Markov Model Applied to Speech, Feature Extraction: MFCC Vectors, Acoustic Likelihood Computation, Embedded Training, Evaluation: Word Error Rate.	**10**	**0**
3	**Basics of Deep Learning:** Introduction, Perceptron Algorithm Explained**,** Multilayer Perceptron, Deep Learning, Model Training, Unsupervised Deep Learning, Framework Considerations	**10**	**0**
4	**Convolutional Neural Networks:** Basic Building Blocks of CNN, Forward and Backpropagation in CNN, Text Inputs and CNNs, Classic CNN Architectures, Modern CNN Architectures, Applications of CNN in NLP, Fast Algorithms for Convolutions	**11**	**0**
5	**Applications and User Interfaces:** Application Architecture, Typical Applications, Computer Command and Control, Telephony Applications, Dictation, Accessibility, Handheld Devices, Automobile Applications, Speaker Recognition **Speech Interface Design:** General Principles, Handling Errors, Dialog Flow. Internationalization	**10**	**0**

Text Books:

1. **Daniel Jurafsky, James H. Martin** *"Speech and Language Processing,"* Pearson, Second Edition,2017.
2. **Uday Kamath, John Liu, James Whitaker** *"Deep Learning for NLP and Speech Recognition,"* Springer, 2019
3. **Xuedong Huang, Alex Acerd, Hsiad-wuen Hon** *"Spoken Language Processing: A Guide to Theory, Algorithm and System Development,"* PH PTR, 2001.

Reference Books:

1. **Lawrence Rabinerand Biing-Hwang Juang**, *"Fundamentals of Speech Recognition,"* Pearson Education, 2003.
2. **Tomm. Mitchell** *"Machine Learning,"* McGraw Hill Education, 22nd reprint 2018.
3. **Nilanjan Dey** *"Intelligent Speech Signal Processing,"*-Academic Press,2019
4. **Umberto Michelucci** *"Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks,"* Apress, 2018.

Journals/Magazines:

1. IEEE Transactions on Neural Networks and Learning Systems, IEEE, https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=5962385.
2. IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE, https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34
3. IEEE / ACM Transactions on Audio, Speech, and Language Processing, IEEE,

https://signalprocessingsociety.org/publications-resources/ieeeacm-transactions-audio-speech-and-language-processing/about-taslp.

4. Speech Communication, Science Direct(Elsevier). https://www.sciencedirect.com/journal/speech-communication/about/aims-and-scope.

SWAYAM/NPTEL:

1. http://www.digimat.in/nptel/courses/video/117105145/L37.html
2. https://nptel.ac.in/courses/106106184

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES			PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	3		
CO3			3	3		
CO4	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22PNI26OE	Total Credits	4	Course Type	Open Elective Course		
Course Title	Advanced Wireless Technology						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Analog and Digital communication systems and antennas and propagation

COURSE OBJECTIVE:

1. To understand the basics and technology of advanced communication system.

COURSE OUTCOMES (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the Satellite fundamentals and types of satellite.	L2
CO2	Illustrate the working of mobile radio system and its subsystems.	L3
CO3	Identify the applications of cellular Technology and system capacity.	L3
CO4	Outline the working principle of propagation model in Mobile communication	L2
CO5	Explain the working principle of GSM Services and data services.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorials
1	**Introduction to Satellite:** Satellite sub systems, Antennas, Transponders, earth station technology, Link calculation, Satellite systems- GEO systems, non-GEO communication systems, Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems	12	0

2	**Evolution of mobile**: Mobile radio communications, paging systems, Cordless telephone systems, comparison of various wireless systems Introduction to Modern Wireless Communication Systems, Second generation cellular networks, third generation wireless networks, fourth generation wireless technologies Wireless in local loop, wireless local area networks, Bluetooth, and Personal Area networks, Over view of WIMAX Technologies, architecture, spectrum allocation.	**10**	**0**
3	**Capacity expansion techniques**: Cellular concept, hand off strategies, Interference, and system capacity: Cell splitting, Sectoring, Repeaters, and Microcells. Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference, and system capacity, tracking and grade off service, improving coverage and capacity	**10**	**0**
4	**Wireless Propagation**: Propagation mechanism, free space propagation model, ground reflection model, path loss, Introduction to fading and diversity techniques, Introduction to MIMO system Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, CDMA, OFDM Wireless Networking	**10**	**0**
5	**GSM system and data services**: GSM architecture, radio link aspects, network aspects Introduction to new data services like High Speed Circuit Switched Data(HSCSD), General Packet Radio Service (GPRS), Enhanced Data Rate for Global Evolution (EDGE), Ultra-wideband systems (UWB).	**10**	**0**

Text Books:

1. **Dennis Roody**, "*Satellite communication*," 4/e, McGraw Hill, 2006.
2. **Herve Benoit**, "*Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework*," 3/e, Focal Press, Elsevier, 2008
3. **Simon Haykin, Michael Mohar**, "*Modern wireless communication*," Pearson Education, 2008

References:

1. **Tomasi**, "*Advanced Electronic Communication Systems*," 6/e, Pearson, 2015.
2. **W.C.Y.Lee**, "*Mobile Cellular Telecommunication*," McGraw Hill, 2010.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project/case study/ field visit	Hard ware implementation Report writing on field visit	Practical experience of RE generation
2	Simulation/ virtual lab	Open-source simulation tools	Simulation

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	P04	P05	PO6
CO1	3	3				
CO2	3	3				
CO3	3	3				
CO4	3	3	3	3		
CO5	3	3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 270**	***Total Credits***	***2***	***Course Type***	Mandatory Course		
Course Title	***Research Methodology and IPR***						
Teaching Learning Process		***Contact Hours***	***Credits***	***Assessment in Weightage and marks***			
	Lecture	**26**	**2**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	***Weightage***	***100%***	***-***	***100%***
	Practical	**0**	**0**	***Maximum Marks***	***50 Marks***	**-**	***50 Marks***
	Total	**26**	**2**	***Minimum Marks***	***25 marks***	***-***	***25 Marks***

COURSE PREREQUISITE:

Research methods to effectively search required information, software for paper formatting like LaTeX/MS Office, Plagiarism software.

COURSE OBJECTIVE:

1. To deliver knowledge on formulation of research problem, research methodology, ethics involved and emphasizing importance of patent along with IPR protection.

COURSE OUTCOMES (COS): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Analyze the research problem, research related information and follow research ethics.	L4
CO2	Apply the concept of report writing to an article and correlate the outcome with other published results.	L3
CO3	Describe the importance of IPR, laws, its protection and developments.	L2
CO4	Demonstrate the skill sets in writing technical report and research proposal using LaTeX.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	**RESEARCH METHODOLOGY**: 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, Plagiarism, Research ethics	6	0
2	**DATA COLLECTION AND ANALYSIS**: Importance and scientific methodology in recording results, statics in research, analysis of data, outcome as new idea, hypothesis, concept, theory, model etc.	5	0
3	**INTERPRETATION AND REPORT WRITING:** Significance of technical writing, research report layout, different steps, how to write a manuscript/ response to reviewers comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment, precautions in writing the report.	5	0
4	**IPR**: Terminology and concept, need for Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of registration and Development: technological research, innovation, patenting and development. Procedure for grants of patents in India and abroad.	5	0
5	**PATENT RIGHTS AND DEVELOPMENTS IN IPR**: Scope of Patent Rights, licensing and transfer of technology. Patent information and databases, geographical indications. New Developments: Administration of patent system and associated law.	5	0

Text Books:

1. **Kothari, C. R.** "*Research Methodology - Methods and Techniques*", New Age International publishers, New Delhi, 2004.
2. **Ranjit Kumar**, RESEARCH METHODOLOGY a step-by-step guide for beginners, SAGE publishers,2011.
3. **T. Ramappa** , "Intellectual Property Rights Under WTO", S. Chand, 2008.

Reference Books:

1. **Stuart Melville and Wayne Goddard**, "Research methodology: an introduction for science & engineering students', Juta & Company,1996.

2. **Rüdiger Wolfrum and Peter-Tobias Stoll, WTO** "Trade-Related Aspects of Intellectual Property Rights", Max Planck Institute for Comparative Public Law and International Law, Boston, 2009.

Journals/Magazines:

1. http://iprmagazine.com/
2. https://www.researchgate.net/publication/321964409_Research_Methodology

SWAYAM/NPTEL:

1. https://nptel.ac.in/courses/109106137

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Write research reports/article/ proposals	LaTeX commands/ MS office	Communication, ethics

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3				2
CO2	2	3				
CO3		2				
CO4		3	3	3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI 280L**	*Total Credits*	*1.5*	*Course Type*	Professional Core Course Laboratory		
Course Title	**Networking Lab- 2**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**0**	**0**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*100 %*	*-*	*100 %*
	Practical	**39**	**1.5**	*Maximum Marks*	*50 Marks*	**-**	*50 Marks*
	Total	**39**	**1.5**	*Minimum Marks*	*25 marks*	*-*	*25* Marks*

COURSE PREREQUISITE: Fundamentals of Computer Networks.

COURSEOBJECTIVE:

1. To develop different network simulation and design techniques using NS2/NS3 simulation software.

COURSE OUTCOMES (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Experiment practically the importance and significance of Protocols and protocol stack	L3
CO2	Apply and test various network configuration scenarios using NS2/NS3 simulators.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

For the experiments below modify the topology and parameters, set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and infer using suitable tool (NS2/NS3).

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.	3
2	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.	3
3	Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.	3

4	Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.	3
5	Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.	3
6	Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment.	3
7	1) Familiarization with concept of IOT, Arduino/Raspberry Pi and perform necessary software installation. 2) Study of Connectivity and configuration of Raspberry-Pi with basic peripherals, LEDS. Understanding GPIO and its use in program.	3
8	Configuration of Raspberry pi with SenseHat Device and use python library for reading and storing of sensor data from SenseHat	3
9	Develop a prototype of IoT application for Smart Light home automation system.	3
10	Develop a prototype of IoT application for home intruder detection system.	3
11	Exercises on simulation using EXATA making use of cellular library.	3
12	Exercises on simulation using EXATA making use of sensor network library.	3
13	Laboratory Test	3

Web/Digital resources:

1. https://www.udemy.com/course/network-simulation-using-ns2/
2. https://www.udemy.com/course/ns2-by-examples/

Course Articulation:

COURSE OUTCOMES↓	**PROGRAM OUTCOMES**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3		3	3	
CO2	3	3		3	3	

High – 3, Medium – 2, Low – 1

Third Semester

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI310**	*Total Credits*	*4*	*Course Type*	PWC / Technical Seminar / Internship in Industry		
Course Title	**Industrial training /Internship / Technical Seminar**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**0**	**0**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*100 %*	---	*100 %*
	Practical	**8 weeks***	**4**	*Maximum Marks*	*50 Marks*	---	*50 Marks*
	Total	**8 weeks***	**4**	*Minimum Marks*	*25 marks*	---	*25 Marks*

*** 8 weeks = (40 hours / week in Industry + 2 hours / week in college)**

COURSE PREREQUISITE: Domain Knowledge in the professional courses.

COURSE OBJECTIVE:

1. Explore career alternatives prior to graduation by integrating theory and practice.
2. To Develop communication, interpersonal and other critical skills in the job interview process.

COURSE OUTCOMES (COs): After completion of the course, the students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Build the knowledge by interacting with industrial personnel, follow engineering practices and discipline prescribed in industry.	L4
CO2	Function individually to implement the given task using modern tools, prepare report and present orally adhering to standard practices.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

COs↓	PROGRAM OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3	3			
CO2	3	3	3		3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI320P**	*Total Credits*	*6*	*Course Type*	*Project work Course*		
Course Title	**Project Work Phase - 1**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**0**	**0**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*100 %*	*---*	*100 %*
	Practical	**12 Weeks****	**6**	*Maximum Marks*	*50 Marks*	**---**	*50 Marks*
	Total	**12 Weeks****	**6**	*Minimum Marks*	*25 marks*	*---*	*25 Marks*

****12 Weeks: 40 Hours / week.**

COURSE PREREQUISITE: Domain Specific Knowledge.

COURSE OBJECTIVE:

1. To generate Domain specific / interdisciplinary idea and methodology leading to product.
2. To perform feasibility analysis, budgetary analysis and schedule the execution of problem.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Identify and formulate a problem through an adequate literature survey, taking into consideration societal, environmental and sustainability issues.	L3
CO2	Design, plan, schedule the execution, anticipate the bottleneck, examine the feasibility, prepare the budget and submit the synopsis.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	
CO2	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1

Fourth Semester

DEPARTMENT	**Electronics and Communication Engineering**						
Course Code	**22PNI410P**	*Total Credits*	*16*	*Course Type*	*Project work Course*		
Course Title	**Project work Phase - 2**						
Teaching Learning Process		*Contact Hours*	*Credits*	*Assessment in Weightage and marks*			
	Lecture	**0**	**0**		**CIE**	**SEE**	**Total**
	Tutorial	**0**	**0**	*Weightage*	*40 %*	*60%*	*100 %*
	Practical	**22 weeks*** **	**16**	*Maximum Marks*	*40 Marks*	**60 Marks**	*100 Marks*
	Total	**22 weeks*** **	**16**	*Minimum Marks*	*20 marks*	*25 Marks*	*45 Marks*

***22 Weeks: 40 Hours / week**

COURSE PREREQUISITE: Domain Specific Knowledge

COURSE OBJECTIVE:

1. To function effectively as an individual for the implementation of an idea and to demonstrate the working prototype / product.
2. To prepare a comprehensive report, article and give an effective presentation.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Develop the project idea within the stipulated time, interpret the results and apply necessary corrections.	L6
CO2	Test the working of project, validate the results, prepare technical report and publish an article.	L6

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	
CO2	3	3	3	3	3	3

High – 3, Medium – 2, Low – 1