RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

VII & VIII SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. **As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.**

About the department:

The Department of Electronics &Telecommunication Engineering (Formerly known as Department of Telecommunication Engineering) was established in 1996 to address the increasing demand for professionals with expertise in communication and networking technology in India. The Department has state of the art laboratories, equipment's, resources and committed faculty having best of the academic and industry recognition. The Department started a **M.Tech program in Digital Communication in the year 2004**. The Department also started a **Research Centre** in the year 2012 and currently has 12 Research Scholars carrying out their Research. Department has collaborations with some of the leading industries like **Ansys, Rohde & Schwarz, JV Micronics, Nokia, Huawei Technologies, Intel, Samsung,** and with leading national and international universities like **Bradley University, IIT-M**, enabling the department to focus on R&D, and thus providing new avenues for PG/UG students for placement and higher studies. Both UG and PG Programs are accredited by the **National Board of Accreditation**. There are **5 Funded Research projects** (Industry and Government) ongoing in the department involving students to carry out innovative projects. Many professional activities are organized regularly to the students under various professional societies like IEEE Sensor Council, IEEE Communication Society, IEEE Antenna and Propagation Society and IETE Bangalore.

The department of ETE has established the Centre of Excellence – **Centre for Antennas and Radio Frequency Systems (CARFS)** Jointly with ECE department on 24th March 2021 to engage in advanced Research leading to innovation in the areas of Antennas & RF Systems. The CARFS has the State of the art Facilities to collaborate with Researchers in other Institutions across the Country and World in various projects.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio- economic needs

MISSION OF THE INSTITUTE

RIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To provide an ambience for the students to excel in studies, research and innovation, focusing on meeting global socio-economic needs from a Telecommunication Engineering perspective

MISSION OF THE DEPARTMENT

- Providing high quality technical education to create world class Telecommunication engineers.
- Creating an ambience for skill development, research and entrepreneurial activities to meet socio-economic needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will excel in professional careers in Industry, Academic, Research and Development that meet the needs of Organizations.

PEO2: Graduates will be able to analyze real life problems and be able to suggest solutions to design complex engineering systems that are technically sound, economically feasible and socially acceptable.

PE03: Graduates will exhibit all-round education that includes communication skills, the ability |to function well in a team, an appreciation for ethical behavior and the ability to engage in lifelong learning.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, analyze, formulate, design and demonstrate applications relevant to telecommunication engineering using electronic devices.

PSO2: Use current technology and modern tools to address solutions for telecommunication products by taking into account safety, healthy and environmental requirements.

PSO3: Apply project management tools to solve Telecommunication systems by exhibiting teamwork and lifelong learning.

Curriculum Course Credits Distribution

BATCH 2018-2022

Course Category/Semester	1	2	3	4	5	6	7	8	Total credits
Humanities, Social Sciences and Management (HSMC)		2			3		3		8
Basic Sciences (BSC)	9	8	4	4					25
Engineering Sciences (ESC)	11	10							21
Professional courses (PCC)-core			21	21	15	11	10		78
Professional Courses (PEC)-Elective					3	6	6		15
Other Open Elective Courses (OEC)					3	3			6
Project work (PROJ)/Internship (IN)						4	1	17	22
Total	20	20	25	25	24	24	20	17	175

SCHEME OF TEACHING
VII SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	TC71	Wireless Networks & Protocols	PCC	4	0	0	4	4
2.	TC72	Optical Communication Systems	PCC	3	1	0	4	5
3.	TC73	Entrepreneurship & Management	HSMC	3	0	0	3	3
4.	TCE741/742/743	Professional Elective-4	PEC	3	0	0	3	3
5.	TCE751/752/753	Professional Elective-5	PEC	3	0	0	3	3
6.	TCL76	Communication systems III Lab	PCC	0	0	1	1	2
7.	TCL77	Wireless Networks & Protocols Lab	PCC	0	0	1	1	2
8.	TCSE	Seminar	Proj/PCC	0	0	1	1	2
Total				**16**	**1**	**3**	**20**	**24**

Note: Minimum of 1 subject should have a tutorial component of 1 credit

List of Electives

TCE741	Deep Learning	TCE751	Network Security
TCE742	Applications of Sensing and Analysis	TCE752	Industrial IOT
TCE743	Multimedia Communication	TCE753	4G LTE/5G Communications

SCHEME OF TEACHING
VIII SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	TCIN	Internship	IN	0	0	3	3	6
2.	TCP	Project Work	PROJ	0	0	14	14	28
Total				**0**	**0**	**17**	**17**	**34**

VII Semester

WIRELESS NETWORKS & PROTOCOLS

Course Code: TC71 **Credit: 4: 0: 0**
Course coordinator: Arvind Kumar G **Contact Hours: 56**

Course Content

UNIT 1

Fundamentals of Cellular Systems: Cellular component identification. Call establishment. Wireless Network Architecture and Operation: The Cell concept, Cellular advantage, Cellular Hierarchy, Cell Fundamentals, Re-use Number, Capacity expansion Techniques - Cell splitting, Cell Sectoring, over laid cells.

UNIT 2

Wireless LAN: Introduction to Wireless LAN 802.11 X Technologies. Evolution of Wireless LAN. Introduction to 802.I5X. Wireless PAN Applications and Architecture. Blue tooth WPAN Adhoc Network Topologies. IEEE 802.15.4 piconets. Introduction to WMAN IEEE 802.16 wireless MANs.

UNIT 3

Mobility Management in Wireless Networks: Mobility Management Functions, Mobility Models, Mobile Location Management, Mobile Registration, Handoff Management, Handoff Techniques, Handoff Types, Handoff Call flows.

UNIT 4

Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Overview, Hardware and Software, Sensor Taxonomy, WN Operating Environment, WN Trends.

UNIT 5

Routing Protocols for Wireless Sensor Networks: Introduction, Routing Metrics, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing.

TEXT BOOKS

1. Gary J. Mullett and Thomson Delmar, "Wireless Telecommunications Systems and Networks", Cengage Learning, 2006.
2. Kazem Sohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley Publication, 2007.
3. Vijay K Garg, "Wireless Communication and Networking", Morgan Kaufman, 2009.
4. Waltenegus Dargie, Christian Poellabauer, "FUNDAMENTALS OF WIRELESS SENSOR NETWORKS – Theory and Practice" Wiley Series on Wireless Communications and Mobile Computing-2010.

REFERENCE BOOKS

1. Theodore S Rappaport "Wireless Communications, Principles and Practice", PHI, 5th edition, 2014.
2. Vijay K Garg, Joseph E Wilkies, Principles of Applications of GSM, Pearson edn – 1999.

COURSE OUTCOMES (COs):

1. Understand and Study cellular technology **(PO 1, 2, 3) (PSO 1)**
2. Discuss the different Wireless LAN protocols. **(PO 1, 2, 3, 4, 12) (PSO 1, 3)**
3. Understand the how Mobility Management is taken care in Mobile networks. **(PO 1, 2, 3, 4, 12) (PSO 1, 3)**
4. Understand the basic sensor network, their architectural elements and applications. **(PO 1, 2, 3, 4, 7, 12) (PSO 1, 2, 3)**
5. Understand the need for Routing and analyze the different Routing Techniques **(PO 1, 2, 4, 9, 11) (PSO 1, 3)**

OPTICAL COMMUNICATION SYSTEMS

Course Code: TC72 **Credit: 3: 1: 0**
Course coordinator: Krishna Prasad S J **Contact Hours: 70**

Course Content

UNIT 1

Introduction of Optical Communication: Introduction, general system, advantages, disadvantages and applications of optical fiber communication, optical fiber waveguides, Ray theory, single mode fiber, cutoff wavelength, mode field diameter, group velocity, phase velocity, group delay, Fiber materials, Optical Cables.

Transmission Characteristics of Optical Fibers: Attenuation, Absorption Scattering Losses Inter and Intra modal dispersions.

UNIT 2

Optical Sources: Semiconductor Theory, DH LED structures, variants, Lasing Principles & conditions, DFB, Stripe geometry and quantum well lasers.

Optical Detectors: Photo detectors, types and performance parameters.

UNIT 3

Fiber Couplers and Connectors: Fiber joints, Mechanical misalignments and end face preparations, Fiber Splicing Connectors & variants.

Optical receivers: Digital optical receiver performance parameters & noises, Eye diagram.

UNIT 4

Analog RF optical technologies: Analog links – Introduction, overview of analog links, CNR, RF over fiber, Microwave photonics, Optical wireless systems and 5G.

Digital links: Digital point to point links, Link power budget & Rise time budget analysis.

UNIT 5

Optical networks, Protocols and standards: WDM standards, Optical networks SONET/SDH, SONET rings and architectures, GPON.

Optical devices: EDFA, Directional couplers, Isolators, circulators, Multiplexers, Star couplers. Optical sensors for IOT and smart devices.

TEXT BOOKS:

1. Gerd Keiser, "Optical Fiber Communications", TMGH, 5th edition, 2015.
2. John M. Senior, "Optical Fiber Communications Principles and Practice", Pearson education, Second edition, 2010.

REFERENCE BOOKS:

1. Govind Agarwal, "Fiber Optic Communication systems", 4th Edition, John Wiley and Sons, 2015.
2. Joseph C Palais, "Fiber Optic Communication", 4th Edition, Pearson Education, 2011.
3. D.A.Krohn, T.Macdaugall, A.Mendez, "Fiber Optic sensors, Fundamentals and applications", Fourth Edition, 2015, SPIE library publications.
4. Z. Ghassemlooy, W. Popoola, S. Raj Bhandari, "Introduction-Optical wireless communication systems", 2nd edition, 2018, CRC Press, eBook ISBN 9781315151724.
5. Maria de Fatima F. Domingues Ayman Radwan, "Optical Fiber Sensors for loT and Smart Devices", Springer Books, 1st Edition, 2017.

COURSE OUTCOMES (COs):

1. Employ optical techniques of optical technologies and optical devices to evolve with latest optical Systems and standards **(PO1, 2,4,5,6,11) (PSO1**)
2. Formulate working principles of standard optical sources and examine their applicability in digital and Analog optical links **(PO1, 2, 3, 6) (PSO1, 2)**
3. Examine and interpret design related fiber joints in optical networks. Examine its applicability in Optical standards and digital optical receivers**. (PO2, 4, 9, 11) (PSO1, 2)**
4. Evaluate and inspect working techniques of optical analog links and digital links. Examine its Applicability in wireless and optical networks. **(PO2,5,7,11) (PSO1,2)**
5. Analyse Optical protocols, standards & devices. Develop strategies to employ them to build optical Communication links **(PO4, 5, 10, 11) (PSO2, 3)**

Entrepreneurship & Management

Course Code: TC73 **Credit: 3:0:0**
Course coordinator: Venu K N **Contact Hours: 42**

Course Content

UNIT 1

Foundations of Entrepreneurship and Entrepreneurial mind: World of an entrepreneur, what is Entrepreneur? Benefits of entrepreneurship, the potential drawbacks of entrepreneurship, entrepreneurial fire, cultural diversity of entrepreneurship, the power of small business, the ten mistakes of entrepreneurship, putting failure into perspective, how to avoid pitfalls, creativity, innovation and entrepreneurship, creativity- necessary survival, creative thinking, barriers of creativity, how to enhance creativity, the creative process, techniques for improving the creative process.

UNIT 2

Designing a competitive business and crafting a winning business plan: Building a competitive advantage, strategic management process, conducting a feasibility analysis, why develop a business plan? Elements of a business plan, what lenders and investors look for in a business plan, making business plan presentation, sole proprietorship, partnership and corporations.

UNIT 3

E-commerce and entrepreneur: Benefits of selling on the web, factors to consider before launching in to E-commerce, twelve myths of e-commerce, strategies of E-success, designing a killer web site, tracking web results, ensuring web privacy and security, pricing strategies and tactics, pricing strategies and methods for retailers, pricing concepts for manufacturers, pricing strategies and methods for service firms, the impact of credit on pricing.

UNIT 4

Nature and functions of management and development of management thought: importance of management, definition of management, management functions, roles of manager, levels of management, managerial skills, management and administration, management a science of art, profession, early classical approaches, neo classical approaches, modern approaches, different views on social responsibility, social responsibilities of business towards different groups, business ethics and corporate governance.

UNIT 5

Planning and decision making, organization: Nature of planning, importance of planning, forms of planning, types of plans, steps in planning, limitations of planning, making planning effective, planning skills, strategic planning in the Indian industry, meaning of a decision, types of decisions, steps in decision making, environment of decision making, common difficulties in decision making.

TEXT BOOKS:

1. Essentials of Entrepreneurship and small business management by Thomas W.Zimmerer and Norman M.Scarborough, PHI 5th edition.
2. Principles of Management, P.C. Tripathi, P N Reddy, TMH Fourth edition.

REFERENCE BOOKS:

1. Management and Entrepreneurship by N.V.R. Naidu and T. Krishna Rao, I.K International Publishing House Pvt Ltd.

COURSE OUTCOME (COs):

1. Interpret the benefits and drawbacks of entrepreneurship **(PO6, 8, 9, 10, 11, 12) (PSO2,3)**
2. Analyze differences among creativity, innovation and entrepreneurship **(PO6, 8, 9, 10, 11, 12) (PSO2,3)**
3. Analyze and appraise about importance of strategic management to a small business and benefits of selling on World Wide Web **(PO6, 7, 8, 9, 10, 11, 12) (PSO2,3)**
4. Appreciate the importance of different levels of management and limitations of administrative Management **(PO7, 8, 9, 10, 11, 12) (PSO2, 3)**
5. Importance of planning and decision making in the success of an organization **(PO6, 7, 8, 9, 10, 11, 12) (PSO2,3)**

Communication Systems III Lab

Course Code: TCL76 **Credit: 0: 0: 1**
Course coordinator: Nisha S L **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS

Optical communication Experiments (Hardware /Simulation Experiments):

1. Study of Analog and Digital Fiber Optic Links using light runner kit
2. Bit error rate and Eye Pattern analysis of Digital Optical links using light runner kit.
3. Study of WDM Fiber Optic Link using light runner kit/Simulation of WDM using Rsoft/Lumerical software
4. Power Budgeting using Light runner /Simulation of power budgeting using Rsoft / Lumerical.
5. Demonstration of usage of Optical Spectrum analyzer, Optical Network Analyzer in Lumerical tool box.
6. Measurement of bending loss, propagation loss, and contact loss by setting up an analog link using a fiber trainer kit.
7. To find maximum bit rate by setting up a digital link using a fiber trainer kit.
8. Measurement of numerical aperture in digital link using a fiber trainer kit.
9. To find frame time, slot time, bit time, and bit rate of a Time Division Multiplexing signal using a fiber trainer kit.
10. Simulation using Rsoft/Lumerical of Optical Fiber links

Digital communication Experiments (Software Experiments using MATLAB/Simulink):

11. Simulation of DPSK generation and detection schemes and observing the signal constellations.
12. Simulation of QPSK generation and detection schemes and observing the signal constellations.
13. Simulate the performance of Quadrature Amplitude Modulation (QAM) scheme in AWGN channel.
14. Simulate the performance M-ary Phase Shift Keying (PSK) scheme in AWGN channel.
15. Simulation of Direct Sequence Spread Spectrum (DSSS) techniques.

TEXT BOOKS

1. Keiser "Optical Fiber Communications", Tata McGraw-Hill Education, 2008.
2. Simon Haykin, Michael Moher "Communication Systems", 5th Edition John Wiley, 2009.

REFERENCE BOOKS

1. Rajiv Ramaswami, "Optical Networks: A Practical Perspective", Elsevier 3rd Edition.
2. Bernard Sklar, "Digital Communications", Pearson education, 2009.

COURSE OUTCOMES (COs):

1. Analysis of WDM and associated technologies in Optical communication systems. **(PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**
2. Evaluate bending loss, propagation loss, and contact loss by setting up an analog link with optical fiber. **(PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**
3. Evaluate maximum bit rate by setting up a digital link and calculate numerical aperture of optical fiber. **(PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**
4. Evaluate frame time, slot time, bit time, and bit rate of a Time Division Multiplexing signal using optical fiber**. (PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**
5. Design and simulate advanced modulation and Demodulation techniques. **(PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**

WIRELESS NETWORKS & PROTOCOLS LAB

Course Code: TCL77 **Credit: 0: 0:1**
Course coordinator: Arvind Kumar G **Contact Hours: 28**

LIST OF EXPERIMENTS

1. To simulate a two node point-to-point network with duplex link. Set the queue size vary the bandwidth and find the number of packets dropped.
2. To simulate three nodes considering one node as a central node. Set the queue size vary the bandwidth and find the number of packets dropped.
3. To Implement and study the characteristics of star topology
4. To Implement and study the characteristics of BUS topology
5. To Simulate a 6 node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3, n4-n5, n0-n5 implement FTP using TCP bulk transfer between the nodes.
6. To Simulate a 6 node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3, n4-n5, n0-n5. Apply TCP agent between n0-n3 and UDP agent between n1-n3 and n4-n5. Apply relevant applications over TCP and UDP agents by changing the parameters and determine the number of packets sent by TCP/UDP.
7. To Simulate a 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.
8. To simulate a wireless mobile ad-hoc network. Install the OLSR routing protocol on these nodes. Create a UDP client on Node1 and the corresponding server on Node N. Plot the number of bytes received versus time at Node3
9. To simulate simple Extended Service Set with transmitting nodes in wireless LAN and determine the performance with respect to transmission of packets
10. To simulate simple Extended Service Set with transmitting nodes in wireless LAN and determine the performance with respect to transmission of packets
11. To capture and analyze Ethernet frames using Wireshark.
12. To capture, analyze packets, and demonstrate 3-way handshake using Wireshark
13. To understand the working of Directory Name Service-- To what IP address is the DNS query message sent?
14. Use ipconfig to determine the IP address of your local DNS server. Are these two IP addresses the same?

TEXT BOOKS:

1. Jha Rakesh Kumar and Kharga Pooja, "A Journey starts from Basic Understanding of NS2 to NS3", LAMBERT, 2015.
2. B Forouzan, "Data communication and Networking", 4thedition, TMH, 2009.
3. William Stallings, "Data and Computer Communication", PHI, 2012.
4. Gerd Keiser "Optical Fiber Communications", TMGrH, 4th edition, 2010 reprint.

COURSE OUTCOMES (COs):

1. To Implement a Wired/Wireless LAN Network (**PO 1, 2, 3, 4, 5, 8, 9, 10,11,12) (PSO 1,2, 3)**
2. Demonstrate different network Topologies and determining the throughput delay, latency of the network**. (PO 1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Understand the working of TCP, UDP, OSLR protocols**. (PO 1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Determining of Static/ Dynamic IP, Change of Static to dynamic IP and vice-versa (**PO 1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Use Wireshark to analyze packets sent/ received via the internet. **(PO 1, 2, 3, 4, 5, 8,9,10,11,12) (PSO 1, 2, 3)**

SEMINAR

Course Code: TCSE **Credit: 0: 0: 1**

Course Content

The evaluation of students will be based on presentation of topics in upcoming technologies along with written report. The rubrics for evaluation of the presentation and the format for the report will be distributed at the beginning of the semester

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Course Code	Course Name	Marks		Total Marks	Credits
		IA	Exam		
TCSE	SEMINAR	100	-	100	1

Course Outcomes (COs):

1. Demonstrate expertise on various State-of-the art communication technologies and identify relevant topics in emerging areas/ societal needs. **(POs 1, 2, 3, 4, 6, 7, 12)**
2. Ability to identify, analyse, interpret and present the novelty of the identified topics from various quality publications of reputed sources. **(POs 1, 2, 3, 4, 10)**
3. Ability to analyse and review the various possible solutions and methods for the technical topic identified based on reviewed literature. **(POs 1, 2, 3, 4, 5, 6)**
4. Understand the various techniques/algorithms for the identified topic, their comparison and validation using relevant tools. **(POs 1, 2, 3, 4, 5, 6)**
5. Ability to prepare a seminar report following ethical values, demonstrate advanced communication/ presentation skills and inculcate lifelong learning abilities. **(POs 8, 9, 10, 12)**

Professional Electives

Deep Learning

Course Code: TCE741 **Credit: 3:0:0**
Course coordinator: Dr. Ramya H R **Contact Hours:42**

Course Content

UNIT 1

Introduction: Human brain, neuron models, neural nets as directed graphs, feedback, neural architectures, knowledge representation, connection to artificial intelligence.

UNIT 2

Learning Process: Error-correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, credit assignment, learning with and without a teacher, learning tasks, memory, statistical learning theory.

UNIT 3

Modern practical deep neural networks: Deep feedforward networks, regularization for deep learning, optimization for training deep models, convolutional Networks.

UNIT 4

Sequence Modelling: Recurrent and recursive nets, practical Methodology, applications

UNIT 5

Deep Learning Research: Linear factor models, auto encoders, variational auto encoders, restricted Boltzmann machine, generative adversarial networks.

TEXT BOOKS

1. Simon Haykin, Neural networks: A comprehensive foundation, Second Edition, Prentice Hall, New Delhi, 1999, ISBN-81-203-2373-4.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

REFERENCE

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
2. Josh Patterson & Adam Gibson, Deep Learning – A Practitioners Approach, O'Reilly, 1st Edition 2017.

COURSE OUTCOMES (COs):

1. Appreciate the basic concepts, learning process, applications and research work of neural networks and deep learning. (**PO2, 3, 4, 5, PSO1, 3)**
2. Examine how various types of learning work and how they can be used Practically (**PO2, 3, 4, 5, PSO1, 3)**
3. Apply deep feed forward concept and convolutional networks to solve practical problems. **(PO 2, 3, 4, 5, PSO 1, 3)**
4. Demonstrate how recurrent and recursive nets function and how practical problems can be mapped to them**. (PO2, 3, 4, 5, PSO1, 3)**
5. Design end-to-end deep learning architectures involving auto encoders, RBM, and generative adversarial networks for practical applications. **(PO2, 3, 4, 5, PSO1, 3)**

Applications of Sensing and Analysis

Course Code: TCE742 **Credit: 3:0:0**
Course coordinator: Dr.Viswanath Talasila **Contact Hours:42**

Course Content

UNIT 1

Systems and Modeling in the Biomechanics of Human Movement: Biomechanics of movement – in sports and medicine, Brief mechanics of the musculo skeleton (specific example of the upper limb) and simple (state space) mathematical models, Measurement of Movement using inertial sensors.

UNIT 2

Algebra and Signal Processing in Music: Introduction to the mathematics of music – from basic algebra to Fourier series; Pingala's Recursive Combinatorial Sequence Generation, the Hemachandra-Fibonacci poetic meters and the first Error-Correcting Codes, Capture of finger movement and mapping to musical notes.

UNIT 3

Embedded Systems Design for measurement of movement and music: Development of a complete embedded system to measure a complete gait cycle, choice of processors/ microcontrollers, selection of sampling rates, Choice and placement of sensors, Architecture of the embedded system, Embedded programming to measure movement (in gait and while playing music), For inertial sensing and for image processing.

UNIT 4

Communication of Movement: Body Area Networks: Basic Theory of Body Area Networks (IEEE 802.15.6), Communication Bands in BAN, Antenna Systems for BAN, Interoperability and Security Issues

UNIT 5

System Integration: Hardware Integration, Software Integration, Interface testing, System testing, Stress testing, High level architecture of system integration

TEXT BOOKS

1. Duane Knudson, Fundamentals of Biomechanics, Springer, Second Edition, 2007

2. The Sound of Numbers, Rachel Wells Hall, Math Horizons, May 31, 2008, http://people.sju.edu/~rhall/proposal.pdf
3. Math for Poets and Drummers; Rachel Wells Hall, Report from the Dept. Of Mathematics and Computer Science, Saint Josephs University, May 31, 2008, http://people.sju.edu/~rhall/Rhythms/P

REFERENCE BOOKS/MATERIAL

1. Some mathematical tools for music making, Miller Puckette, Conference on Art+Math, Boulder Colorado, 2005. http://msp.ucsd.edu/Publications/artmath-reprint.pdf
2. Fourier Analysis and Applications to Sound Processing, University of Oslo, Mathematics in Natural Sciences, 2017,
3. http://www.uio.no/studier/emner/matnat/math/MAT-INF2360/v12/part1.pdf
4. Wireless Body Area Networks – a survey; S Movassaghi et. al., IEEE Communication Surveys and Tutorials, Vol 16, 2014
5. MAC Protocols for Wireless BANs, B Touijer, YB Maissa and S Mouline, Wireless Communications and Mobile Computing Conference, 2017
6. Communication Protocols for BANs, LETI, 2012, http://www.capdigital.com/wp-content/uploads/2012/11/Atelier_Wear-a-BAN_Presentation_CEA-pdf.pdf
7. Overview of the System Integration Process, NDDOT, 2008, https://www.dot.nd.gov/divisions/maintenance/docs/OverviewOfSEA.pdf.
8. Northrop Grumann, Best Practices for System Integration, https://indiastorage.blob.core.usgovcloudapi.net/ndia/2011/system/13007_HouserThursday.pdf

COURSE OUTCOMES (COs):

1. The state space systems approach can be used to model the Biomechanics of human movement **(PO1, 2, 3, 4, 6; PSO 1, 2)**
2. Engineering mathematics and signal processing can be used to analyze music and creation of music **(PO1, 2, 3, 4, 5, 6, 9, 10, 12; PSO 1, 2, 3)**
3. Embedded systems theory can be used to measure and analyze human movement and music **(PO1, 2, 3, 4, 5; PSO 1, 2)**
4. Communication systems, in the form of Body Area Networks, can be used to sense and communicate vital information about body parameters in real time **(PO 1, 2, 3, 4, 5, 6, 9, 10; PSO 1, 2, 3)**
5. Some basics of System integration provides a holistic view of how different technologies are brought together into a single working system **(PO1, 2, 3, 4, 9, 10, 12; PSO: 1, 2, 3)**

Multimedia Communication

Course Code: TCE743 **Credit: 3:0:0**
Course coordinator: Arvind Kumar G **Contact Hours:42**

Course Content

UNIT 1

Multimedia Communications: Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology.

UNIT 2

Text Compression: Introduction, Compression principles, text compression, Stastical Huffman Coding, Dynamic Huffman Coding, Arithmetic Coding, Lempel –Ziv Coding.

UNIT 3

Image Compression: Introduction, Graphics Interchange Format, Tagged image file Format, READ coding procedure for Digitized Documents, Digitized Pictures- JPEG encoding and decoding. Forward DCT. Quantization.

UNIT 4

Audio Compression: Introduction, DPCM, ADPCM, Adaptive Predictive Coding, Linear Predictive Coding, Code Exited LPC, MPEG audio coders, Dolby Audio Coders.

UNIT 5

Video Compression: Introduction, video compression principles. H.261, H.263 standards, MPEG-1, MPEG-2, MPEG-4 formats, HDTV.

TEXT BOOKS

1. Fred Halsall, Multimedia Communications, Pearson education, 2001 ISBN - 9788131709948.
2. K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2004.

REFERENCE BOOKS

1. Z. Li and M.S. Drew, "Fundamentals of Multimedia", Pearson Education (Asia) Pte. Ltd., 2004.
2. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", 2nd edition, Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2004.
3. M. Tekalp, "Digital Video Processing", Prentice Hall, USA, 2005.

COURSE OUTCOMES (COs):

1. To acquire the basic knowledge of multimedia communication technologies including audio, image, video, text compression techniques. **(PO 1,2,3) (PSO 1)**
2. Understand digitization principle techniques required to analyze different media types **(PO 1,2,3) (PSO 1)**
3. Analysis/comparison of various coding techniques, case study and problem solving as per given data. **(PO 1,2,3,4) (PSO 1)**
4. Evaluation of standard source coding protocols for multimedia **(PO 1,2,3,4) (PSO 1)**
5. Application of coding techniques for data storage and communication of multimedia **(PO 1,2,3,4) (PSO 1)**

Network Security

Course Code: TCE751 **Credit: 3:0:0**
Course coordinator: Arvind Kumar G **Contact Hours:42**

Course Content

UNIT 1

Symmetric Ciphers: Introduction to Network Security, Research trends & applications, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, traditional block cipher structure, the data encryption standard (DES). A DES example, the strength of DES, AES structure, AES transformation function.

UNIT 2

Block Cipher operation: block cipher design principles, multiple encryption and triple DES, Electronic Code Book (ECB), Cipher block chaining mode (CBC), Cipher feedback mode (CFM).

UNIT 3

Public key cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Key management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic

UNIT 4

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Problems.

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols.

UNIT 5

Electronic Mail Security: Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64conversion, PGP random number generator.

IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security payload), Security associations, Key management, Problems).

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security", Pearson Education, 6th edition, 2014

REFERENCE BOOKS

1. Behrouz A. Forouzan, “Cryptography and Network Security”, TMH, 2014
2. Atul Kahate, “Cryptography and Network security”**,** TMH, 2014

COURSE OUTCOMES (COs):

1. Analyze the basic concepts of network security to predict and classify attacks on a network **(PO1, 2, 3, 5, 7) (PSO 1, 2)**
2. Illustrate the process for hiding the information with cryptographic algorithms **(PO1, 2, 3, 8, 9, 10) (PSO 1, 3)**
3. Understand different key management distribution mechanisms **(PO1, PO2, PO3, PO5, PO7) (PSO 1, 2)**
4. Analyze security issues in IP and wireless networks **(PO1, 2, 3, 4) (PSO1)**
5. Analyze the mechanisms of implementing user authentication and intruder detection **(PO1, 2, 4, 5, 6, 7) (PSO 1, 2)**

Industrial Internet of Things (IIOT)

Course Code: TCE752 **Credit: 3:0:0**
Course coordinator: Dr. S. G. ShivaPrasad Yadav **Contact Hours:42**

Course Content

UNIT 1

Overview of IIOT, Industry 4.0 and Applications: Introduction, IOT Architecture, Application based IOT protocols, Cloud computing, fog computing, Sensor cloud and Big data

Introduction to Industry 3.0, Industry 4.0: Difference between Industry 3.0 & 4.0, Cyber Physical Systems and IIOT, Prerequisites and Applications of IIOT, Design requirements of IIOT, Drivers, smart Business perspective, Cybersecurity, Impacts of Industry 4.0, Application examples.

UNIT 2

IIOT Basics, Sensors and Actuators: Basics of Industrial IoT: Industrial Processes, Industrial Internet Systems, Industrial Sensing and Processes, Sensors - Characteristics, Sensor Categories, Actuators – Thermal, Hydraulic, Pneumatic and Electromechanical actuators, Case study discussion.

UNIT 3

Industrial Data Transmission, Security and Industrial data Acquisition: Industrial Data transmission- Foundation Fieldbus, Profibus, HART, Interbus, bitbus, CC-Link, Modbus, Batibus, DigitalSTROM, CAN, Wireless HART, LoRa and LoRaWAN, Industrial data Acquisition, Distributed control system, PLC and SCADA, Security aspects in IIOT, Case study discussion.

UNIT 4

IIOT Analytics, Role of Machine Learning & Data Science in Industries: Data Sources, IIOT Analytics, categorization of analytics, Challenges, Artificial Intelligence, Machine Learning, Data Science in Industries, Applications, Case study discussion.

UNIT 5

Business Models, Reference Architecture of IIOT and Key technologies: Business Models of IOT & IIOT, Reference Architecture of IOT & IIOT, Key Technologies – off site and onsite- Cloud computing, Fog computing, Augmented Reality, Virtual Reality, Big Data & Advanced Analytics, Smart Factories, Lean Management system and applications.

TEXT BOOKS

1. Sudip Misra Chandana Roy and Anandarup Mukherjee, "Introduction to Industrial Internet of Tings and Industry 4.0", CRC Press, 2021.
2. Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Things", Apress, 2017.

REFERENCE BOOKS

1. Sabina Jeschke, Christian Brecher, Houbing Song and Danda B. Rawat "Industrial Internet of Things: Cybermanufacturing Systems", Springer, 2017
2. Ismail Butun, "Industrial IoT - Challenges, Design Principles, Applications, and Security, Springer, 2020
3. Jiafu Wan, Iztok Humar and Daqiang Zhang, "Industrial IoT Technologies and Applications, Springer, 2016

COURSE OUTCOMES (COs):

1. Understand the concepts of Industrial Internet of Things (IIoT), Industry 4.0, Cyber physical systems with a flavor of cloud computing, fog computing, big data technology along with the recent emerging trends & Applications of IIOT. **(PO1, 2, 3, 4, 5, 9, 10,11,12) (PSO 1,2, 3)**
2. Discover key IIoT concepts including design, Impact and benefits of Industrial Internet system, Industrial sensing, processes, sensors, actuators and communication exploring the IIOT reference architectures **PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Realize the value created by collecting, communicating, coordinating, and analyzing the data from connected devices of IIOT **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
4. Examine key technologies of IIOT that will likely shape the industrial landscape with the help of various Business models and IIOT analytics considering the role of Machine Learning & Data sciences **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
5. Understand how to develop and implement novel IOT technologies, solutions and applications for various domains of Industries **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**

4G LTE/5G Communications

Course Code: TCE753 **Credit: 3:0:0**
Course coordinator: S.M Kusuma **Contact Hours:42**

Course Content

UNIT 1

LTE-Advanced for IMT-Advanced: LTE Specifications and 3GPP Structure. System Architecture Based on 3GPP SAE: Basic System Architecture Configuration with only E-UTRAN Access Network, and Non-3GPP Access Networks, IMS Architecture.

UNIT 2

Introduction to OFDMA, SC-FDMA and MIMO in LTE: LTE Multiple Access Background, OFDMA Basics, MIMO Basics. Physical Layer: Transport Channels and their Mapping to the Physical Channels, Uplink down link Physical Layer Signaling Transmission.

UNIT 3

Radio Resource Management: Overview of RRM Algorithms, Admission Control and QoS Parameters, Downlink Dynamic Scheduling and Link Adaptation, Uplink Dynamic Scheduling and Link Adaptation, Interference Management and Power Settings, RRC Connection Maintenance.

UNIT 4

5GArchitecture waveforms and channel models: 5GArchitecture.ORAN Introduction to MM wave 5G Radio Access Technologies: Design principles - Multi-carrier with filtering - Non-orthogonal Multiple Access - Radio access for dense deployments – Radio Access.

UNIT 5

5G Application for Communication: Machine-type communications: Fundamental techniques for MTC - Massive MTC - Ultra-reliable low-latency MTC - Device-to-device (D2D) communications - Multi-hop D2D communications - Multi-operator D2D communication - Simulation methodology: - New challenges in the 5G modelling.

TEXT BOOK

1. HarriHolma and AnttiToskala, “LTE for UMTS Evolution to LTE-Advanced”, Second Edition - 2011, John Wiley & Sons, Ltd.
2. AfifOsseiran, Jose F. Monserrat and Patrick Marsch, - “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.

REFERENCE BOOKS

1. Arunabha Ghosh, Jun Zhang, Jeffrey G., “Fundamentals of LTE”’, 1st Edition, Sept 2010, Prentice Hall Communications
2. StefaniaSesia, IssamToufik, and Matthew Baker, “LTE – The UMTS Long Term Evolution; From Theory to Practice’, John Wiley & Sons Ltd, 2009
3. Wei Xiang, KanZheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017.
4. Jonathan rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

COURSE OUTCOMES (COs):

1. Understand the fundamental concepts of 4G LTE and 5G communication **(PO1,2,4,5,6,10) (PSO1, 2, 3)**
2. Apply and solve the problems related to OFDMA, SC-FDMA and MIMO, NOMA **(PO1,2,3,4,10,12) (PSO1, 2, 3)**
3. Analyze the various radio access technologies, protocols related 4G LTE/5G **(PO1,2,3,5,6,10,12) (PSO 1,2,3)**
4. Analyze the design principles of 4GLTE/5G Waveforms and channel models **(PO 1,2,3,4,5,6,9,12) (PSO 1,2,3)**
5. Evaluate the performance of access network for 4G LTE / 5G**. (PO 1,2,3,4,10,8,12) (PSO 1,2,3)**

VIII Semester

INTERNSHIP

Course Code: TCIN
Credit: 0: 0: 3: 0

Course Content

The evaluation of students will be based on an intermediate presentation, along with written report containing a Certificate from the employer. The rubrics for evaluation of the presentation and the questionnaire for the report will be distributed at the beginning of the internship.

Course Code	Course Name	No. of Hrs./Week		Duration of Exam (Hrs.)	Marks		Total Marks	Credits
		Lecture	Practical/Field Work		IA	Exam		
TCIN	Internship	-	-	-	100	-	100	3

Course Outcomes (COs):

1. Develop fundamental knowledge on the emerging technologies appropriate to telecommunication engineering (**POs 1, 2, 3, 4, 6, 7, 11, 12) (PSO 1, 2, 3)**
2. Demonstrate expertise in identifying and solving the problems specific to communication domain. **(POs 1, 2, 3, 4, 6, 7, 8, 11, 12) (PSO 1, 2, 3)**
3. Gain exposure to industry/organization work culture and practices with focus on modern tools/techniques used in the industry and understand the limitations of the use of current technology. **(POs 1, 2, 3, 5, 6, 7) (PSO 1, 2)**
4. Demonstrate effective management of personal behavior, ethics and time management towards achieving the internship goal contributing as an individual/ team member in multidisciplinary environments. **(POs 8, 9, 10, 11) (PSO 3)**
5. Demonstrate effective presentation & communication skills, time management and create proper documentation of the work. **(POs 7, 9, 10, 11, 12) (PSO 2, 3)**

PROJECT WORK

Course Code: TCP
Credit: 0 :0: 14: 0

Course Content

Students will complete the technical project work under the guidance of the faculty member in the department. The quality of the work will be judged in three presentations, where the panel consists of the guide and other faculty members in the project domain.

Subject code	Subject	No. of Hrs./Week		Duration of exam	Marks		Total marks	Credits
		Lecture	Practical/ Field work		IA	Exam		
TCP	PROJECT WORK	-	14	-	50	50	100	14

Course Outcomes (COs):

1. Review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications **(POs 1, 2, 3, 4, 6, 7, 9, 11, 12) (PSO 1, 2, 3)**
2. Identify the clear objectives & methodology for implementing the project by visualizing the Hardware and Software **(POs 1, 2, 3, 4, 6, 7, 9, 11, 12) (PSO 1, 2, 3)**
3. Design and Implementation of identified Problem using appropriate modern tools and Techniques in the area of telecommunication/ multidisciplinary areas **(POs 1, 2, 3, 4, 5, 6, 7, 9, 11, 12) (PSO 1, 2, 3)**
4. Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual **(PO 1, 2, 8, 9, 10, 11, 12) (PSO 1, 3)**
5. Ability to write the thesis following ethical values and publish the work in quality conferences/journals supporting lifelong learning abilities **(POs 8, 9, 10, 12) (PSO 3)**