MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous institution Affiliated to VTU, Belgaum)

Autonomous Programme

Bachelor of Engineering

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

SYLLABUS

VII & VIII Semester
(2021-22 Admitted Batch)

Academic Year 2024-25

Scheme & Syllabus for BE (E&C) VII and VIII semesters
2024-25 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.

Scheme of Evaluation (Theory Courses)

Assessment	Marks
THREE CIE's conducted for a total of 30 marks	30
Activities	20
SEE	50
Total	100

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	10
Record Writing	20
Laboratory CIE conducted by the Course coordinator	20
SEE	50
Total	100

Examination	Maximum Marks	Minimum Marks to Qualify
CIE	50	20
SEE	50	20

VII SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	21EC701	ARM Embedded System Design	3-0-0	3	3
IPCC	21EC702	Wireless Communication and Networks	3-0-2	4	5
PCL	21EC703	Embedded System Design Laboratory	0-0-2	1	2
PEC	21EC7XX	Professional Electives-II	3-0-0	3	3
PEC	21EC7XX	Professional Electives-III	3-0-0	3	3
OEC	21OEXX	Open Elective -II	3-0-0	3	3
PI	21PROJ1	Main Project work phase-1	0-0-4	2	4
PI	21EC704	Technical Seminar	0-2-0	2	4
AEC	21RMIP	Research Methodology & Intellectual Property rights (Mandatory non-credit)	0-1-0	AUDIT	2
			Total	**21**	**29**

Professional Electives II

PEC	21EC741	MEMS	3-0-0	3
PEC	21EC742	Nanotechnology	3-0-0	3
PEC	21EC743	Cyber Security	3-0-0	3
PEC	21EC744	Internet Protocol Engineering	3-0-0	3

Professional Electives III

PEC	21EC751	Digital Image Processing	3-0-0	3
PEC	21EC752	Low Power VLSI Design	3-0-0	3
PEC	21EC753	Big Data Analysis	3-0-0	3
PEC	21EC754	5G Technologies and Satellite Communication	3-0-0	3

Open Elective-II

OEC	21OEEC71	Sensors and Actuators	3-0-0	3
OEC	21OEEC72	5G Technologies and Beyond	3-0-0	3
OEC	21OEEC73	Satellite Communication	3-0-0	3
OEC	21OEEC74	Radar Systems	3-0-0	3

VIII SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PI	21PROJ	Main Project work phase-2	0-0-8	04	08
PI	21INT3	Research / Industry Internship -III	0-0-24	12	24
			Total	**16**	32

VII SEMESTER

ARM EMBEDDED SYSTEM

Course Code :21EC701	**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, Conditional Execution. ALP programming. **Introduction to the THUMB instruction set** Introduction, THUMB register usage, ARM – THUMB interworking, 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, 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 Boot loader **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.

ACTIVITY

ARM microcontroller based application for activity:

1. **Digital Thermometer:**

- Use an ARM microcontroller and a temperature sensor (e.g., LM35 or DS18B20).
- Display the temperature readings on a 7-segment display or an LCD screen.

2. **LED Blinking Pattern:**

- Create a pattern of blinking LEDs using ARM GPIO pins.
- Experiment with different sequences and timings to make various patterns.

3. **Digital Clock:**

- Build a digital clock using an ARM microcontroller and a real-time clock (RTC) module.
- Display the time on a 16x2 LCD.

4. **Button Controlled LED:**

- Connect a push button to an ARM microcontroller.
- Write a program to toggle an LED on and off each time the button is pressed.

5. **Analog to Digital Converter (ADC) Display:**

- Use the ADC feature of an ARM microcontroller to read an analog voltage.
- Display the converted digital value on an LCD.

6. **PWM LED Brightness Control:**

- Use Pulse Width Modulation (PWM) to control the brightness of an LED.
- Adjust the brightness using a potentiometer or buttons.

7. **Simple Alarm System:**

- Use a PIR motion sensor connected to an ARM microcontroller.
- Trigger an alarm (like a buzzer) when motion is detected.

8. **Servo Motor Control:**

- Control a servo motor using an ARM microcontroller.
- Use buttons or a potentiometer to change the position of the servo.

9. **Ultrasonic Distance Measurement:**

- Interface an ultrasonic sensor (e.g., HC-SR04) with an ARM microcontroller.
- Measure the distance to an object and display it on an LCD.

10. **Capacitive Touch Sensor:**

- Use a capacitive touch sensor with an ARM microcontroller.
- Control an LED or buzzer based on touch inputs.

11. **Smart Doorbell:**

- Build a smart doorbell with video streaming capabilities using an ARM microcontroller, camera module, and Wi-Fi.
- Allow users to view the video feed and communicate with visitors via a smartphone app.

12. **Bluetooth-Based Smart Lock:**

- Design a smart lock system controlled via a Bluetooth-enabled smart phone app.
- Use an ARM microcontroller to control the lock mechanism and manage Bluetooth communication.

13. **Digital Stethoscope:**

- Develop a digital stethoscope using an ARM microcontroller and a sensitive microphone.
- Amplify and filter the heart sounds and display the waveform on an LCD.

I. Plan of action: Group is created having 4 students, for each group above mentioned application is given to design and implement.

II. Rubrics for activity:

Sl. No	Criteria	Marks	Evaluation	
1	Writing Code	05	Minor mistakes and required guidance - (1-3 marks)	Correct code and does not taken guidance- (4-5marks)
2	Hardware Implementation	10	Require guidance- (5-7marks)	No guidance- (8-10 marks)
3	Report and Presentation	05	Report require correction and average presentation- (1-3 marks)	Good report and presentation- (4-5 marks)

Articulation Matrix

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

WIRELESS COMMUNICATION AND NETWORKS

Course Code: 21EC702	**LTPC: 3-0-2-4**
Exam Hours: **3**	Hours / Week: 5
SEE: **50 Marks**	Total hours: 40+12= 52

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, Z-Wave, 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, Signal Processing. Wireless Systems and Standards-III: DECT- Features and Specifications, Architecture, Functional Concept, Radio Link, PACS-System Architecture, Radio Interface.	**10 Hrs.**

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.

PRACTICAL COMPONENT OF WIRELESS COMMUNICATION AND NETWORKS (Integrated Lab)

Conduct the following experiments using suitable simulation software.

Sl. No.	Experiments
1.	Simulation of Path loss Model
2.	Simulation of Link budget Model
3.	Simulation of Time Division Multiplexing and Demultiplexing.
4.	Simulation of different channel models
5.	Simulation of PN Sequence for CDMA

ACTIVITIES

1. **Continuous Evaluation (Max. Marks:10):**
   a. **Objective:** To record and document the results of experiments conducted
   b. **Plan of Action:**
      - Each student must maintain observation and record for documenting the results.
      - Each experiment documented in the record must contain aim of the experiments, components required, circuit, theory related to the experiment, theoretical calculation and results obtained.
      - Each experiment will be evaluated and will be averaged to 10 marks.

2. **Lab CIE (Max. Marks:10)**
   a. **Objective:** To conduct the experiments on the theoretical problems in the lab.
   b. **Plan of Action:**
      - Each student will be given an experiment to conduct.
      - Students must perform theoretical calculations followed by practical conduction of the experiment after getting approval from the concerned course faculty.
      - Document the results obtained and compare the theoretical and practical results.

Mapping of Course Outcomes [COs] and Program Outcomes [POs]:

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

Embedded System Design Laboratory

Course Code: 21EC703	**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.	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	3	3			3								3	2
CO2	3	3			3								3	2
CO3	3	3			3								3	2
CO4					3				3			3	3	2

Professional Electives-II

MEMS

Course Code: 21EC741	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 MEMS and Nanotechnology, and its design and fabrication methods.

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

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

COs	Statements	POs
1.	Demonstrate knowledge on fundamental principles and concepts of MEMS and Nanotechnology	1, 2
2.	Apply Science and Engineering Mechanics for Microsystems design	1, 2
3.	Apply different fabrication methodology used in MEMS devices.	2, 3
4.	Analyze micro-systems technology for technical feasibility as well as practicality using modern tools for the design of MEMS and Microsystems	3,5

Course Contents:

MODULE-1	Teaching Hours
OVERVIEW OF MEMS & MICROSYSTEMS: MEMS & Microsystems, Microsystems and Microelectronics, The multidisciplinary nature of Microsystems design and manufacture. Applications of MEMS and Microsystems, **Materials for MEMS, and Microsystems: S**ubstrates and Wafers, Active Substrate Materials, Silicon as a Substrate Material. **WORKING PRINCIPLES OF MICROSYSTEMS:** Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Micro fluidics	**10 Hrs**
MODULE-2	
ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN: Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin-Film Mechanics **SCALING LAWS IN MINIATURIZATION:** Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer.	**10 Hrs**
MODULE-3	
MICROSYSTEM FABRICATION PROCESSES: Introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition – ,Electro-chemistry, Plasma, Sputtering **MICRO MANUFACTURING.** Bulk micro manufacturing, Surface Micromachining, The LIGA Process.	**10 Hrs**
MODULE-4	
MICROSYSTEMS DESIGN: Introduction, Design Considerations, Process Design, Mechanical Design, Mechanical Design Using Finite Element Method, Design of a Silicon Die for a Micro pressure Sensor. **Introduction to Nanoscale Engineering:** Overview of Nanotechnology, Overview of Nanofabrication Techniques, Prevalent Nanoscale Products and Applications, Nanoscale Engineering Analysis, Challenges in Nanoscale Engineering	**10 Hrs**

TEXTBOOKS:

1. TaiRanHsu,"MEMS and Microsystems Design and Manufacture", TataMcraw Hill,2002.
2. Marc Madou," Fundamentals of Microfabrication",CRCpress1997.

REFERENCES:

1. Stephen D. Senturia, "Micro systemDesign",KluwerAcademicPublishers,2001
2. ChangLiu,"FoundationsofMEMS",PearsoneducationIndialimited,2006
3. www.tutorialspoint.com

MEMS Activities

Activities 1 and 2 depend on the presentation simulation and modeling MEMS device.

Activity Number	Activity Name	Description	Marks	POs
1	**Activity-1**	Presentation of reputed journals related to sensors and actuators based. on the: Displacement, Force, Pressure Optical Bio, Chemical, etc.	**10**	**2,5,9,**
2	**Activity-2**	Simulation and Modeling of sensors and actuators based on the: Displacement, Force, Pressure Optical Bio, Chemical, etc. The Optiwave, COMSOL, MEEP simulation tools can be used for the same.	**10**	**2,5,9,**

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

NANO TECHNOLOGY

Course Code: 21EC742	**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	Demonstrate the synthesis of nano particles by various techniques.	1,2
2	Explain working of basic instruments used in characterization of nano particles.	1,2
3	Discuss the application of nanotechnology to mechanical and civil domains	1,2
4	Classify the nano materials based on the dimensions.	1,2

Course Contents:

MODULE-1	Teaching Hours
Introduction to Nano materials Nanotechnology, Frontier of future-an overview, Length Scales, Variation of physical properties from bulk to thin films to nano materials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Synthesis of Nano materials: Bottom-Up approach: Chemical Routes for Synthesis of nano materials-Sol-gel, Precipitation, Solution Combustion synthesis, Hydrothermal, SILAR, Chemical Bath Deposition. Top-Down approach-Ball milling technique, Sputtering, Laser Ablation	10 Hrs.
MODULE-2	
Characterization of Nanomaterials Basic principles and instrumentations of Electron Microscopy –Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes-Scanning Tunneling microscope, Atomic Force Microscope –different imaging modes, comparison of SEM and TEM, AFM and STM, AFM and SEM. Basic principles of working of X-ray diffraction, derivation of Debye-Scherrer equation, numerical on Debye Scherrer equation, Optical Spectroscopy-Instrumentation and application of IR, UV/VIS (Band gap measurement)	10 Hrs.
MODULE-3	
Carbon Based Materials Introduction, Synthesis, Properties (electrical, Electronic and Mechanical), and Applications of Graphene, SWCNT, MWCNT, Fullerenes and other Carbon Materials: Carbon nano composites, nano fibres, nano discs, nano diamonds.	10 Hrs.
MODULE-4	
Nanotechnology in Energy storage and conversion Solar cells: First generation, Second generation and third generation solar cells: Construction and working of Dye sensitized and Quantum dot sensitized solar cells. Batteries: Nanotechnology in Lithium ion battery-working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms, limitations of graphite anodes, Advances in Cathodic materials, Anodic materials, Separators Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes.	10 Hrs.

TEXT BOOKS:

1.Nano Materials –A.K. Bandyopadhyay/ New Age Publishers

2.Nanocrystals: Synthesis, Properties and Applications –C.N.R. Rao, P. John Thomas and G. U. Kulkarni, Springer Series in Materials Science

3.Nano Essentials-T. Pradeep/TMH

4.Peter J. F. Harris, Carbon nanotube science: synthesis, properties, and applications. Cambridge University Press, 2011

5.M.A. Shah, K.A. Shah, "Nanotechnology: The Science of Small", Wiley India, ISBN 13: 9788126538683

Activity 1:Applications of Nanotechnology

Submission of the report for any one of the following Application

Nanotech Applications and Recent Breakthroughs: Introduction, Significant Impact of Nanotechnology and Nanomaterial, Medicine and Healthcare Applications, Biological and Biochemical Applications (Nano biotechnology)

Activity 2:

Submission of the report for any one of the following Application

Electronic Applications (Nano electronics), Computing Applications (Nano computers), Chemical Applications (Nano chemistry), Optical Applications (Nano photonics), Agriculture and Food Applications, Recent Major Breakthroughs in Nanotechnology.

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

CYBER SECURITY

Course Code :21EC743	LTPC: 3-0-0-3
Exam Hours :**3**	Hours / Week :**3**
SEE :**50 Marks**	Total hours :**40**

Course Objective: Students will be able to gain knowledge on Cyber security and laws.

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

Sl. No.	Course Outcomes	Mapping To POs
1.	Comprehend knowledge on cyber crime terminologies	PO1
2.	Explain Cyber offenses and Botnets	PO1,PO8
3.	Gain insight on Modern Tools and Methods used on Cyber crime	PO1,PO5
4.	Identify Phishing, Identity Theft and need of computer forensics	PO1,PO6

Course Contents:

Module-1	Teaching Hours
Introduction to Cyber crime: **Cybercrime:** Definition and Origins of the Word, Cybercrime, and Information Security, who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking, and Indian Laws., Global Perspectives **Cyber Offenses: How Criminals Plan Them:** Introduction, how criminal splantheattacks. Social Engineering, Cyber Stalking, Cybercafé &cybercrimes.	**10 Hrs.**
Module-2	
Botnets: The fuel for cybercrime, Attack Vector **Tools and Methods used in Cyber crime:** Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyware, Virus, and Worms, Trozen Horses and Backdoors, Steganography, Do Sand DDOS Attacks, Attacks on Wireless networks.	**10 Hrs.**
Module-3	
Phishing and Identity Theft: Introduction, methods ofphishing, phishing, phishing techniques, spear phishing, Types ofphishing scams, phishing tool kits and spy phishing, countermeasures, Identity Theft, personally Identifiable Information, Types of Identity Theft, Techniques of ID theft, Identity Theft : countermeasures, How to efface your online Identity.	**10 Hrs.**
Module-4	
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Lifecycle, Chain of Custody Concepts, network forensics. Approaching a computer Forensics Investigation, special tools and techniques	**10 Hrs.**
TextBooks: 1.SunitBelapureandNinaGodbole,"CyberSecurity:Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, FirstEdition(Reprinted2018)	

Activity Number	Activity Name	Description	Marks	Pos
1	**Activity 1**	Password Creation Exercise	**10**	**2,5,9,**
2	**Activity 2**	Presentation and Poster Designing	**10**	**2,3**

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												3	1
CO2	2							2					2	2
CO3	3				3								2	3
CO4	2					3							1	2

INTERNET PROTOCOL ENGINEERING

Course Code: 21EC744	**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 (wi-fi 802.11), Point to point WAN technologies, Connecting Devices. Self study: 802.15 -Bluetooth	**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, Introduction to Routing protocols- Distance vector Routing, Link State Routing, OSPF routing Self study: ARP and RARP protocols	**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, SNMP-Network Management, Network Security- Network Layer security, transport layer security, application layer security, firewalls. Self study: 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.

Activity-1

Visit to any school or organization with minimum of 100 computing nodes and submitting a detailed report on network architecture, service provider, subscription details and bandwidth, firewall and filters used etc.

10 marks

Actuvity-2

Assignment questions covering self-study topics and emerging protocols in the internet society.

10 marks

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

Professional Electives-III

DIGITAL IMAGE PROCESSING

Course Code : 21EC751	LTPC: 3-0-0-3
Exam Hours : **3**	Hours / Week : **3**
SEE : **50 Marks**	Total hours : **40**

Course Objective: Understanding of Image Processing basic concepts such as Image Enhancement, Restoration, and Image transforms, image compression and color image processing.

Course Outcomes: [COs] at the end of the course the student will be able to:

COs	Statements	POs
1.	Ability to understand the image fundamental concepts in digital image processing, and also understand image formation and the role of human visual system.	1, 2
2.	Apply image transform techniques in spatial and frequency domain and able to understand image Compression and transmission techniques.	1, 2
3.	Analyze the basic concepts of DIP operations such as Enhancement in spatial domain and frequency domain using filters.	1, 2
4.	Implement the basic concepts of image restoration and degradation along with Noise models and mathematical models using filters.	1, 2

Course Contents:

MODULE-1	Teaching Hours
Digital Image Fundamentals: Digital Image Processing, fundamental Components and steps of an Image processing system, Elements of Visual Perception, Image sensing and acquisition. **Image Sensing and Acquisition**, Image Sampling and Quantization, Some Basic Relationships between Pixels.	**10 Hours**
MODULE-2	
Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, Basis images. **Image Compression:** Fundamentals, Image compression models, Lossless compression, Lossy compression.	**10 Hours**
MODULE-3	
Image Enhancement : Image Enhancement in Spatial domain, Some Basic Gray Level Trans -formations, Histogram Processing. **Image enhancement in the Frequency Domain filters**, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, Homomorphic filtering.	**10 Hours**
MODULE-4	
Model of image degradation/restoration process, Noise models, Restoration in the Presence of Noise, Only-Spatial Filtering Periodic Noise Reduction by Frequency Domain Filtering. **[Self-Learning:** noise models] **Color Fundamentals**. Color Models, Pseudo color Image Processing., processing Basics of full color image processing. **[Self-Learning:** color models]	**10 Hours**

TEXT BOOKS:

1. **Rafael C.Gonzalez and Richard E.Woods,** "Digital Image Processing", Pearson Education, 3rd Edition, 2009.
2. **Anil K. Jain,**" Fundamentals of Digital Image Processing", Pearson Education, 2001.

REFERENCE BOOKS:

1. **S. Jayaraman, S. Esakkirajan, T. Veerkumara** "Digital Image Processing", TMH, 2008, 1st Edition.
2. **S. Sridhar : Digital image Processing,** Oxford university press, India,2011.

Activity Number	Activity Name	Description	Marks	POs
1	Presentation	Image Processing Applications	10	1,2,3,5,9

2	Using C programs/ Matlab	1.Program on reducing the Size of an Image	10	1,2,3,5,9
		2.Program on histogram of an image		
		3. Program on histogram on equalization of an image		
		4. Program on spatial filtering		
		5.program on smoothing filters in spatial filtering		
		6.Implement Butterworth low power filters in frequency domain		
		7. Implement Gaussian low power filters in frequency domain		
		8. program on removing salt and pepper and noise using mean and median filter		
		9. program on removing Gaussian noise and uniform noise using mean filter		
		10.Write a program in pseudo color image processing		
		11. Write a program on color compliments		

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											3	1
CO2	2	3											3	3
CO3	3	1											2	1
CO4	2	3											2	1

LOW POWER VLSI DESIGN

Course Code :21EC752	**LTPC: 3-0-0-3**
Exam Hours :**3**	Hours / Week :**3**
SEE : **50 Marks**	Total hours :**40**

Course Objective: Provide the in-depth knowledge about the need for low power design, different power dissipations, technology impact on low power electronics and other special techniques for power reduction and low power techniques.

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

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

Sl.No	Course Outcomes	Mapping to POs
1	Describe the need for low power, power dissipations and the basic principles of low power design.	1, 2
2	Discuss the techniques for transistor network restructuring and Reorganization for power efficiency and special latches and flip-flops.	1, 2
3	Analyze different low power optimization techniques for the reduction of switching activities and the technology impact on low power electronics.	1,2
4	Explain different power reduction techniques for clock networks and SRAMs.	1,2,9,10

Course Contents:

MODULE-1	Teaching Hours
Introduction: Need for low power VLSI chips, charging and discharging capacitance, short circuit current in CMOS Circuit, Short-circuit Current of an Inverter, Short-circuit Current Variation with Output Load, Short-circuit Current Variation with Input Signal Slope. **CMOS Leakage Current:** Reverse Biased PN-junction, Subthreshold Channel Leakage, Leakage Current in Digital Design, static current. .(Text1) **Basic principles of low power design**: Reduce Switching Voltage, Reduce Capacitance, Reduce Switching Frequency, Reduce Leakage and Static Current, low powerfigure of merits. .(Text1)	**10 Hours**
MODULE-2	
Circuit: Transistor and Gate Sizing, Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction, Equivalent Pin Ordering, Network Restructuring and Reorganization, Transistor Network Restructuring, Transistor Network Partitioning and Reorganization.(Text1) **Special Latches and Flip-flops**: Flip-Flop and Latch Circuits, Self-gating Flip-flop, Low Power Digital Cell Library, Cell Sizes and Spacing, Adjustable Device Threshold Voltage. .(Text1)	**10 Hours**
MODULE-3	
Logic: Gate Reorganization, Local Restructuring, Signal Gating, Logic Encoding, Binary versus Gray Code Counting, Bus Invert Encoding.(Text1) **Device and Technology Impact on Low Power Electronics:** Introduction, Dynamic Dissipation in CMOS, Effects of $V_{dd}$and $V_t$on Speed, ConstraintsonV$_t$ Reduction, Transistor Sizing and Optimal Gate Oxide Thickness, Impact of Technology Scaling, Technology and Device Innovations. (Text2)	**10 Hours**
MODULE-4	
Special Techniques Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques. **Low Power Techniques for SRAM:** SRAM Cell, Memory Bank Partitioning, Pulsed Wordline and Reduced BitIine Swing, Case Study: Design of an FIFO Buffer. (Text 1)	**10 Hours**

TEXT BOOK:

1. 'Practical Low Power Digital VLSI Design', Gary K. Yeap, Kluwer Academic, 1998
2. 'Low Power Design Methodologies', Jan M.Rabaey, MassoudPedram, Kluwer Academic,

Reference Books

1. 'Low-Power CMOS VLSI Circuit Design', Kaushik Roy, Sharat Prasad, Wiley, 2000
2. 'Low power digital CMOS design', A.P.Chandrasekaran and R.W.Broadersen, Kluwer Academic, 1995
3. 'Low power VLSI CMOS circuit design', A Bellamour and M I Elmasri, Kluwer Academic, 1995.

Activity No.	Activity Name	Description	Marks	POs
1	Case Study	Design and comparison of power consumption using different power techniques in SRAMs	10	9,10
2	Simulation	Using open access simulator	10	5, 9, 10

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

Course Title	BIG DATA ANALYSIS		
Course Code	21EC753	L-T-P-C	(3-0-0)
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Describe big data features on Hadoop platform.

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

#	Course Outcomes	Mapping to POs	Mappingto PSOs
1.	Apply basic Concepts of Big data Analytics	1,3	1
2.	Identify open-source technologies for big data	3,5	1
3.	Describe the building blocks of Hadoop	1,2	1
4.	Use big data tools and techniques	4,5	1

Course Contents:

MODULE – 1	10 Hrs

Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization.

Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location- Based Services, Online Advertising, Risk Management.

MODULE – 2	10 Hrs

Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.

Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.

MODULE – 3	10 Hrs

Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels.

Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.

MODULE – 4	10 Hrs

Map-Reduce and the New Software Stack 2, Communication Cost Models: Algorithms Using Map-Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce, **Communication Cost Models**: Complexity Theory for Map- Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.

Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream , Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.
2. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC

1. https://nptel.ac.in/courses/106/104/106104189

Activity Number	Activity Name	Description	Marks	POs
1	Analysis of large data sets in Python	Handling of large datasets in python	10	2,5,9,
2	Study the python libraries	Study the python libraries to handle data	10	2,5,9,

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

5G TECHNOLOGIES AND SATELLITE COMMUNICATION

Course Code: 21EC754	**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 enable the student to become familiar with satellite, and communication with the ground station. Gain the various advanced communication networks and 5G cellular networks.

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

COs	Statement	POs
1	Analyse technologies for internet of things, applications in different areas and 5G requirements and initiatives.	1,2
2	Inspect 5G architecture, its flexibility and deployment.	1,2, 3
3	Comprehend the orbital mechanics and launch methodologies.	1,2
4	Understand the basic principles of radio and satellite navigation system	1,2

Course Contents:

Module-1	**Hours**
Enabling Technologies for Internet of Everything: 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 System Smart 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-2	**Hours**
5G use cases and system concept: Use cases and requirements, 5G system concepts. **The 5G architecture:** Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment	**10**
Module-3	**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.	**10**
Module-4	**Hours**
Satellite Sub-Systems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment. **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**

Text Books:

1. **Satellite Communications** – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003

2. **Satellite Communications Engineering** – Wilbur L. Pritchard, Robert A Nelson and Henri

G.SuyderhoudPearson Publications, 2nd Edition, 2003.

3. **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.
4. **5G and Beyond Wireless Systems Book:** 2021 in Springer Series in Wireless TechnologyEditors: Manish Mandloi, DevendraGurjar, PrabinaPattanayak, Ha Nguyen

Activity-1 : Visit to any unit or organization and submit a detailed report on 5G network architecture, subscription details, bandwidth, Satellite Communication requirements and working principle etc. **10 marks**

Actuvity-2 Presentation on emerging technologies in the current trend. **10 marks**

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

Open Elective-II

SENSORS AND ACTUATORS

Course Code: 21OEEC71	**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-ArenyRamón, and John G. Webster Sensors and Signal Conditioning, AWiley-InterscienceePublication, 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. JacobFraden , Handbook of modern sensors, Springer 2015.
2.**Senturia**, Stephen D, Microsystem Design, KLUWER ACADEMIC PUBLISHERS
3. *Marc J. Madou*, Fundamentals of Micro-fabrication and Nanotechnology, Second Edition, CRC PRESS.

Activity Number	Activity Name	Description	Marks	POs
1	**Activity-1**	Presentation of reputed journals related to sensors and actuators based. on the: Displacement, Force, Pressure Optical Bio, Chemical,etc.	**10**	**2,5,9,**
2	**Activity-2**	Simulation and Modelling of sensors and actuators based on the: Displacement, Force, Pressure Optical Bio, Chemical,etc. The Opti wave, COMSOL, MEEP simulation tools can be used for the same.	**10**	**2,5,9,**

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

5G TECHNOLOGIES AND BEYOND

Course Code: 21OEEC72	**LTPC:3-0-0-3**
ExamHours: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.	Analyze 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.	Analyze the 5G and 6G technologies form mobile networks and communication.	PO1,PO2

Course Contents:

MODULE-1	Teaching Hours
TechnologyEvolutionofWirelessCommunicationsASurveyandLookForward: 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 Next Generation 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 TechnologiesandEnablingBusinessModelsforNextGenerationWirelessCommunications, Integrated Framework for Enabling Technologies and Enabling Business Models for Next Generation Wireless Communications.	**10**
MODULE-2	
Enabling Technologies for Internet of Everything: Introduction, Enabling Technologies for IoE, Cloud Computing, Fog Computing, Edge Computing, Machine to Machine, Machine Learning, Data Management and Security in IoE,SystemManagementandProtectionforIoE,ApplicationsofIoE,Healthcare,Education System Smart Environment, Enabling IoE in Developing Countries. **5GIntroduction:**Historicalbackground,FromICTtothewholeeconomy,Rationaleof 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 casesandrequirements,5Gsystemconcept. **The5Garchitecture:**Introduction,High-levelrequirementsforthe5Garchitecture, Functional architecture and 5Gflexibility, Physical architecture and 5Gdeployment	**10**
MODULE-4	
MIMOAntennas:A5GCommunicationPerspective: Introduction,SingleElement VersusMultipleAntennaSystem,MIMOAntennaSystem,ComparativeStudyofSISO, MIMO and Massive MIMO System, mm-Wave MIMO, Antenna Array Beam forming. **The6GVision**:Introduction,EvolutionofMobileNetworks,andInternet,6GNetwork	**10**

ArchitecturesandKeyEnablingTechnologies.Four-TierNetworks:Space-Air-Ground-Underwater, Key Enabling Technologies, Millimetre-Wave and Terahertz Communications, Reconfigurable Intelligent Surfaces, From Network Soft warization to Network Intelligentization, Toward 6G: A New Era of Convergence.	

Text Books:

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 Technology Editors: Manish Mandloi, DevendraGurjar, PrabinaPattanayak, Ha Nguyen
3. **Ebrahimzadeh, A., Maier, M. (2021).** Toward 6G: A New Era ofconvergence. 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. **NextGenerationMobilesystems:**3G&beyond:Etoh.M(ed.),Wiley 2005.

Activity Number	Activity Name	Description	Marks	Pos
1	Report	Prepare a report on emerging trends in home automation in 2024 using 5G Technologies.	10	2,5
2	Simulation	Design and Simulate a model for various applications in 5G using Arduino	10	2,5,9

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

Satellite Communication

Course Code : 21OEEC73	LTPC: 3-0-0-3
Exam Hours : **3**	Hours / Week : **3**
SEE : **50 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)}

COs	Statements	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.

Activity Number	Activity Name	Description	Marks	POs
1	Technical Presentation	Preparation of posters and presentation of different types of Radar, VSAT, GPS etc.	10	1,2,3,5,9
2	Industrial visit	Visit to any unit or organization and submit a detailed report on network architecture, subscription details, bandwidth, Satellite Communication requirements and working principle etc.	10	1,2

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

RADAR SYSTEMS

Course Code : 21OEEC74	LTPC: 3-0-0-3
Exam Hours : **3**	Hours / Week : **3**
SEE : **50 Marks**	Total hours : **40**

Course Objective: Use of the components of a radar system and their relationship to overall system performance, the radar operating environment and techniques used to confront it, and top level measures of performance.

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 basic concepts of radar Systems and its application. Discuss the concept of Radar antenna.	1,2
2	Analyzing the Radar equations and transmitted power equation.	2
3	Analyzing the various concepts of MTI, Pulse Doppler Radar and Tracking Radar.	1,2
4	Build the concept of different types of clusters. Analyzing and understanding the fundamentals and Functionalities of Radar Antenna and Radar Receivers.	2

Course Contents:

Module-1	Teaching Hours
An introduction to Radar: Basic Radar, The simple form of the radar equation, Radar block diagram, Radar frequencies, Applications of the Radar**. [Self-Learning]:** Applications of the Radar**]** **The Radar equation:** Introduction, Transmitter power, Detection of Signals in Noise, Receiver Noise and the Signal to Noise Ratio, Probabilities of detection and False Alarm, Radar cross section of targets.	**10Hrs.**
Module-2	
MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay line Cancellers, Digital MTI Processing, Moving Target Detector. **TrTTracking Radar:** Tracking with Radar, Monopulse Tracking, Conical Scan and sequential Lobing**.**	**10 Hrs.**
Module-3	
Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors. **Radar Clutter:** Introduction to Radar clutter, Surface Clutter to Radar Equation, Land Clutter**.**	**10 Hrs.**
Module-4	
The Radar Antenna: Functions of Radar Antenna, Antenna Parameters, Reflector Antennas. **Radar Receiver:** The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver. **[Self Learning:** Noise Figure]	**10Hrs.**

Text Book:

1. **Merrill I. Skolnik**, "Introduction to Radar Systems", 3rd Ed., TMH, 2001.

Reference Book:

1. **Byron Edde,** "RADAR: Principles, Technology and Applications", Pearson Education, 2004.

Activity Number	Activity Name	Description	Marks	POs
1	**Conduction of Experiment**	Design and Simulate a model for various applications using Arduino	10	2,5,9,
2	**Presentation**	Presentation on different Radar Receiver and Radar Antenna	10	2,3

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

Course Title	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS		
Course Code	21RMIP	**LTPC**	(2-2-0)Audit
CIE	100 marks	**Hours / Week**	4
SEE	--	**Total hours**	28

Course objective: Understand research methodology, design, data collection, and analysistechniques and gain knowledge of Intellectual Property Rights (IPR) with a focus on patents, designs, trademarks, and copyrights, including their registration and protection procedures.

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

COs	Statement	POs	PSOs
1.	acquire research skills and conduct comprehensive literature reviews	8,10, 12	-
2.	apply research design knowledge to create prototype	3,4, 8, 10, 12	-
3.	evaluate methods for data collection, analysis, and sampling design	4, 8, 10, 12	-
4.	understand global and Indian patent scenarios, as well as registration requirements, infringements and protections related to trademarks, copyrights, and designs	6,8, 10, 12	-

COURSE CONTENTS:

Module - I	**7 Hrs.**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledgeflow through Citations, Acknowledgments.

Module - II	**7 Hrs.**

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis. **Experimental Designs:** Introduction to Randomized Block Design, Complete Randomized Design, Latin Square Design, and Factorial Design.

Module - III	**7 Hrs.**

Method of Data Collection: Primary and Secondary Data Collection. **Sampling Design:** Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design. **Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors. Procedure for Hypothesis Testing: Mean, Variance, and Chi-square Test.

Module - IV	**7 Hrs.**

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. **Patents:** Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. **Design:** What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design. **Trademarks:** Essentials of a Trademark,

Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights.

Activity Components

Students select a research topic and perform a literature review, identifying existing knowledge, synthesizing prior art, and compiling relevant citations leading to publishing a survey paper.
Students develop research proposals, including the formulation of research hypotheses.
Students collect primary or secondary data, design a sampling procedure, and perform data analysis using statistical techniques.
Students analyze real-world case study/studies for legal issues and propose solution/s to infringement cases.
The rubrics for evaluation will be set suitably as decided by the BOS and will be announced to the students at the beginning of the semester.

Text Book

Kothari C R. Research methodology: Methods and techniques. New Age International; 2004.
Pandey N, Dharni K. Intellectual property rights. PHI Learning Pvt. Ltd.; 2014 Jul 30.
Deb D, Dey R, Balas V E. Engineering research methodology. A Practical Insight for Researchers. 2019;153.

Reference Book:

Thiel D V. Research methods for engineers. Cambridge University Press; 2014 Sep 11.

Course Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								3		2		3		
CO2			3	3				3		2		3		
CO3				3				3		2		3		
CO4						3		3		2		3		

VIII SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PI	21PROJ	Main Project work phase-2	0-0-8	04	08
PI	21INT3	Research / Industry Internship -III	0-0-24	12	24
			Total	**16**	**32**

PROJECT WORK

Course Code: 21PROJ **LTPC: (0-0-8-4)**

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

Course Title	Research/Industry Internship III		
Course Code	21INT3	(L-T-P)C	(0-0-24) 12
Exam	3 Hrs.	Weeks	14-16 weeks
CIE	100 Marks	Total Hours	---

Course Objective: It involves a short theoretical or experimental research project supervised by a researcher/ To bridge the gap between the theoretical knowledge obtained in the classrooms and the practical skills required in the actual workplace

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

#	Course Outcomes	Mapping to PO's
1	Get exposure to real world job environment and gain practical experience	1,2,3,4,5,10,12
2	Generating technical paper/s and publish in refereed journal/s and conferences	1,2,8,9,10,12

Guidelines for Research Internship III

Purpose	It involves a short theoretical or experimental research project supervised by a researcher.
Skills acquired	Planning and scheduling. Documentation. Critical thinking. Data collection. Data analysis. Appreciating and practicing the ethical values.
Expected Outcomes	Generating technical paper/s and publish in refereed journal/s. Possibility of acquiring an intellectual ownership and patent. Build a prototype for an idea on which the research was carried out. File patent/s.
Selection	In consultation with a researcher/ researchers working in MCE research Centre A research institute Company's R and D department.
Team Size	Can be carried out either individually or in a team(Upto 5 students)
Venue	Laboratory of college A research institute Company's R and D department.
Supervision	Internship shall be carried out under the supervision of a faculty mentor* at the department level For all students attending in-house internship, the attendance should be maintained by the Faculty mentor
Parameters for Assessment	Diary Report presentation skill Technical Paper Recommendation Letter from the guide
Evaluation	CIE (100 Marks)–The CIE marks shall be awarded by a committee* consisting of the faculty mentor and two faculty members of the Department, one of whom shall be the Guide (applicable for in-house interns). The schedule for evaluation will be announced by chairman BOE at the end of the semester. The Evaluation can be done in *phases as decided by the internal BOS* of the department. The contents of the report and the evaluation Rubrics will be set by the Department based on the assessment parameters SEE (100 Marks)– Contribution to the internship and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. Marks shall be awarded based on the evaluation of the diary, report, presentation skill and viva voce

*For interdisciplinary internship its necessary to involve an expert from each discipline	
Guidelines for Industry Internship III	
Purpose	To bridge the gap between the theoretical knowledge obtained in the classrooms and the practical skills required in the actual workplace
Skills acquired	Applying the theoretical knowledge in a practical scenario Build confidence in applying the skills learnt Documentation Communication Appreciating and practicing the ethical values
Expected Outcomes	Get exposure to a real world job environment and gain practical experience Build confidence in applying the skills learnt. Enhances Placement Opportunity
Selection	Can select individually Can seek the help from the department
Team Size	Can be carried out either individually or in a team(not exceeding 5students).
Venue	In a domain specific organization
Supervision	Internship shall be carried out under the supervision of a faculty mentor* at the department level. One faculty mentor can supervise a maximum of 20 students.
Parameters for Assessment	Diary Report presentation skill Recommendation Letter from the guide
Evaluation	CIE (100 Marks) -The CIE marks shall be awarded by a committee* consisting of the faculty mentor and two faculty members of the Department, one of whom shall be the Guide (applicable for in-house interns). The schedule for evaluation will be announced by chairman BOE at the end of the semester. The Evaluation can be done in *phases as decided by the internal BOS* of the department. The contents of the report and the evaluation Rubrics will be set by the Department based on the assessment parameters SEE (100 Marks)- Contribution to the internship and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. Marks shall be awarded based on the evaluation of the diary, report, presentation skill and viva voce
*For interdisciplinary internship its necessary to involve an expert from each discipline	

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3					3		3		
CO2	3	3						3	2	2		3		