MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous UG Program

Syllabus
of
VII and VIII Semester (FOURTH YEAR 2020 ADMITTED BATCH)

Academic Year 2023-24

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme & Syllabus for BE (E&C) VII and VIII semesters
2023-24 Academic year

VISION OF THE DEPARTMENT

To produce industry ready, research oriented and socially responsible Electronics & Communication Engineers.

MISSION OF THE DEPARTMENT

- To create an ambience for learning.
- To conduct research, beneficial to the society.
- To promote industry-academic interaction at all-levels.
- To be continuously agile to the needs of the stake holders.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates will:

PEO1: Design and test Electronics & Communication systems and be successful professional in the field of ECE and allied areas.

PEO2: Be a good leader, team worker with strong communication skills.

PEO3: Possess capability to pursue higher education and be involved in research in the core and allied areas of E&C engineering and be a lifelong learner.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them to various areas, like Signal and image processing, VLSI, Embedded systems, photonics, networks, MEMS, antennas etc., in the design and implementation of complex systems.

PSO2: Possess the skills to analyze and solve problems, using the latest software tools and hardware available in E & C Engineering along with analytical skills for real-time applications.

PROGRAMOUTCOMES

The program is targeted at developing the following competencies, skills and abilities amongst students of E & C Engineering:

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

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

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

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

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

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

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

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

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

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

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

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

VII Semester					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact hours**
HSM-9	20EC701	Entrepreneurship & Management	3-0-0	3	3
PC-26	20EC702	Internet Protocol Engineering	3-0-0	3	3
PC-27	20EC703	Wireless Communication and Networks	3-0-0	3	3
PC28	20EC704	ARM Embedded System	3-0-0	3	3
PC-29	20EC705	Embedded Systems laboratory	0-0-2	1	2
PC-30	20EC706	VLSI Laboratory	0-0-2	1	2
PR-2	20EC707	Mini Project-II	0-0-4	2	4
PE-4	20EC74X	Elective IV	3-0-0	3	3
OE-2	20OEXXXX	Open Elective II	3-0-0	3	3
SW-2	20SW2	SWAYAM Course 2 (Non Credit Mandatory course)		0	0
Total				**22**	**26**

Elective IV	
20EC741	5G Technologies and Beyond
20EC742	Artificial Intelligence
20EC743	Satellite Communications

Open Elective (for other branches of Engineering)			
20OEEC71	Embedded system designs	20OEEC75	Automotive Electronics
20OEEC72	8051Microcontrollers	20OEEC76	E waste management
20OEEC73	Sensors and Actuators	20OEEC77	Data Communication Networks
20OEEC74	Machine learning	20OEEC78	Internet of Things

VIII Semester					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact hours**
PC-3	20EC801	Seminar	0-2-0	1	2
PR-4	20EC802	Project Work	0-0-18	9	18
PR-5	20EC803	Internship	0-4-0	2	2
HSM-10	20EC804	Intellectual Property Rights and Cyber Law	3-0-0	3	3
PC-31	20EC805	Industry driven course	1-0-0	1	1
PE-5	20EC85X	Elective V	3-0-0	3	3
Total				**19**	**29**

Elective V	
20EC851	Multimedia Communication
20EC852	Fundamentals of speech recognition
20EC853	Digital Control systems

VII SEMESTER

ENTREPRENEURSHIP AND MANAGEMENT

Course Code: **20EC701** **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: To make the students understand the various plans for a new business idea and think on the ways and means of organizing and launching an enterprise.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Define entrepreneurship and its intricacies and Ponder over the feasibility of a venture.	6,8,11, 12
2	Develop plan for a new business idea.	8, 11
3	Organize and launch an enterprise	7, 8, 11
4	Identify options in managing the process involved in business by considering various factors affecting human resource management.	7, 10, 11

Course Contents:

MODULE-1	Teaching Hours
Entrepreneurs & Entrepreneurship: Introduction, what is Entrepreneurship? Who are Entrepreneurs and what do they do? **The Context of Entrepreneurship**: Issues affecting entrepreneurship in action, identifying environmental opportunities, Understanding competitive advantage.	**10 Hrs.**
MODULE-2	
Researching the Venture's Feasibility: Generating and evaluating business ideas, researching competitors, Researching finance options. **Planning the Venture:** Developing organizational vision and mission, Organizational culture issues, Developing and writing the business plan.	**10 Hrs.**
MODULE-3	
Organizing the Venture: Legal forms of business organization, other legal issues, Organizational design issues. **Launching the Venture:** Establishing the organizational goals and strategies, designing the venture's production & operations management function, establishing the Venture's marketing function, designing the venture's information systems and establishing the venture's financial and accounting systems.	**10 Hrs.**
MODULE-4	
Managing Processes: Making decisions, Measuring and evaluating organizational performance, Stimulating and making changes – Being a change agent and Contemporary issues in managing the venture. **Managing People:** Human resource management issues, Motivating employees, Employee work teams and leadership and other people issues. 10 Hrs	**10 Hrs.**

TEXT BOOKS:

1. **Entrepreneurship in Action**, Mary Coulter, PHI 2nd Edition.

REFERENCES:

1. **Entrepreneurship Development,** E. Gordon & K. Natarajan, Himalaya publishers, 2008.
2. **Entrepreneurship Development**, S S Khanka, S Chand & Co., New Delhi.
3. **Entrepreneurship Development and Management,** A. K. Singh, JBA publishers, New Delhi.
4. **Principles of Management** – P.C.Tripathi, P.N.Reddy – Tata McGraw Hill

INTERNET PROTOCOL ENGINEERING

Course Code: 20EC702 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week : 3
SEE: **50 Marks** Total hours : 40

Course Objective: Overall knowledge gained in this course will enhance the ability of Electronics and Communication Engineering students to deal with analysis and design of computer networks and protocols associated with them in their profession.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Recognize the functionalities of the various layers of OSI and TCP/IP model and identify the different internetworking devices and protocols associated with them.	1,2
2.	Design fixed length and variable length network blocks to carryout, delivery forwarding and routing using IPv4 and IPv6 addresses	1,2, 3
3.	Describe the functionalities associated with transport layer.	1,2
4.	Illustrate the working of application layer protocols such as DNS, FTP, SMTP, DHCP, RTP and VOIP for data communication over internet	1,2

Course Contents:

MODULE-1	Teaching Hours
Introduction- History, protocols and standards, OSI Model and TCP/IP Protocol suite, Layers, addressing modes, IP versions, framing techniques. **[Self-Learning:** RFC report**]** LAN-Wired LANs- Multiple Access Techniques, Wired LAN(Ethernet) and Wireless LANs (802.11 and 802.15), Point to point WAN technologies, Connecting Devices.	**10 Hrs.**
MODULE – 2	
IP Addressing- Introduction, Classful and classless addressing, IPv4 and IPv6 address formats and types, Variable length blocks in IPv4. **Delivery, forwarding and routing IP Packets**- Types of delivery, forwarding techniques with classful and classless addressing, static and dynamic routing, Introduction to Routing protocols- RIP, IGMP.	**10 Hrs.**
MODULE-3	
Internet Protocol- Datagram formats of IPv4 and IPv6, fragmentation, ICMP message types and formats. **UDP and TCP-** Process to process communication, frame format of UDP packets, UDP operation, Services and features of TCP, TCP segment format, TCP Connection establishment and Termination, Congestion control in TCP.	**10 Hrs.**
MODULE-4	
Applications- DNS definition, DNS in internet, resolution in DNS, FTP-File transfer, SMTP, DHCP operation and configuration, WWW- architecture, streaming stored audio/video and streaming live audio/video, Real time Transport Protocol-RTP, Introduction to VOIP.	**10 Hrs.**

TEXT BOOK:

1. Forouzan B A, "TCP/IP Protocol Suite", TMH, 4th edition, 2010.

REFERENCE BOOKS:

1. Gopalan and SivaSelvan, "TCP/IP Illustrated", PHI, New Delhi,2008.
2. **A. Tanenbaum,** "Computer Networks", 3rd Edition, PHI,1883.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	3	1												
CO2	3	2	2											
CO3	3	2												
CO4	3	2												

WIRELESS COMMUNICATION AND NETWORKS

Course Code: 20EC703 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: To make the students understand the various wireless architectures from a design and performance perspective

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Acquire the basics of Wireless Communication and Networks.	1
2.	Realize the complicated nature of wireless propagation and use of simple models to determine power requirements.	2,3
3.	Classify multipath channel models and analyze the operational principles of the various components of diversity techniques.	3
4.	Describe some of the existing and emerging Cellular and Non-Cellular Wireless Networks.	2

Course Contents:

MODULE-1	Teaching Hours
Introduction to Wireless Communication and Cellular Concept: Evolution, 2G, 2.5G, 3G,4G,5G Networks, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Coverage and Capacity in Cellular systems. **Mobile Radio Propagation: Large scale path loss-** Free Space Propagation model, Three basic propagation mechanisms, reflection, Ground Reflection (Two-ray) Model, Diffraction, Scattering.	**10 Hrs.**
MODULE-2	
Mobile Radio Propagation: Small scale path loss- Small scale multipath propagation, Parameters of Mobile Multipath Channels, Types of Small-scale fading **Diversity Techniques**: Selection diversity Improvement, Maximal ratio Combining Improvement, Selection Diversity, Scanning Diversity, Maximal and Equal Gain Combining, Polarization, Time, Frequency diversity, RAKE Receiver	**10 Hrs.**
MODULE-3	
Non-Cellular Networks: LoRA technology, Zigbee, ZWave, SIGFOX Wireless Systems and Standards-I: AMPS-Overview, Call Handling, CDMA Digital Cellular Standard (IS-85)-Frequency and Channel Specification, Forward CDMA and Reverse CDMA Channels	**10 Hrs.**
MODULE-4	
Wireless Systems and Standards-II: Global System for Mobile (GSM)-Services, Features, System Architecture, Radio Subsystem, Channel Types, Frame Structure,	**10 Hrs.**

Signal Processing. Wireless Systems and Standards-III: DECT- Features and Specifications, Architecture, Functional Concept, Radio Link, PACS-System Architecture, Radio Interface.	

TEXT BOOKS:

1. Theodore S. Rappaport – "Wireless Communications: Principles and Practice" Pearson Education, Second Edition, Eleventh Impression 2013

REFERENCE BOOKS:

1. **S.S Manvi,** "Wireless and Mobile Networks, Concepts and Protocols", Second Edition, 2010.
2. **William C Y LEE**, "Mobile Communications Engineering" McGraw Hill Second Edition, 2010.
3. **D.P.Agarwal**, "Wireless communication" Thomson learning, 2nd Edition 2007Second edition, 2010.

ARM EMBEDDED SYSTEM

Course Code :20EC704 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week: 3
SEE :**50 Marks** Total hours: 40

Course Objective: To enable the students to understand the importance and applications of ARM Design, know the architecture of ARM processors, use instruction sets of ARM processor and analyse the adaptation of C code, firmware, OS, Interrupts, caches, etc. in ARM embedded systems.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Depict the organization, architecture, bus technology, memory and operation of the ARM Processors.	1, 2
2.	Employ the knowledge of the Instruction set of ARM processors to develop basic Assembly Language Programs.	1, 2
3.	Develop the techniques involved in writing C code for ARM processors and Exception & Interrupt handling in ARM Processors.	1,2,3
4.	illustrate the importance and use of Firmware, OS, and cache in ARM Embedded systems.	1,2,3

Course Contents:

MODULE-1	Teaching Hours
ARM Embedded Systems Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. **ARM Processor Fundamentals** ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.	**10 Hours**
MODULE-2	
Introduction to the ARM Instruction set Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ConditionalExecution. ALP programming. **Introduction to the THUMB instruction set** Introduction, THUMB register usage, ARM – THUMB interworking, other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions. ALP programming	**10 Hours**
MODULE-3	
Efficient C Programming: Overview of C Compilers and optimization, Basic C data types, Local Variable Types, Portability issues **Exception and Interrupt Handling:** Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset, Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Schemes (**general description only** of the schemes)	**10 Hours**
MODULE-4	
Firmware: Firmware and Bootloader **Embedded Operating Systems:** Fundamental Components **Caches:** The memory Hierarchy and caches memory-caches and memory management units, Cache architecture basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.	**10 Hours**

TEXT BOOKS:

1. Andrew N Sloss, Dominic System and Chris Wright, "ARM System Developers Guide", Elsevier, Morgan Kaufmann publisher, 1st Edition, 2008.

REFERENCE BOOKS:

1. **Furber S,** "ARM System on chip Architecture", 2nd edition, Addison Wiley, 2008.
2. **Rajkamal**, "Embedded System", Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√												
CO2	√	√												
CO3	√	√	√											
CO4	√	√	√											

Embedded Systems Laboratory Using ARM CORTEX M3/M4

Course Code: 20EC705 **LTPC: 0-0-2-1**
Exam Hours: 3 Hours / Week: 2
SEE: **50 Marks**

Course Objective: The student will learn programming of ARM CORTEX M3/M4 processor.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	PO's
1.	Realize the architecture of ARM7 CORTEX M3/M4 processor.	1,2,5
2.	Design and write assembly language programs using ARM CORTEX M3/M4 processor.	1,2, 5
3.	Design and implementation of ARM-7 CORTEX M3/M4 interfacing modules.	1,2, 5
4.	Develop communications skills through group work and report preparation.	1,2, 5,9, 12

Course Contents:

Exp No.	Experiment Title
I	Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation simulator and the required software tool.
1.	Write an ALP to find the sum of 10 integer numbers.
2.	Write an ALP to multiply two 16-bit binary numbers.
3.	Write an ALP to find factorial of a number.
4.	Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM
5.	Write an ALP to find the square of a number (1 to 10) using look-up table.
6.	Write an ALP to find the largest/smallest number in an array of 32 numbers.
II	Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil µvision-4 tool/compiler.
7.	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.

8.	Interface a DAC and generate Triangular and Square waveforms.
9.	Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
10.	Interface a simple Switch and display its status through Relay, Buzzer and LED.

REFERENCE BOOKS:

1. Joseph Yiu ,"The Definitive guide to ARM CORTEX M3 and M4 processors" 3rd Edition ,Elsevier.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√			√									
CO2	√	√			√									
CO3	√	√	√		√				√					
CO4	√	√	√		√				√			√		

VLSI LABORATORY

Course Code: 20EC706 **LTPC: 0-0-2-1**
Exam Hours: 3 Hours / Week: 2
SEE: **50 Marks**

Course Objective: The students will have hands-on experience on design concepts underlying VLSIs chips.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Simulate combinational and sequential circuits using MOSFET'a and logic gates.	2,3
2.	To build higher level combinational and sequential blocks using user defined structural model	2, 3
3.	To learn physical design, Lambda design rule or micron-based design and layout making of VLSI circuits.	3, 4,5
4.	Optimize the logic gate area using modern tools.	3, 4,5

Course Contents:

Exp No.	Experiment Title
I	**nulation of schematic and layout using DSCH 2.6c and Microwind tools**
1.	Logic inverter
2.	Two input logic gates- AND, OR, NAND, NOR, EXOR, EXNOR
3.	Half adder and Full adder
4.	2-Bit parallel adder
5.	Magnitude comparator
6.	D Flip – Flop with reset
7.	T Flip – Flop with reset
8.	J-K Flip Flop
9.	Ring Oscillator
10.	Clock divider (by 4)
11.	4 –bit Shift Register with enable
12.	Schmitt trigger
13.	4:1 Multiplexer and 1:4 Demultiplexer

TEXT BOOK:

1. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley, 3rd Edition, 2002.

REFERENCE BOOKS:

1. Neil H E Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design – A circuits and Systems perspective", Pearson Education, III Ed., 2006.
2. A.Albert Raj and T.Latha, "VLSI Design", PHI, 2008.

MINI PROJECT II

Course Code: 20EC707 **LTPC: 0-0-4-2**

- Student batches having four members (minimum) have to do projects relevant to solving societal problems.
- A guide along with two faculty members will be evaluating the project in three phases(15+35+ 50 marks) for a total of 100 marks (**no SEE**).
- Students have to identify the problem and do the literatures survey for phase I evaluation, then mid evaluation for phase II and final project demo and report submission in phase III evaluation.

SWAYAM COURSE II

Course Code: 20SW2 **Non Credit mandatory course**

- **Students have to register for NPTEL course of 8weeks duration and obtain the relevant certificate.**
- **No CIE or SEE examination**
- **Student mentors have to provide the information to the SWAYAM course co-ordinator.**

ELECTIVE IV

5G Technologies And Beyond

Course Code :20EC741 **LTPC: 3-0-0-3**

Exam Hours: 3 Hours / Week: 3

SEE: **50 Marks** Total hours: 40

Course Objective: The objective of the course is to provide exposure to the new communication systems and services for 5G networks and beyond where technologies enabled for wireless communication for improvement of communication system is analyzed.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}

Upon completion of the course, the student shall be able to:

COs	Statement	POs
1.	Comprehend the evolution of recent wireless communication systems and enabling technologies and models for next generation wireless communications., applications.	PO1, PO2
2.	Analyse technologies for internet of things, applications in different areas and 5G requirements and initiatives.	PO1, PO2,PO5
3.	Examine 5G architecture, its flexibility and deployment.	PO1, PO2
4.	Analyse the 5G and 6G technologies for mobile networks and communication.	PO1, PO2

Course Contents:

MODULE-1	Teaching Hours
Technology Evolutionof WirelessCommunicationsA Survey and Look Forward: Introduction, Historical Background and Evolution of Wireless Systems, Application Scenarios of Next Generation Wireless Systems, Requirements of Next Generation Wireless Systems, need for 5G and Beyond, Enabling Technologies of Next Generation Wireless Systems. **Enabling Technologies and Enabling Business Models for NextGeneration Wireless Communications:** Introduction,Main Contributions and Related Works, Enabling Technologies and Enabling Business Models for Wireless Communications, Assessment of Enabling Technologies and Enabling Business Models for Previous-Generation, Current-Generation, and Emerging-Generation Wireless Communications, Assessment of Enabling Technologies and Enabling Business Models for Next Generation Wireless Communications, Integrated Framework for Enabling Technologies and EnablingBusiness Models for Next Generation Wireless Communications.	**10**
MODULE-2	
Enabling Technologiesfor Internet ofEverything: Introduction, Enabling Technologies for IoE, Cloud Computing, Fog Computing,Edge Computing, Machine to Machine, Machine Learning,Data Management and Security in IoE,System Management and Protection for IoE,Applications of IoE, Healthcare, Education SystemSmart Environment, Enabling IoE in Developing Countries. **5G Introduction:** Historical background, From ICT to the whole economy, Rationale of 5G: high data volume, twenty-five billion, connected devices and wide requirements, , Global initiatives, Standardization activities.	**10**
MODULE-3	
5G use cases and system concept: Use cases and requirements, 5G system concept. **The 5G architecture:**Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment	**10**

MODULE-4	
MIMO Antennas: A 5GCommunication Perspective: Introduction,Single Element Versus Multiple Antenna System, MIMO Antenna System,Comparative Study of SISO, MIMO and Massive MIMO System,mm-Wave MIMO,Antenna Array Beamforming. **The 6GVision**: Introduction, Evolution of Mobile Networks, and Internet,6G Network Architectures and Key Enabling Technologies. Four-Tier Networks: Space-Air-Ground-Underwater, Key Enabling Technologies, Millimetre-Wave and Terahertz Communications, Reconfigurable Intelligent Surfaces, From Network Softwarization to Network Intelligentization,Toward 6G: A New Era of Convergence.	**10**

Text Book:

1. **Usman, M., Wajid, M., & Ansari, M.D.** (Eds.). (2020). Enabling Technologies for Next Generation Wireless Communications (1st ed.). CRC Press. https://doi.org/10.1201/9781003003472.
2. **5G and Beyond Wireless Systems Book:** 2021 in Springer Series in Wireless TechnologyEditors: Manish Mandloi, Devendra Gurjar, PrabinaPattanayak, Ha Nguyen
3. **Ebrahimzadeh, A., Maier, M. (2021).** Toward 6G: A New Era of convergence. United Kingdom: Wiley.

Reference books:

1. **Dohler, M., & Nakamura, T. (2016).** 5G Mobile and Wireless Communications Technology (A. Osseiran, J. Monserrat, & P. Marsch, Eds.). Cambridge: Cambridge University Press. doi:10.1017/CBO9781316417744.
2. **Next Generation Mobile systems:**3G & beyond: Etoh. M(ed.), Wiley 2005.

ARTIFICIAL INTELLIGENCE (3-0-0)

Course Code: 20EC742 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **100 Marks** Total hours: **40**

Course Objective: The student should be made to Study the concepts of Artificial Intelligence and learn the methods of solving problems using Artificial Intelligence

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Identify problems that are amenable to solution by AI methods.	1, 12
2	Identify appropriate AI methods to solve a given problem	1, 2
3	Formalize a given problem in the language/framework of different AI methods	4, 5
4	Implement basic AI algorithms	10

Course Contents:

MODULE-1	Teaching Hours
INTRODUCTION History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.	**10 Hrs**
MODULE-2	
PLANNING Planning withforward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.	**10 Hrs**
MODULE-3	
REASONING: Uncertainity – Probabilistic reasoning–Filtering and prediction– Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.	**10 Hrs**
MODULE-4	
LEARNING: Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.	**10 Hrs**

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approch", Pearson Education, India2003.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: Addison-Wesley, 2002.

REFERENCE:

1.David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1882.

SATELLITE COMMUNICATIONS

Course Code: 20EC743 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **100 Marks** Total hours: **40**

Course Objective: To provide them with a sound understanding of how a Satellite Communications system successfully transfers information from one earth station to another.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	Pos
1	Comprehend orbital mechanics and launch methodologies.	1,2
2	Describe satellite subsystems and link design for transmission & reception of signals.	1,2
3	Compare various satellite access techniques.	1,2
4	Explain the basic principles of radio and satellite navigation.	1,2

Course Contents:

MODULE-1	Teaching Hours
Orbital Mechanics and Launchers: A brief History of Satellite Communication, Kepler's Three Laws of Planetary Motion, Describing the Orbit of a Satellite, Locating the Satellite in the Orbit, Locating the Satellite With Respect to the Earth, Orbital Elements, Look Angle Determination, Orbital Perturbations, Orbit Determination, Space Launch Vehicles and Rockets, Placing Satellites Into Geostationary Orbit, Orbital Effects in Communications Systems Performance, Manned Space Vehicles.	**10 Hours**
MODULE-2	
Satellite Sub-Systems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment. **Satellite Link:** Basic transmission theory, system noise temperature and G/T ratio, Design of Downlinks, Ku-Band GEO Satellite Systems, Uplink Design.	**10 Hours**
MODULE-3	
Propagation effects: Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospheric Scintillation and Low angle fading, Rain Induced attenuation, rain induced cross polarization interference. **Multiple Access:** Frequency Division Multiple Access(FDMA), Intermodulation, Calculation of C/N. Time Division Multiple Access(TDMA), Frame structure, Burst structure, Satellite Switched TDMA Onboard processing, Demand Assignment Multiple Access (DAMA) – Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.	**10 Hours**
MODULE-4	
Low Throughput Systems and Small Satellites: Small Satellites, Operational Use of SmallSats, Low Throughput Mobile Communications Satellite Systems, VSAT Systems. **Satellite Navigation & Global Positioning Systems:** The Global Positioning System, Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers, GPS C/A code accuracy, Differential GPS.	**10 Hours**

Text Books:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2rd Edition, 2003
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud Pearson Publications, 2nd Edition, 2003.

Open Electives

EMBEDDED SYSTEM DESIGN

Course Code: 20OEEC71 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **50 Marks** Total hours: 40

Course Objective: To make students familiar with the basic concepts and terminology of the target area, the embedded systems design flow. – To give students an understanding of the embedded system architecture.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Comprehend the requirements for embedded systems to design an embedded system using microprocessor/microcontrollers	1 2,
2	Analyse how the memory, peripheral components and buses interact in an embedded system	1, 2
3	Develop the code to implement the applications of ARM processor.	2, 3
	Design and develop the programming skills for embedded devices.	1, 2,3

Course Contents:

MODULE-1	Teaching Hours
Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	**10 Hrs.**
MODULE-2	
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory hadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.	**10 Hrs.**
MODULE-3	
Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	**10 Hrs.**
MODULE-4	
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and multitasking, Task Scheduling.	**10 Hrs.**

TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

8051 MICROCONTROLLER

Course Code: 20OEEC72 **LTPC: 3-0-0-3**
Exam Hours: 3 Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: The objective of this course is become familiar with the architecture and the instruction set. Impart knowledge about assembly language programs and 8051 C. Provide strong foundation for designing real world application using microcontrollers.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	Pos
1.	Explain the architecture and use the instruction set of microcontrollers.	1
2.	Apply the programming concepts that work on real time monitoring system.	2
3.	Apply programming of I/O ports in order to interface the controller to external devices.	2
4.	Develop and implement Microcontroller based systems.	2

Course Contents:

MODULE-1	Teaching Hours
Microprocessors and Micro controllers, The 8051 Architecture: Introduction, 8051 Microcontroller Hardware. Addressing modes, External data Moves, PUSH and POP Opcodes, Data exchanges, Example Programs; Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Example Programs. Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs.	**10 Hrs**
MODULE-2	
The JUMP and CALL Program range, Jumps, calls and Subroutines, Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs	**10 Hrs**
MODULE-3	
Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051C. Basics of Serial Communication, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C.	**10 Hrs**
MODULE-4	
8051 Interrupts, Programming Timer Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051/52, Interrupt programming in C.Keyboard, parallel and serial ADC, DAC, Stepper motor interfacing.	**10 Hrs**

TEXT BOOKS:

1. **Kenneth J. Ayala,** "The 8051 Microcontroller Architecture, Programming &Applications", Cengage Learning, 3rd Edition, 2004.
2. **Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay**,"The 8051 Microcontroller and Embedded Systems – using assembly and C ", Pearson Education India, 2nd Edition, 2007.
3. **John H Davies**, "MSP430 Microcontroller Basics", Newnes Publications, Elsevier,2008

REFERENCE BOOKS:

1. **Dr. RamaniKalpathi, Ganesh Raja**," Microcontrollers and Applications" 1 st edition, Sanguine publications, 2007.
2. **J Raj Kamal**, "Microcontrollers Architecture, Programming Interfacing and System Design", 1st edition Pearson Education,2005.
3. **Udayashankar M. Mallikarjunaswamy**, "8051 Microcontroller Hardware software & applications.TMH 2000.

SENSORS AND ACTUATORS

Course Code: 20OEEC73 **LTPC: 3-0-0-3**
Exam Hours: 3 **Hours / Week: 3**
SEE: 50 Marks **Total hours: 40**

Course Objective: The objective of the course is educating students in micro technology and its use to fabricate sensors and systems.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}

Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Understand basics of sensors, actuators and their operating principle.	1,2
2.	Educate the students on different types of deposition methods for designing and developing sensors.	3
3.	Apply fabrication and manufacturing processes for the design of sensors and actuators	4
4.	Apply appropriate miniaturization, fabrication and manufacturing techniques, and research methods such as FEM techniques for the design of MEMS and microsystems	4,5

Course Contents:

MODULE-1	**Teaching Hours**
Basics of Energy Transformation: Transducers-Types of transducers, Sensors: - Sensor Classification, Selection criteria, Sensor Descriptions-Temperature sensor, magnetic field sensor, light sensor and Strain Gauge, Actuators descriptions -Piezoelectric actuator, Thermal actuator and electrical actuator. **Understanding of thin film physics:** MOSFET Characteristics, Application in MOSFET and its variants -GASFET, OGFET, ADFET, ISFET, PRESSFET, CEMFETs and, BIOFET	**10 Hrs**
MODULE-2	
Thin Film Deposition Techniques I: Chemical Vapor Deposition, APCVD, LPCVD, PECVD, HDPCVD.Thin **Film Deposition Techniques II:** Physical Vapor Deposition, Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition.	**10 Hrs**
MODULE-3	
Fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation Micro **Manufacturing:** Bulk micro manufacturing, Surface Micromachining, The LIGA Process.	**10 Hrs**
MODULE-4	
Working principles of Sensors and Actuators: Micro sensors, Actuation using thermal forces, piezoelectric crystal, electrostatic forces, Microvalves, Micropumps. **Design and fabrication process of Microsensors:** Design Considerations, Process Design, Mechanical Design, Simulation of Microfabrication Process Using FEM, Design of a Silicon Die for a Micro pressure Sensor.	**10 Hrs**

TEXT BOOKS

1.Pallas-Areny Ramón, and John G. Webster Sensors and Signal Conditioning, A Wiley-Interscience Publication, 2001

2. James D. Plummer, Michael Deal, Peter D. Griffin, Silicon VLSI Technology: Fundamentals, Practice, and Modeling, Pearson ,2001

3. Tai Ran Hsu, "MEMS and Micro Systems : Design and Manufacture", Tata McGraw Hill, 2002

REFERENCES:

1.Jacob Fraden , Handbook of modern sensors, Springer 2015.

2. **Senturia**, Stephen D , Microsystem Design, KLUWER ACADEMIC PUBLISHERS

3.*Marc J. Madou*, Fundamentals of Microfabrication and Nanotechnology, Second Edition, CRC PRESS.

MACHINE LEARNING

Course Code: 20OEEC74 **LTPC: 3-0-0-3**
Exam Hours: 3 **Hours / Week: 3**
SEE: 50 Marks **Total hours: 40**

Course Objective: The objective of this course is to introduce the concepts of Machine Learning and Artificial Neural Networks.

Course Outcomes: At the end of the course the student will be able to:

COs	Statements	POs
1.	Understand the core concepts of Machine learning to apply on real world problems.	1, 2
2.	Illustrate the underlying mathematical relationships within and across Machine Learning algorithms.	1, 2
3.	Apply the various algorithms of supervised and unsupervised learning	1, 2
4.	Analyze and design the genetic algorithms for optimization engineering problems	2,3

Course Contents:

MODULE-1	Teaching Hours
Introduction: Learning, Types of Learning, Supervised Learning, The Machine Learning Process. Some Terminology, Testing Machine Learning Algorithms, Some Basic Statics **Neurons, Neural Networks, and Linear Discriminants**: Hebb's Rule, McCulloch and Pitts Neurons, Neural Networks, Perceptron: The Learning Rate, The Bias Input, The Perceptron Learning Algorithm, An Example of Perceptron Learning: Logic Functions, Linear Separability: The Perceptron Convergence Theorem, The Exclusive Or Function, Preprocessing, Linear Regression.	**10 Hrs**
MODULE-2	
Multi-Layer Perceptron: Going Forwards, Back Propagation of Error: Multi-Layer Perceptron Algorithm. Initialising the Weights, Different Output Activation Functions, Local Minima, Picking up Momentum, Multi-Layer Perceptron in Practice: Amount of Training Data, Number of Hidden Layers, When to stop learning. **Dimensionality Reduction:** Linear Discriminant Analysis(LDA), Principal Components Analysis (PCA), Independent Components Analysis (ICA), Locally Linear Embedding, ISOMAP.	**10 Hrs**
MODULE-3	
Radial Basis Functions: Receptive Fields, The RBF Networks, Interpolations and Basis Functions **Support Vector Machines:** Optimal Separation, Kernels, SVM Algorithm. **Evolutionary Learning:** The Genetic algorithm, Genetic Operators, Using genetic algorithm**,** Genetic Programming.	**10 Hrs**
MODULE-4	
Reinforcement Learning: Overview, Example: Getting Lost, Markov Decision Processes, Values, Back on Holiday: Using Reinforcement Learning, Difference Between SARSA and Q-Learning, Uses of Reinforcement Learning. **Learning with Trees:** Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Classification Example. **Unsupervised Learning:** The k-Means Algorithm, Vector Quantization, Self-Organizing Feature MAP.	**10 Hrs**

TEXT BOOKS:

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC.

REFERENCE BOOKS:

1. **Tom M. Mitchell**, "Machine Learning", McGraw-Hill Education, (INDIAN EDITION), 2013.
2. **Ethem Alpaydin**, "Introduction to Machine Learning", 2nd Edition, PHI Learning Pvt. Ltd., 2013.

AUTOMOTIVE ELECTRONICS

Course Code: 20OEEC75 **LTPC: 3-0-0-3**
Exam Hours: 3 Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Objective: To understand the concepts of automotive electronics, its evolution and future trends.

Course Outcomes: At the end of the course the student will be able to:

COs	Statements	Pos
1.	understand the fundaments of automotive systems, sensors and its monitoring mechanisms aligned to automotive systems	1,2
2.	Understand, design and model various automotive control systems	1,3
3.	Understand the vehicle onboard off board diagnostics and a review of future automotive electronic system.	1,2

Course Contents:

MODULE-1	Teaching Hours
Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System. **Air/Fuel Systems** – Fuel Injection Systems, Air Intake System, Air/ Fuel Management.	**10 Hrs**
MODULE-2	
Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator **Exhaust After-Treatment Systems –** AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems.	**10 Hrs**
MODULE-3	
Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control **Communication –** Serial Data, Communication Systems, Protection, Body and Chassis Electrical Systems, Remote Keyless Entry, GPS **Vehicle Motion Control –** Cruise Control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension.	**10 Hrs**
MODULE-4	
Automotive Instrumentation – Sampling, Measurement & Signal Conversion of various parameters. **Integrated Body –** Climate Control Systems, Electronic HVAC Systems, Safety Systems – SIR, Interior Safety, Lighting, Entertainment Systems **Automotive Diagnostics –** Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems **Future Automotive Electronic Systems –** Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System.	**10 Hrs**

REFERENCE BOOKS:

1.William B. Ribbens: Understanding Automotive Electronics, 6th Edition, SAMS/ElsevierPublishing.

2.Robert Bosch GmbH: Automotive Electrics Automotive Electronics Systems and Components, 5th edition, John Wiley& Sons Ltd., 2007.

E-WASTE MANAGEMENT

Course Code: 20OEEC76 **LTPC: 3-0-0-3**
Exam Hours: 3 Hours / Week: 3
SEE: **50 Marks** Total hours: 40

Course Outcomes (COs) At the end of the course the student will be able to:

COs	Statement	POs
1.	Understand Multidisciplinary nature of environmental studies and Investigate how and why things happen, and make their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills.	6,7,12
2.	Understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues	6,7,12
3.	To develop the sense of awareness among the students about the environment and its various problems.	6,7,9,12
4.	Acquiring the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment.	6,7,12

Course Contents:

Module -1	Teaching Hours
Multidisciplinary nature of environmental studies- Definition, scope and importance. Need for public awareness. Natural Resources-Renewable and non-renewable resources: Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer, pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, Case studies. f) Land resources: Land as a resource, land degradation, man induced and slides, soil erosion and desertification Role of individual in conservation of natural resources. Equitable use of resources for sustainable life styles.	10 Hours
Module -2	
Biodiversity and its conservation-Introduction Biogeographical classification of India, Value of biodiversity: consumptive, productive, social, ethical, aesthetic and option values. India as a mega-diversity nation Hot-spots of biodiversity Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts Endangered and endemic species of India. Environmental Pollution-Definition Causes, effects and control measures of Air pollution Water pollution Soil pollution Marine pollution Noise pollution Thermal pollution nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution case studies Disaster management: floods, earthquake, cyclone and landslides.	10 Hours
Module -3	
E-waste growth- An overview, hazards of E-waste, what is E-waste, digital dump yard, how to minimize E-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment.	10 Hours
Module -4	
E-Waste Recycling Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials.	10 Hours

TEXT BOOK:

1. **Bharucha Erach**, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013
2. E-Waste Managing the Digital Dump Yard, Edited by **Vishakha Munshi**, ICFAI University Press (Chapter 1)
3. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by **Rakesh Johri**, The Energy and Resources Institute, New Delhi (Chapter 1, 5)

DATA COMMUNICATION NETWORKS

Course Code: 20OEEC77 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week :3
SEE: **50 Marks** Total hours :40

Course Objective: Overall knowledge gained in this course will enhance the ability of students to deal with analysis and design of computer networks and protocols associated with them in their profession.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Define the functionalities of the various layers of OSI and TCP/IP model and learn the concepts of different data communication networks.	1,2
2	Understand and implement line coding techniques, multiple access techniques, IPv4 and IPv6 addressing	1,2, 3
3	Define the functionalities associated with transport layer.	1,2
4	Illustrate the working of application layer protocols.	1,2, 3

Course Contents:

MODULE-1	Teaching Hours
Introduction- OSI Model and TCP/IP model (Functions of each layers in both models), Examples of Data communication networks- Mobile networks, DSL network, FTTH networks, Bluetooth networks. **Physical layer-**Analog and digital signals, Bandwidth and channel capacity, Data transfer nodes, Line coding techniques.	**10 Hrs**
MODULE-2	
Datalink Layer: -Multiple access Techniques (ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA), connecting devices- Hub/repeater, switch, router. **Network layer**- Concepts of delivery, forwarding and routing, IPv4 and IPv6 addressing, transition from IPv4 to IPv6.	**10 Hrs**
MODULE-3	
Transport Layer- UDP- Features and datagram formats, TCP- Features, connection establishment, data transfer and connection termination and datagram format **Application layer**– DNS-Need for DNS, resolution in DNS, FTP- Control and Data connections, SMTP	**10 Hrs**
MODULE-4	
Application layer- Features of application layer protocols HTTP, VOIP, IP TV,RTP **Data Security**-Need for data security, symmetric and asymmetric encryption and decryption, IDEA algorithm, concept of firewall,**Cloud computing-** Concepts and features (Block diagram approach)	**10 Hrs**

TEXT BOOK:

1. **Forouzan** B A, "Data communications and Networking", TMH, 4th edition, 2010.

REFERENCE BOOKS:

1. Gopalan and SivaSelvan, "TCP/IP Illustrated", PHI, New Delhi,2008.

2. **A. Tanenbaum,** "Computer Networks", 3rd Edition, PHI,1883.

3.**William Stallings**, "Network Security and Cryptography", 7th Edition, Pearson India.

Course Title	INTERNET OF THINGS		
Course Code	20OEEC78	**(L-T-P)C**	(3-0-0)3
SEE duration	3 hour	**Hours / Week**	03
CIE (Theory) marks	40	**CIE Activity marks**	10
SEE marks	50	**Total contact hours**	40

Course Objective:

Objective of the course is to understand about the fundamentals of networking, things in IoT and connecting things with the internet and IoT usage domains in everyday life.

Course Outcomes (COs): Upon completion of the course, students shall be able to

Sl. No.	Course outcomes	Mapping to POs
1.	Describe the evolution of IoT, IoT networking components, and addressing strategies in IoT.	1
2.	Classify various sensing devices and actuator types.	1
3.	Explaindesign methodology of IoT systems and associated IOT technology-cloud computing	1
4.	Illustrate architecture of IOT Applications	1,5

Course Contents:

MODULE –1	10 Hrs.

Basics of Networking: Introduction, Network Types, Layered network models

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence ofTechnologies, IoT Networking Components

Textbook 1: Chapter 1- 1.1 to 1.3 Chapter 4 – 4.1 to 4.4

MODULE –2	10 Hrs.

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensor examples,Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

Textbook 1: Chapter 5 – 5.1 to 5.9

MODULE –3	10 Hrs.

IoT Developing Internet of Things:- IoT Platforms Design Methodology: Introduction,IoT Design Methodology; Case Study on IoT System for Weather Monitoring

Text book 2:Chapter 5- 10 steps in IoT design methodology.

ASSOCIATED IOT TECHNOLOGIES

Cloud Computing: Introduction, Virtualization, Cloud Models

Textbook 1: Chapter 10– 10.1 to 10.3

MODULE – 4	10 hrs.

IOT CASE STUDIES

Agricultural IoT – Introduction and Case Studies

Vehicular IoT – Introduction

Healthcare IoT – Introduction, Case Studies

IoT Analytics – Introduction

Textbook 1 Chapter 12- 12.1-12.2; Chapter 13– 13.1; Chapter 14- 14.1-14.2; Chapter 17- 17.1

Text Books :

1. SudipMisra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.
2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.

Reference Books:

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

VIII Semester BE (E&C)

VIII Semester					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact hours**
PC-3	20EC801	Seminar	0-2-0	1	2
PR-4	20EC802	Project Work	0-0-18	9	18
PR-5	20EC803	Internship	0-4-0	2	2
HSM-10	20EC804	Intellectual Property Rights and Cyber Law	3-0-0	3	3
PC-31	20EC805	Industry driven course	1-0-0	1	1
PE-5	20EC85X	Elective V	3-0-0	3	3
Total				**19**	**29**

Elective V	
20EC851	Multimedia Communication
20EC852	Fundamentals of speech recognition
20EC853	Digital Control systems

SEMINAR

Course Code: 20EC801 **LTPC: 0-2-0-1**
Hours / Week :2

Course Objective: Students will know recent technologies and understand assumptions and arguments.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Identify and review recent research literature published in reputed journals.	1,2
2	Identify and understand assumptions, and arguments that exist in the work of authors.	2
3	Write technical documents and give oral presentations related to work completed.	2,8,9,10

Topics must be selected by the student in consultation with relevant course faculty/Project guide and the topic must reflect recent advances in Engineering and technology and it should be of current trends and relevance. The topics must be approved by the departmental committee and Project guide. The topics must be selected from recent IEEE papers OR standard journals.

Report: 30 marks.

PPT Slides: 20 marks.

Oral presentation: 30 marks.

Quality of the selected paper and Viva: 20 marks.

Total: 100 marks.

Seminar must be conducted during the VIII semester in a phased manner.

PROJECT WORK

Course Code: 20EC802 **LTPC: (0-0-18-9)**

Exam Hours: **3**
SEE: **50 Marks**

Course Objective: The student will demonstrate the working of hardware/software model.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Apply engineering & management principles in their projects in a multidisciplinary/E and C environment.	1,2,11
2	Design and conduct experiments and interpret the results to provide valid conclusions.	3,4,5
3	Select and apply appropriate techniques for the design & analysis of systems using modern simulation techniques, computing, and hardware tools.	4,5
4	Function effectively either as a member or a leader in multi-disciplinary activities and to communicate effectively with both the peers and others.	9,10
5	Identify solutions to be provided taking the environmental issues and sustainability into consideration.	6,7

GUIDELINES FOR THE PREPARATION OF B.E. PROJECT REPORTS

- **Project reports should be typed neatly only on one side of the paper with 1 .5 or double line spacing** on a A^4 size bond paper (210 x 287 mm). The margins should be: Left - 1.25", Right - 1, Top and Bottom - 0.75".
- The total **number of reports** to be prepared are
- One copy to the department
- One copy to the concerned guide(s)
- Two copies to the sponsoring agency
- One copy to the candidate.
- Before taking the **final printout,** the approval of the concerned guide(s) is mandatory and corrections, if any, must be incorporated in the thesis.
- For making copies, **dry tone Xerox** is suggested.
- Every copy of the report must contain
- Inner Title page (White)
- **Outer Title page** with a plastic cover
- Certificate in the format enclosed both from the college and the organization where the project is carried out.
- **An abstract / synopsis not exceeding 100 words, indicating salient features of the work carried out must be included**
- **Four copies of the abstract are to be submitted to the Department on the date of submission separately**

6. The **organization of the report** should be as follows

  - Inner title page
  - Abstract or Synopsis
  - Acknowledgments
  - Table of Contents

- List of table & figures (optional)
- Usually numbered in roman
- **Chapters** (to be numbered in Arabic) containing **Introduction**-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, **Main body** of the report divided appropriately into chapters, sections and subsections.
- The **chapters, sections** and **subsections** may be numbered in the decimal form for e.g. Chapter 2, sections as **2.1, 2.2** etc., and subsections as **2.2.3, 2.5.1** etc.
- The chapter must be left or right justified (**font size 16**). Followed by the title of **chapter centered (font size 18)**, section/subsection numbers along with their headings must be left justified with section number and its **heading in font size 16** and subsection and its heading in font size 14. The body or the **text of the report should have font size 12.**
- The **figures** and **tables** must be numbered chapter wise for e.g.: **Fig. 2.1** Block diagram of the proposed model, **Table 3.1** Normal ECG, range, age group etc.
- The **last chapter** should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
- **Reference OR Bibliography:** The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. **[3].** The section on references should list them in serial order in the following format.

- **For textbooks** - Simon Haykin, Neural Networks- A Comprehensive Foundation, Prentice-Hall India, Second Edition, 2005.
- **For papers** – G.E. Chirstensen, S.C. Joshi and M.I. Miller, " Volumetric transformation of brain anatomy", IEEE Transaction of Medical Imaging, Vol 2, pp.864-877, 1887.

Only SI units are to be used in the report. Important Equations must be numbered in decimal form for e.g. **V=IZ** …….**(3.2)**

All equation numbers should be right justified.

- The **project report** should be brief and include descriptions of work carried out by others only to the minimum extent necessary. **Reproduction of material available elsewhere should be strictly avoided.** Downloaded material should not be used. In case used, it should be properly acknowledged.
- Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.
- Proper **attention** is **to be paid not only to the technical contents but also to the organization of the report and clarity of the expression.** Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project.
- **Hardware projects** must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
- Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run

the same, etc. **If the developed software uses any public domain software downloaded from some site,** then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.

- Sponsored Projects must also satisfy the above requirements along with statement of accounts & bills for the same dully attested by the concerned guides to process further. They must also produce NOC from the concerned guide before taking the internal viva examination.
- The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
- Separator sheets, used if any, between chapters, should be of thin paper.

(*On a separate sheet*)

MALNAD COLLEGE OF ENGINEERING

HASSAN- 573201

Department of Electronics and Communication Engineering

CERTIFICATE

This is to Certify that the project work

……Title

is a bonafide work carried out by

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

Mr./Ms ……...,USN ……..

in partial requirement for the award of ***Bachelor of Engineering*** in Electronics and Communication of the Malnad College of Engineering, Hassan, an autonomous institution affiliated to **Visvesvaraya Technological University, Belgaum** during the year…… It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide Signature of the HOD

Signature of the Principal

External Viva

Name of the examiners Signature with date

1.

2.

The project work is to be carried out in **three phases**

- **Project Phase – I** Duration of two weeks between VII and VIII semesters. Candidates in consultation with the guides shall carry out literature survey / visit premier institutions/ laboratory/ industry to finalize the topic of the project. Evaluation of the project and its feasibility is evaluated in the concerned department in the beginning of the VIII semester. Total **credits shall be 02 (10 Marks)**
- **Project Phase – II Eight weeks** duration during the VIII semester students are expected to finalized the project work and indicate intermediate results, design carried out/ algorithms developed must be validated. **Total credits shall be 03 (15 Marks)**
- **Project Phase – III Project evaluation shall** be taken up during this phase. At the end of the semester project work evaluation and Viva – Voce examination shall be conducted. **Total credits shall be 04 (25 Marks)**
- The working condition of the project work carried out must be shown to the committee
- The continuous evaluation of the project phase – I, II, and III shall be carried out by the committee consisting of Head of the department, Senior Faculty and guide.

- ❖ In general the project work of good standard

- ➢ Relevance of the topic for the project in the present context
- ➢ Problem formulation / methodology / limitation / existing methods / proposed method / comparisons / selection criteria
- ➢ A comprehensive Literature Survey is to be conducted based on the topic
- ➢ Experimental observation / theoretical modeling / Hard ware design / algorithms developed for implementation
- ➢ Results — Presentation & Discussion
- ➢ If description of the work is explained with a snap shot give Figure no and indicate the internal details. Using tables, graphs give relevant explanation and highlight the findings
- ➢ Conclusions and scope for future work / limitation of the project work / merits / demerits

PROJECT EVALUATION

CIE - 50 Marks, SEE - 50 Marks

Project report should have the following contents

Sl. No.	**Particulars**
1.	Relevance of the subject in the present context / motivation
2.	Objective of the Project
3.	Literature Survey
4.	Methodology / limitation
5.	Organization of the report
6.	System design
7.	Algorithms / flow charts
8.	Experimental observation / theoretical modeling
9.	Results & Discussion
10.	Conclusions and scope for future work
11.	References
12.	Appendices

INTERNSHIP

Course Code: 20EC803 **LTPC :(0-4-0-2)**

Course Objectives: To upgrade technical knowledge through undergoing industry or institution level job training

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}

Upon successful completion of this course, the student shall be able to:

COs	Statement	POs
1	Develop critical thinking and problem solving skills	2, 4
2	Acquire report writing skills on specific tasks undertaken at the industry / institute in any specialization streams of Electronics and Communication Engineering	2, 3, 9, 10
3	Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function.	1, 3
4	Develop work habits and attitudes necessary for job success.	7,8, 10

- Students will have to attend industrial internship for a period of four weeks (minimum).
- Report has to be submitted along with the certificate from the industry.
- Student will be evaluated for 100 marks (no SEE).

INTELLECTUAL PROPERTY RIGHTS AND CYBER LAW

Course Code: 20EC804 **LTPC: 3-0-0-3**
Exam Hours: 3 Hours / Week : 3
SEE :**50 Marks** Total hours :40

Course Objective: Developing contextual knowledge to access societal health, safety, legal and consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs) Upon completion of the course, students shall be able to:

COs	Statement	POs
1	To understand and commit to professional ethics and responsibilities to obtain Intellectual Property Rights like Patents, Copyright &Trademarks.	1,6, 8,11
2	Understand the impact of Patents, Copyrights & Trademarks and demonstrate the knowledge of cyber law for the societal and environmental context.	6,8,12
3	To use IPRs and cyber law to access, societal, health, safety & Cultural issues.	6,7,8,11,12
4	To work in multiple teams to effectively communicate IPR & Cyber Law.	6,8,9, 11,12

Course Contents:

MODULE-1	**Teaching Hours**
Basic principles of IP laws & Patents: Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non – patentable inventions.	**10 Hrs**
MODULE-2	
Procedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license. Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment. Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee. Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law. Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed. Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.	**10 Hrs**
MODULE-3	
Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording. Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right. Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement.	**10 Hrs**

MODULE-4	
Cyber Law: An introduction, Definition, why cyber law in India, Evolving cyber law practices- for corporates, privacy in Indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph act, Cyber Stalking. Indian Cyber law: Protecting Indian children online, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India.	**10 Hrs**

TEXT BOOKS:

1. Dr. T Ramakrishna, "Basic principles and acquisition of Intellectual Property Rights", CIPRA, NSLIU-2005.
2. Dr.B.L.Wadehhra, "Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 2002.
3. Cyberlaw-The Indian perspective by Pavan Duggal, 2008 Edition.

REFERENCE BOOKS:

1. Dr. T Ramakrishna, "Ownership and Enforcement of Intellectual Property Rights",CIPRA,NSLIU-2005. 2. "Intellectual Property Law (Bare Act with short comments)", Universal Law PublishingCo.Ltd. 2007
3. "The Trade marks Act 1888 (Bare Act with short comments)", Universal Law PublishingCo. Ltd., 2005.

INDUSTRY DRIVEN COURSE

Course Code: 20EC805 **LTPC** :(1-0-0-1)

- This course will be initiated by an industry person having a minimum experience of 10 years.
- The syllabus will be framed by the concerned industry person.
- Teaching (Preferably online) 1 Hour/week
- No Semester End Examination
- CIE Evaluation for 100 marks will be done by the industry person.
- A Faculty Coordinator will coordinate with the industry person for CIE activities.

Elective V

MULTIMEDIA COMMUNICATION (3-0-0-3)

Course Code: 20EC851 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **50 Marks** Total hours: **40**

Course Objective: To make the students to get familiarize with the evolution of multimedia, importance of compression to all media types in relation to psychophysical observation for efficient communication over the network

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to :

COs	Statement	POs
1	Acquire the current state-of-the-art developments in Internet technologies for multimedia communications.	1,12
2	Acquire digitization principle techniques required to analyze different media types.	2
3	Analyze compression techniques required to compress Image and Video.	2
4	Apply the knowledge of multimedia communication to design new algorithms with improved effectiveness.	3

Course Contents:

MODULE-1	Teaching Hours
Introduction to Multimedia: Basics of Multimedia, Multi-media and Hypermedia, WWW, Overview of Multimedia Software Tools, Graphics and Image Representation: Graphics and Image Data Types, Popular File Formats Fundamental **Concepts in Video:** Types of Video Signals, Analog Video, Digital Video	**10 Hrs**
MODULE-2	
Basics of Digital Audio: Digitization of Sound, musical instrument digital interface (MIDI), Quantization and Transmission of Audio.**Compression Algorithms:** Introduction, Distortion Measures, Quantization, Transform Coding, Wavelet – Based Coding, Wavelet Packets, Embedded Zero tree of Wavelet. **[Self-Learning**: Quantization]	**10 Hrs**
MODULE-3	
Image Compression Standards: The JPEG Standard, the JPEG2000 Standard, the JPEG-LS Standard, Bi level Image Compression. **[Self-Learning:** JPEG Standard] **Video Compression Techniques:** Video Compression based on motion compensation, search for motion vectors, H.261 and H.263.	**10 Hrs**
MODULE-4	
MPEG Video Coding I: Overview, MPEG – 1, MPEG -2, Overview, MPEG – 4, Object Based Visual Coding in MPEG – 4 **MPEG Video Coding II: Synthetic** Object Coding in MPEG – 4, MPEG – 4 Object Types, Profiles and Levels, MPEG – 4 Part 10/H.264, MPEG – 7	**10 Hrs**

TEXT BOOK:

1. **Ze - Nian Li and Mark S. Drew**," Fundamentals of Multimedia", Springer Science & Business Media, 2nd Edition. 2014.

REFERENCE BOOK:

1. **Ralph Steinmetz & Klara Nahrstedt**, "Multimedia: Computing, Communications and Applications" –Pearson, 3rd Edition, 2005.

FUNDAMENTALS OF SPEECH RECOGNITION (3-0-0-3)

Course Code: 20EC852 **LTPC: 3-0-0-3**
Exam Hours: **3** Hours / Week: **3**
SEE: **50 Marks** Total hours: **40**

Course Objective: To provide students with opportunities to develop the fundaments in speech recognition and students will be able to design a speech recognition system.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to :

COs	Statement	POs
1	Analyze the models for speech production system.	5
2	Investigate the speech perception system.	5
3	Implement the fundamentals of speech coding.	4
4	Discuss the fundamentals of speech recognition.	10

Course Contents :

Module 1	Teaching Hours
The speech signal: Production, perception, And Acoustic-Phonetic Characterization. Introduction, Speech production process, representing speech in the time and frequency domains, speech sounds and features, approaches to ASR by machine.**Signal Processing and Analysis Methods for Speech Recognition:** Introduction, the bank of filters Front-end processor, linear predictive coding model for speech recognition, vector quantization.	**10 Hrs**
Module 2	
Pattern-Comparison Techniques: Introduction, speech detection, distortion measures-mathematical and perceptual considerations, spectral distortion measures, introduction of spectral dynamic features into distortion measure. S**peech recognition system design and implementation issues:** Introduction, Application of source coding techniques to recognition, template training methods, performance analysis and recognition enhancements.	**10 Hrs**
Module 3	
Theory and implementation of HMM: Introduction, discrete-time Markov processes, extensions of HMMs. The three models for HMMs, types of HMMs, continuous observation densities in HMMs, autoregressive HMMs.**Speech recognition based on connected word models**: Introduction, general notation for the connected word recognition problem, two-level dynamic programming algorithm, and level building algorithm.	**10 Hrs**
Module 4	
Grammar networks for connected digit recognition, segmental K-Means training procedure, connected digit recognition implementation. Large vocabulary continuous speech recognition: Introduction, sub word speech units. **Language models for large vocabulary speech recognition,** statistical language modeling, perplexity of the language model, overall recognition system based on sub word units, context dependent sub-word units.	**10 Hrs**

TEXT BOOK:

1. Lawrence RabinerBiingHwang Juang, " Fundamentals of Speech recognition", Pearson Education, 1st Indian reprint 2003.

REFERENCE BOOK:

1. Thomas F Quatieri, "Discrete-time Speech Signal Processing: principles and practice", Pearson Education, 1st Indian reprint 2004.

DIGITAL CONTROL SYSTEMS

Course Code : 20EC853 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week : 3
SEE : **50 Marks** Total hours : **40**

Course Objective: The objective of this course is to make the students understand the control system with performance specifications, modeling and simulation of dynamic controller
system using transfer techniques and state space methods
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to :

COs	Statement	POs
1.	Formulate and interpret the results of practical problems of physical systems using mathematical modeling in control systems..	1,5
2.	Apply the concepts of time domain analysis and frequency domain analysis.	1,10
3.	Recognize& become familiar about the stability of linear control systems.	2&3
4.	Analyze the stability of closed loop control system using root locus,	2, 5

Course Contents:

Module 1	Teaching Hours
Signal Processing in Digital Control : Configuration of the Basic Scheme, principles of Conversion. Basic Discrete- Time Signals, Time – Domain for Discrete Time Systems, Transfer Function Models. **Stability** on the Z Plane and the jury Stability Criterion, Sampling as impulse Modulation, Sampled Spectra and Aliasing, Filtering. Practical Aspects of the Choice of Sampling Rate Principles Of discretization.	**10 Hrs**
Module 2	
Models of Digital Control Devices and Systems: Introduction, z-Domain Description of Sampled Continuous Time Plants, z-Domain Description of Systems with Dead Time. **Implementation of Digital controllers**, Digital Temperature Control System, Digital Position Control System.	**10 Hrs**
Module 3	
Design of Digital Control Algorithms: Introduction, z-Plane Specifications of Control System Design. **Digital Compensator Design** Using Frequency Response Plots and Root Locus Plots.	**10 Hrs**
Module 4	
State-Variable Analysis of Digital Control Systems: State Descriptions of Processors, State Descriptions of Sampled Continuous-time Plants. **State Descriptions of Systems** with Dead – Time, Solution of Difference Equations.	**10 Hrs**

TEXT BOOKS:

1. M. Gopal, "Digital Control Systems and State Variable Methods" –-TMH-3rd Ed., 2008

REFERENCE BOOKS:

1. **B. C. Kuo**– "Digital control Systems"– Holt-Saunders International Edition,2000
C. L. Philips & H. T. Nagle, "Digital Control Systems" : – PHI, II Ed,2002.