SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
P. G. DEPARTMENT OF APPLIED ELECTRONICS
Faculty of Science and Technology

Programme: M. Sc. (Applied Electronics)

PROGRAMME OUTCOMES (POs)

Upon completion of the M.Sc. Applied Electronics Programme, the student would be able to:

PO1	Deep subject Knowledge and intellectual breadth	Develop extensive knowledge in various areas of Electronics.
PO2	Professional Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the standard practices.
PO3	Creative & Critical Thinking	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO4	Innovation, Research and Problem Solving	Identify, formulate, review research literature, and analyse problems using the first principles of mathematics and engineering sciences. Apply the knowledge of mathematics, science, engineering fundamentals and electronics to the solution of problems. Design solutions for electronic and allied systems, system modules or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Demonstrate the knowledge of, and need for sustainable development.
PO5	Team work and Communication Skills	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Present/communicate research at national/international level, write effective articles, reports and design documentation, make effective presentations, and give and receive clear instructions. Communicate disciplinary knowledge to the community and broader public.
PO6	Professionalism and Leadership Readiness	Demonstrate personal accountability and effective work habits, e.g., punctuality, working productively with others, and time as well as workload management. Use the strengths of others to achieve common goals
PO7	Lifelong learning	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
PO8	Competence for Digital World	Prepare well for living, learning and working in a Digital Society; Choose and apply appropriate modern tools/frameworks/platforms/instruments, software simulators, techniques, resources, and modern engineering and ICT tools to complex activities with an understanding of the limitations. Use existing digital technologies ethically and efficiently to solve problems, complete tasks, and accomplish goals.
PO9	Global Citizenship	Act with an informed awareness of global issues. Engage in initiatives that encourage equity and growth for all.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the two-year M. Sc. Applied Electronics programme, the student would be able to

PSO 1: Analyze specific problems relevant to Applied Electronics by applying the knowledge of Electronic Devices and Circuits, Linear and Digital Integrated Circuits, Communication Engineering, Analog and Digital Electronics, Microprocessors, Microcontrollers, VLSI, Embedded Systems, Smart Sensors, Digital Signal Processing, Microwave Engineering, Embedded System Design, Computer Organization, Optical Fiber Communications, Mobile Communications, etc.

PSO 2: Design systems containing hardware and/or software using the significant analytical knowledge in Electronics and applying modern product development tools/frameworks.

PSO 3: Apply and transfer interdisciplinary systems and Engineering approaches to the various areas, like Communications, Signal processing, VLSI and Smart Sensors.

PSO4: Demonstrate skills by carrying out cost-effective projects with a flexibility to balance between research- and application- oriented work that require innovative approaches.

Employability Potential of the Programme

M. Sc. AE programme focuses on applied Sciences and engineering courses. Initially, it was started in the Faculty of Engineering and Technology with a view to provide exposure to applied sciences, courses relevant to electronics engineering and allied disciplines. In the past, many students have been placed in MNCs including but not limited to Oracle, Tektronix, Infosys, TCS, Cognizant, Persistent, Scientech, IBM, Marvell, BSNL, Tech Mahindra, Syntel, L&T Infotech, Videocon, CDAC, Samsung, Robonics Pvt Ltd., Jindal Saw Ltd., Electronics Art Pvt Ltd., etc.

Further, numerous students have completed their Master of Electronics Engineering as well as Ph.D. in Electronics Engineering and joined esteemed institutions like Indian Institute of Technology, Guwahati, Sant Gadge Baba Amravati University, Amravati as Professors and amongst them, a few have been leading the departments and institutes as HoDs and Principals, respectively. Some other students have been placed in banking sector such as HDFC Bank, ICICI Bank, Equitas Bank, Canara Bank, etc. Moreover, some students have secured jobs in Indian Navy, Merchant Navy, Ministry of Defence, Airport Authority of India, BSNL, etc. In addition, some students have successfully established their small enterprises and now they are self-employed. Nevertheless, they are providing jobs to other students as well.

Applied Electronics contributes to a lot of innovation in the fields of healthcare, automation, automotive, robotics and computer & IT. Because of the stupendous technological growth all over the world, there exist several jobs in electronics sector. Almost, everything runs on electrical devices, gadgets, and control systems, one can't do without electronics graduate in the company. Being an electronics graduate will act as an entrance in varied industries including Automotive Industry, Defence Industry, Real Estate, Construction, Electronics Industry, Marine Industry, Oil and Gas Industry, Power generation industry, Railways, Marine, Telecom industry, and many more.

Student can work in a variety of areas, as electronics are used in many things including but not limited to acoustics, defence, medical instruments, mobile phones, nanotechnology, radio and satellite communication, robotics, etc.

As a responsibility, student will need to:

- discuss proposals with clients
- work with colleagues to design new systems, circuits and devices or develop existing technology
- test theoretical design
- write specifications and technical reports
- follow defined development processes
- systematically improve the detailed design of a piece of electronic equipment
- ensure that a product will work with devices developed by others, can be made again reliably, and will perform consistently in specified operating environments
- create user-friendly interfaces
- ensure safety regulations are met
- carry out project planning and prepare budgets
- supervise technicians, craftspeople and other employees

Popular Job Profiles for Students of M Sc Applied Electronics

Students can work in a variety of manufacturing (product) and service sector organisations, including broadcasting, consulting, data communication, entertainment, research and development, and system support. The following are some of the most common job titles for an electronics and communication engineer. Areas of employment include but not limited to Service Engineer, Electronics Engineer, Electronics Design Engineer, Field Test Engineer, Communications Engineer, Customer Support Engineer, Field Test Engineer, Network Planning Engineer, Electronics and Communications Consultant, Electronics Technician, Research and Development Software Engineer, Senior Sales Manager, Technical Director, Analog applications engineer, Telecom engineer, VLSI and embedded systems (Automation) industries, Data processing industries

Self-Employment / Start-ups/Business Prospects for M Sc Applied Electronics students

Self-employment does cater the best jobs for students. However, establishing a start-up is likely to be risky at the initial stages. But a well-trained student can always try to broaden his/her business prospect by accumulating valuable knowledge. Moreover, gaining appropriate skills during the programme helps one to frame a strategic plan and execute it ideally.

Since in the current scenario, there are not a lot of start-ups in the Electronics industry, so competition would be comparatively less. A start-up in this field could be incorporated in any of the following avenues: Smart sensors, Robotics, VLSI, Optical Communication, Embedded Systems, Digital Electronics and many more.

Why contemplate higher studies after M.Sc. Applied Electronics?

With a degree in higher studies, students can increase the chances of career options. Students can join M.E. or M. Tech. Programmes in Electronics Engineering. Master degrees offer to reinforce fundamental concepts in areas like communication, machine learning, high processing circuits etc. In addition, a higher degree in education can support with greater job opportunities and advanced level training that cannot be acquired during graduation level education.

Additionally, higher studies apart from providing several advantages, job opportunities for electronics and communication engineers, also strengthen the existing knowledge foundation. It permits an individual career aspirant to move across the global landscape to experience professional growth seamlessly.

To summarize, students can explore global career opportunities and switch job roles smoothly. They can grab high salary packages. They can enhance knowledge and skills. Job security is ensured and enormous career advantages are gained. Consequently, this results in building strong networks.

Appendix-A

Master of Science (M.Sc. Applied Electronics) Full Time Two Years Degree Programme :-

1) A Student shall have to be admitted every year in the respective Institute/ College/University Department for completion of an academic year of this two year Degree programme.

2) The M.Sc. Degree shall consist of four semesters i.e. Semester I & II in the first academic year, Semester III & IV in the second academic year.

3) Student has to complete all four Semesters successfully for the award of Degree of Master of Science and fulfill conditions as per Ordinance No. 19.

4) Every Semester of M.Sc. Applied Electronics programme shall be of at least 90 teaching days in a semester and shall be of at least 180 teaching days in an academic year.

5)The Examinations shall consist of the subjects as indicated in the Scheme of Examinations as per **Appendix – 'A1 to A4'.**

6) The Semester wise structure of the programme is as follows.

Appendix- A1

Sant Gadge Baba Amravati University Amravati

Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Applied Electronics)

(Two Years- Four Semesters Degree Programme- C.B.C.S)

(M. Sc. Part-I) Semester- I

S. N.	Subject	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme						
			Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing	
											Theory		Practical		Total Marks		
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	Electrical Engineering & Network Analysis (DSC-1)	1AE1	4	1	-	5	5	-	5	3	80	20			100	40	P
2	Electronic Devices and Circuits (DSC-2)	1AE2	4	1	-	5	5	-	5	3	80	20			100	40	P
4	Communication Engineering (DSC-3)	1AE4	4	1	-	5	5	-	5	3	80	20			100	40	P
5	Object Oriented Programming C++ (DSC-4)	1AE5	4	1	-	5	5	-	5	3	80	20			100	40	P
6	Electric & Magnetic Fields (DSC-5)	1AE6	4	1	-	5	5	-	5	3	80	20			100	40	P
7	Electrical Engineering & Network Analysis (DSC-1) Laboratory	1AE7	-	-	2	2	-	1	1	3			25	25	50	25	P
8	Electronic Devices and Circuits (DSC-2) Laboratory	1AE8	-	-	2	2	-	1	1	3			25	25	50	25	P
9	Object Oriented Programming C++ (DSC-4) Laboratory	1AE9	-	-	2	2	-	1	1	3			25	25	50	25	P
10	Basic Electronic Workshop Laboratory (AEC-1)	1AE10			2	2	-	1	1	3			25	25	50	25	P
11	**#Internship/Field Work/Work Experience @**	1AE11															
12	**Open elective/ GIC/Open skill/MOOC***	1AE12															P
	TOTAL					33			29						700		

L: Lecture, T: Tutorial, P: Practical

Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Applied Electronics) according to their convenience; @ denotes Ancillary Credit

Note : Internship /Apprenticeship/Field Work / Work Experience (During vacations of Semester I to Semester III) for duration of minimum 60 hours to maximum 90 hours mandatory to all the students, to be completed during vacations of Semester I to III. This will carry 2 Credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.

- OEC (Optional) can be studied during semester I to IV

Sant Gadge Baba Amravati University Amravati
Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Applied Electronics)
(Two Years- Four Semesters Degree Programme- C.B.C.S)
(M. Sc. Part-I) Semester- II

S. N.	Subject	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme						
			Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing	
											Theory		Practical		Total Marks		
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	Linear Integrated Circuits DSC-6	2AE1	4	1	-	5	5	-	5	3	80	20			100	40	P
2	Mobile Communication DSC-7	2AE2	4	-	-	4	4	-	4	3	80	20			100	40	P
3	AEC-2 on DSC-7	2AE3	-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
4	Digital Integrated Circuits DSC-8	2AE4	4	1	-	5	5	-	5	3	80	20			100	40	P
5	Microprocessor and Microcontroller DSC -9	2AE5	4	1	-	5	5	-	5	3	80	20			100	40	P
6	**Professional Elective –** DSE-1	2AE6X	4	1	-	5	5	-	5	3	80	20			100	40	P
7	Integrated Circuits (DSC-6 & DSC-8) Laboratory	2AE7	-	-	2	2	-	1	1	3			25	25	50	25	P
8	Professional Elective (DSE-1) Laboratory	2AE8	-	-	2	2	-	1	1	3			25	25	50	25	P
9	Microprocessor and Microcontroller (DSC-9) Laboratory	2AE9	-	-	2	2	-	1	1	3			25	25	50	25	P
10	**#Internship/Field Work/Work Experience@**	2AE10															
11	**Open elective/ GIC/Open skill course/MOOC***	2AE11															
	TOTAL					31			28						675		

2AE6x DSE: 2AE61 Electronic Instrumentation, 2AE62 Control Systems, 2AE63 Introduction to Data Science

Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Applied Electronics) according to their convenience;
@ denotes Ancillary Credit

Appendix- A3

Sant Gadge Baba Amravati University Amravati
Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Applied Electronics)
(Two Years - Four Semesters Degree Course- C.B.C.S)
(M. Sc. Part-II) Semester- III

S. N.	Subject	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme						
			Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing	
											Theory		Practical				
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External	Total Marks	Marks	Grade
1	Digital Signal Processing DSC-10	3AE1	4	1	-	5	5	-	5	3	80	20			100	40	P
2	Embedded System Design DSC-11	3AE2	4	-	-	4	4	-	4	3	80	20			100	40	P
3	AEC-3 on DSC-11	3AE3	-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
4	Internet of Things –IOT (SEC)	3AE4	-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
5	**Professional Elective –** DSE-2	3AE5X	4	1	-	5	5	-	5	3	80	20			100	40	P
6	**Open elective/ GIC/Open skill course/MOOC***	3AE6															
7	Digital Signal Processing (DSC-10) Laboratory	3AE7	-		2	2	-	1	1	3	-	-	25	25	50	25	P
8	Embedded System Design (DSC-11) Laboratory	3AE8	-	-	2	2	-	1	1	3			25	25	50	25	P
9	Project and Seminar	3AE9	-	-	6	6	-	3*	3*	-			--	--	--	--	--
10	IOT (SEC) Lab.	3AE10	-	-	2	2	-	1	1	3			25	25	50	25	P
11	Project (IOT SEC)	3AE11			1	1	-	1	1	1	-	-	25	25	50	25	P
12	**#Internship/Field Work/Work Experience@**	3AE12															
						29			23*						550		

3AE5x Professional Elective : 3AE51 Smart Sensors, 3AE52 Remote Sensing, 3AE53 Computer Organization [*Note: Board of Studies will prepare pool of electives]
Open Elective (OEC) GIC /Open Skill Course (within faculty or interfaculty) / MOOC /(5 credits for each)
Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Applied Electronics) according to their convenience; @ denotes Ancillary Credit

*Credits of Project and Seminar (3AE9) shall be carried forward and added to the Fourth Semester in 4AE8

Appendix- A4

Sant Gadge Baba Amravati University Amravati
Scheme of Teaching, Learning & Examination leading to the Degree Master of Science (Applied Electronics)
(Two Years - Four Semesters Degree Course- C.B.C.S)
(M. Sc. Part-II) Semester- IV

S. N.	Subject	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme						
			Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing	
											Theory		Practical		Total Marks		
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	Microwave Engineering DSC-12	4AE1	4	1	-	5	5	-	5	3	80	20			100	40	P
2	Optical Fiber Communications DSC - 13	4AE2	4	1	-	5	5	-	5	3	80	20			100	40	P
3	VLSI Design DSC-14	4AE3	4	-	-	4	4	-	4	3	80	20			100	40	P
4	AEC-4 on DSC-14	4AE4	-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
5	Digital Communication DSC-15	4AE5	4	1	-	5	5	-	5	3	80	20			100	40	P
6	**Professional Elective :** DSE-3	4AE6X	4	1	-	5	5	-	5	3	80	20			100	40	P
7	Microwave Engineering and Optical Fiber Communications (DSC-12 & DSC-13) Laboratory	4AE7	-	-	2	2	-	1	1	3	-	-	25	25	50	25	P
8	Project and Seminar	4AE8 **3AE9**	-	-	6	6	-	*	3+3	3	-	-	100	100	200	100	P
9	**#Internship/Field Work/Work Experience@**	4AE9															
10	**Open elective/ GIC/Open skill course/MOOC***	4AE10															
						33			32						775		

4AE6x Professional Elective#: 4AE61 Artificial Intelligence, 4AE62 Biomedical Engineering 4AE63, Computer Networks
4AE9# includes its equivalent predecessors **1AE11/2AE10/3AE12** and it denotes the **Internship/Field Work/Work Experience** undertaken and completed by students in the preceding semesters' vacations, viz., First OR Second OR Third Semester

*Credits of Project and Seminar (3AE9) have been carried forward and added to the Fourth Semester in 4AE8, so that the Total Credits for Project and Seminar add up to 6 (3 +3)

Total Credits: 112

M.Sc. Applied Electronics (CBCS)

SEM III
3AE1 Digital Signal Processing DSC-10

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Identify the discrete time signals and identify the type system.
2. Compute the z-transform of a sequence, identify its region of convergence, and compute the inverse z-transform.
3. Evaluate the Fourier transform of a signal.
4. Design FIR and IIR filters.
5. Convert analog filter to digital filter
6. Understand the concepts of Multirate Digital Signal Processing and need of Filter banks.

Unit I : Introduction to DSP, Frequency domain description of signals& systems, Discrete time sequences systems, Linearity, unit sample response, Convolution, Time invariant system, Stability criteria for discrete time systems, Solution of linear difference equations. (10Hrs)

Unit II : Introduction to Fourier transform of Discrete Time Signal and its properties, Inverse Fourier transform, Sampling of continuous time signal, Reconstruction of continuous time signal from sequences, Z-Transform and its properties, complex Z-plane, ROC, Determination of filter coefficients, relationship between Fourier transform and Z-Transform, Inverse Z-Transform. (10Hrs)

Unit III: DFT and its properties, Circular convolution, linear convolution from DFT, FFT, and Decimation in time and frequency algorithm, and Introduction to wavelet transform. (10Hrs)

Unit IV: Filter categories, Direct form I, Direct form II, Cascade and parallel structure for IIR and FIR Filter, Frequency sampling structures for F.I.R. filter, Steps in Filter Design, Design by pole zero placements, FIR filter design by Windowing method, Rectangular, Triangular and Blackman window (10Hrs)

Unit V: Analog filter types: Butterworth, Elliptic and Chebyshev filter, Filter Specifications, formulae, filter order, Methods to convert analog filter into digital filters, Mapping of differential, impulse invariant, Bilinear, Matched Z transformation. (10Hrs)

Unit VI: Multi rate DSP, Introductory concept of multi rate signal processing, Design of practical sampler, Rate converters, Decimators and Interpolator, Filter bank application and examples (10Hrs)

Text books:

1. Proakis and Manolakis:Digital Signal Processing, 3/e, Pearson Education
2. S. Salivahan, A. Vallavaraj: Digital Signal Processing (TMH)

Reference Book:

B. P. Lathi: Signal Processing and Linear Systems, Oxford University Press

3AE2 Embedded System Design DSC-11

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Explain architecture of Microcontroller
2. Distinguish real-time embedded systems from other systems.

3. Describe fundamentals of embedded based firmware design.
4. Evaluate the need for real-time operating system.
5. Interpret real-time algorithm for task scheduling.
6. Summarize technique used for product enclosure design and development.

Unit I : **Architecture of Microcontroller 89C51:**
Architecture, GPR, SFR, Address, Data & Control bus generation, Memory structure (Data and Program memory), IO Ports, Interrupts, Timer/Counter, serial communication, Block diagram and description of architectures of Processors: Von Neumann, Harvard, RISC , CISC, DSP, Multi Core Processor. (10Hrs)

Unit-II: **Introduction to Embedded System:**
Embedded Systems versus General Computing Systems, History, advantages and disadvantages, Classification of Embedded System: Small scale, medium scale, sophisticated, stand-alone, real time, Networked, Mobile, major application areas. (10Hrs)

Unit-III: **Embedded System Design:**
Embedded System block diagram, Components of embedded system, characteristics of embedded system, Memories for embedded systems, Design Metrics/Specifications- General Purpose and Domain Specific Processors, Processor power, memory, operating system, Reliability, power consumption, flexibility, time-to prototype. (10Hrs)

Unit-IV: **Software Development Tools:**
Operation and selection, Integrated Development Environment (IDE), Cross- Complier, Assembler, compiler, cross compiler, Emulator and Flash/OTP Programmer. In-Circuit Emulator (ICE), debugger, Embedded C- Assembly Language V/S Embedded C, Programming Microcontroller 89C51 with C. (10Hrs)

Unit-V: **Communication Protocols-**
Need of communication interface in embedded system, Serial V/S Parallel Communication, Synchronous V/S Asynchronous Communication, RS232, MAX 232, 8051 connection with RS232 , Concepts of Communication protocols- Serial Communication Protocol: I2C, CAN, USB, Wireless Communication Protocol: IrDA, Bluetooth, Zigbee, IEEE802.11 (10Hrs)

Unit-VI: **Real Time Operating System**
Operating System, Comparison between general purpose OS and RTOS, Architecture of RTOS, functions of RTOS, concepts of various task scheduling algorithms of RTOS, Inter-task Communication, Share data problem- Semaphore, Mutex, Dead lock (10Hrs)

Text books:

1) The 8051 Microcontroller and Embedded System Using Assembly and C, Mazidi, Mazidi & McKinlay, Prentice Hall
2) Introduction to Embedded Systems, Shibu K. V., McGraw-Hill

Reference books:

1) The 8051 Microcontroller by K. J. Ayala, Penram International
2) Embedded Systems by Raj Kamal, TMH
3) Microcontrollers Theory and Applications, Ajay V. Deshmukh, Tata McGraw Hill

3AE3 AEC-3 on DSC-11

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Describe fundamentals of embedded based firmware design.
2. Interpret real-time algorithm for task scheduling.
3. Summarize technique used for product enclosure design and development.

Based on the topics like
Operation and selection, Integrated Development Environment (IDE), Cross- Complier, Assembler, compiler, cross compiler, Emulator and Flash/OTP Programmer. In-Circuit Emulator (ICE), debugger, Embedded C- Assembly Language V/S Embedded C, Programming Microcontroller 89C51 with C to improve the ability to apply the knowledge. (10Hrs)

3AE4 **IOT- Internet of Things**–IOT (SEC)

Cos (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Explore various protocols of sensor networks.
2. Program and configure Arduino boards for real world connectivity.
3. Python programming and interfacing for Raspberry Pi.

UNIT I

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks. (10Hrs)

UNIT II

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, (10Hrs)

UNIT III

Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi (10Hrs)

TEXT BOOKS

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press)
2. Make sensors: Terokarvinen, kemo, karvinen and villey valtokari, 1st Ed., Maker Media, 2014.

REFERENCES

1. Internet of Things: A Hands-on Approach, by Arshdeep Bahga and Vijay Madisetti.
2. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013.
3. Programming The Internet Of Things: An Introduction To Building Integrated, Device-To-Cloud IoT Solutions, by Andy King ,O'REILLY publications

3AE5X **Professional Elective –** DSE-2

3AE51 Smart Sensors

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Describe the principles of smart sensors
2. Analyze intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication
4. Justify various control techniques for smart sensors
5. Evaluate smart sensors by the assessment of reliability testing and packaging.
6. Evaluate standards of smart sensors

Unit I: Smart Sensor basics: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, wearable sensors, integration of micromachining and microelectronics, (10Hrs)

Unit II: Using MCUs/DSPs : MCU Control , MCUs for Sensor Interface Peripherals, ,Memory , Input/Output ,Onboard A/D Conversion , Power-Saving Capability , Local Voltage or Current Regulation, Modular MCU Design, DSP Control, Software, Tools, and Support, Sensor Integration (10Hrs)

Unit III: Communications for Smart Sensors: Introduction, Definitions, Sources (Organizations) and Standards, Automotive Protocols, Industrial Networks, office and building automation, home automation, Protocols in Silicon, Transitioning Between Protocols (10Hrs)

Unit IV: Control Techniques: Programmable Logic Controllers , Open-Versus Closed-Loop Systems, PID Control, Fuzzy Logic, Neural Networks , Combined Fuzzy Logic and Neural Networks ,Adaptive Control, The Impact of Artificial Intelligence on sensors (10Hrs)

Unit V: Energy harvesting for wireless sensor nodes, application driven technology implementation and development, EH technologies, Energy storage, Sensor Fusion, packaging, testing and reliability implications of smarter sensors (10 Hrs)

Unit VI: Setting Standards for Smart Sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, Networked smart sensors, More standards impacting sensors: sensor plug and play, Future sensing system requirements, sensor apps, cloud sensing, alternate views of smart sensing, the Smart Loop (10 Hrs)

Textbook:

Understanding Smart Sensors, Randy Frank, 3e, Artech House, 2013

Reference Books:

1. WEARABLE SENSORS Fundamentals, Implementation and Applications, SECOND EDITION, Edited by EDWARD SAZONOV, Academic Press, Elsevier, 2021
2. Smart Sensors and MEMS Intelligent Sensing Devices and Microsystems for Industrial Applications, Second Edition, Edited by Stoyan Nihtianov and Antonio Luque, Woodhead Publishing, Elsevier, 2018
3. Micro and Smart Systems: Technology and modeling by G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Aatre, Willey Publications, 2012

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3AE52 Remote Sensing

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Comprehend the basics of remote Sensing
2. obtain knowledge of the sensor characteristics of various RS Systems and imaging
3. Interpret and analyze remote sensing
4. Develop visual interpretation skills
5. Analyse & Process the digital images using various techniques
6. Describe the applications of remote sensing

Unit I: Concept of Remote Sensing: Introduction, Definition of Remote Sensing, Data, Remote Sensing Process, Advantages and limitations of Remote Sensing,
Types of Remote Sensing, Characteristics of Images, Orbital Characteristics of Satellite, Remote Sensing Satellites, History of Remote Sensing and Indian Space Programme, (10Hrs)

Unit II: Photographic Imaging : Introduction, Camera Systems , Types of Camera , Filter , Film, Geometry of Aerial Photography,

Digital Imaging : Introduction , Sensors, Detectors, Imaging by Scanning Technique , Thermal Remote Sensing: Thermal Imaging, Thermal Image and Temperature Mapping, Thermal Remote Sensing Sensors, (10Hrs)

Unit III: Microwave remote sensing: Introduction, RADAR imaging, Airborne Versus Space-Borne Radars, Ground-Truth Data and Global Navigation Satellite System, Photogrammetry Introduction, Photogrammetric Process, Acquisition of Imagery and its Support Data , Orientation and Triangulation , Stereo Model Compilation (10Hrs)

Unit IV: Visual Image Interpretation: Introduction, Information Extraction by Human and Computer, Remote Sensing Data Products, Image Interpretation, Elements of Visual Image Interpretation, Interpretation Keys, Generation of Thematic Maps, Thermal Image Interpretation, Radar Image Interpretation (10Hrs)

Unit V: Digital Image Processing: Introduction, Image Processing Systems, Pre-processing, Image Enhancement, Contrast and Brightness Enhancement, Filtering, Image Transformation, Fourier Transformation , Image Classification Supervised Classification, Unsupervised Classification (10Hrs)

Unit VI: Applications of remote sensing: Introduction, land cover and land used, agriculture, forestry, geology, mapping, oceans and coastal monitoring , monitoring of atmospheric constituents . (10Hrs)

Text Book: B. Bhatta- REMOTE SENSING AND GIS, Oxford university press higher education

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3AE53 Computer Organization

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand basics of computer organization
2. Know functions of memory management unit
3. Comprehend Instruction pipeline, ALU and CPU structure
4. Appreciate differences between the CISC and RISC
5. Illustrate the concept of microprogramming
6. Familiarize with the multi-processor organizations: SMP, NUMA, Clusters

UNIT I : Organization and architecture, structure and function, Computer evolution and performance: Brief history of computer, designing for performance , computer components, computer function , bus interconnection, PCI (10 Hrs)

UNIT II : External devices, I/O modules, I/O Channels and lOPs, SCSI and firewire interfaces, operating system overview, memory management, swapping, partitioning , paging , virtual memory. (10 Hrs)

UNIT III : ALU: Machine instruction characteristics , operand types, operation types, Addressing modes, instruction formats, CPU structure, processor organization register organization, instruction cycle, instruction pipelining. (10 Hrs)

UNIT IV : RISC machine, instruction execution characteristics, register file concept, compiler based register optimization , RISC architecture, RISC pipelining, RISC vs CISC, case study of power PC 620. (10 Hrs)

UNIT V : Control unit operation: Micro operation, control of processor Hardwired implementation, micro program control : Concepts, microinstructions sequencing and execution, application of microprogramming. (10 Hrs)

UNIT VI : Multiple processor organizations, symmetric multiprocessors, Mainframe SMP, Cache coherence and MESI protocol, clusters . Non uniform memory access. Vector computation (10 Hrs)

Text books:

1) William Stallings" Computer organization and architecture", 11th Edition, (Pearson education), 2019
2) A.S. Tanenbaum" Structured computer organization" 6/e, Pearson Education, 2016

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3AE6 **Open elective/ GIC/Open skill course/MOOC***

Open Elective (OEC) GIC /Open Skill Course (within faculty or interfaculty) / MOOC /(5 credits for each)

3AE7 Digital Signal Processing (DSC-10) Laboratory

12-15 experiments based on the syllabus of 3AE1, that are preferably uniformly distributed over the syllabus.

3AE8 Embedded System Design (DSC-11) Laboratory

12-15 experiments based on the syllabus of 3AE2, that are preferably uniformly distributed over the syllabus.

3AE9 Project and Seminar

Seminar Course Outcomes

After completion of the course the students will be able to:

1. Study research papers for understanding of a new field, in the absence of textbooks/reference books, to summarize and review them.
2. Identify promising new directions of various cutting edge technologies
   Impart skills in preparing detailed report describing the project and results
3. Communicate effectively by making an oral presentation before an evaluation committee

Project Course Outcomes:

After completion of the course the students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation, objectives and solution.
3. Design the system incorporating hardware or software or a hybrid approach
4. Analyse and synthesize the results of the detailed studies conducted, lay down validity and design criteria, interpret the result for application/solution to the problem, develop the concept and detailed design solution and to effectively communicate the Project Report rationale
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Project (including 4AE8). The project work should be either hardware and/or software based. A project report should be submitted in three copies. Every student has to submit seminar report and deliver a seminar on advance state-of the-art topics.

3AE10 IOT (SEC) Lab.

12-15 experiments based on the syllabus of 3AE4, that are preferably uniformly distributed over the syllabus to develop skills..

3AE11 Project (IOT SEC)

Students have to submit a small/mini project individually on 3AE4

3AE12 #Internship/Field Work/Work Experience@

Students may complete their Internship/Field Work/Work Experience in First OR Second OR Third Semester of M. Sc. (Applied Electronics) according to their convenience; @ denotes Ancillary Credit

SEM IV

4AE1 Microwave Engineering DSC-12

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand operations of microwave tubes.
2. Illustrate the Microwave solid state devices
3. Describe characteristics of microwave propagation through waveguides.
4. Use S-parameters for characterization of microwave devices.
5. Measure various parameters of microwave system.
6. Explain Microwave communication system

Unit I: Microwave tubes: Electromagnetic frequency spectrum, noise in conventional tubes, Two cavity Klystron, Reflex Klystron, Traveling Wave Tube, Magnetron (cylindrical type). (10Hrs)

Unit II: Microwave solid state devices: Tunnel diode, negative resistance amplifier, Gunn diode, parametric amplifier, PIN diode, TRAPATT, IMPATT, introduction to MASER. (10Hrs)

Unit III: Transmission of microwaves: Rectangular wave guide, TE,TM, wave propagation, cut-off frequency, cut-offwavelength, group and phase velocity, wave impedance, Circular wave guide, types of strip lines, strip line characteristics. (10Hrs)

Unit IV: Microwave Passive Components: Microwave terminations, Attenuator, Phase shifter, Faraday's rotation, Devices employing faraday's rotation (Isolator and Circulator),Directional couplers, scattering matrix formulation of N-port junction. (10Hrs)

Unit V: Microwave Resonator and Filter: Basic RLC resonant circuit(series and parallel), Quality factor, Rectangular cavity resonator and their Q, TEmnp, TMmnp mode propagations, Re-entrant cavity, and Circular cavity resonator. (10Hrs)

Unit VI: Microwave communication system: Microwave link carrier chain, Troposphere scatter link using frequency diversity, LOS (Line Of sight) communication system, microwave absorption (Fading), Noise in microwave communication system. (10Hrs)

TEXT BOOKS:

1) M.L. Sisodiya and G.S. Raghuwanshi: "Microwave Circuits and Passive devices", (WEL)
2) K.C. Gupta: " Microwave engineering"(WILEY)
3) M. Kulkarni: "Microwave and Radar Engineering" Umesh Publication

REFERENCE BOOKS:

1) Liao, Samual Y. : "Microwave devices & circuits" Tata McGraw Hill Co. Ltd., New Delhi
2) Collin, Robert E.: "Foundations for microwave Engineering" McGraw Hill, New York.
3) Pozar: Microwave Engg, Wiley Eastern

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4AE2 Optical Fiber Communications DSC -13

COs (Course Outcomes)

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

1. understand optical fiber communication system
2. Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.
3. Illustrate optical sources
4. Explain optical fiber manufacture g techniques
5. Illustrate optical detectors.
6. Design optical fiber communication system and its performance measures.

Unit I: Optical fiber wave-guide: Total internal reflection, Snell's law, Theory of circular

wave guide, Modes in optical fibers, Single mode fiber, Multimode fiber, N.A., Power flow (10Hrs)

Unit II: Transmission Characteristics of Fiber: Attenuation, Absorption losses, scattering losses, bending losses, dispersion, and intra modal - inter modal dispersion, bandwidth, and nonlinear effects in single-mode fiber. (10Hrs)

Unit III: Optical Sources: Optical emission from semiconductors, LED, efficiency, double hetero junction LED, Basic concept of Lasers, Semiconductor injection lasers. (10Hrs)

Unit IV: Optical Fibers: Manufacturing, fiber splicing and connectors, different manufacturing techniques, different splicing techniques and connectors. (10Hrs)

Unit V: Detectors: Optical detection principle, absorption, quantum efficiency, responsivity, PIN photo diode, APD and noise in photodiode. (10Hrs)

Unit VI: Optical Electronic System: Optical transmitter, receiver, digital system planning consideration, power budgeting coherent and noncoherent systems, modulation demodulation scheme, wavelength division multiplexing. (10Hrs)

Text Books:

1. Senior J.M.: "Optical Fiber Communication and Application", Prentice Hall of India Pvt Ltd. New Delhi
2. G.Keiser: "Optical Fiber Communication", Mc-Graw Hill International Book Common. New York
3. R. P. Khare: Fiber Optics and Optoelectronics, Oxford University Press

Reference Books:

1) Gowe : Optical Communication System, Prentice Hall
2) D.K.Mynbaev : Fiber Optic Communication L.I.Scheiner Technology, LPE, Pearson Education

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4AE3 VLSI Design DSC-14

COs (Course Outcomes)

On completion of this course the student should be able to:

1. Design digital circuit,
2. Design digital circuit using Behavioral and data flow modelling
3. Design digital circuit using structural modelling
4. Model digital circuits with VHDL, simulate, synthesize and prototype in PLDs.
5. Analyze and Realize CMOS based logic circuit
6. Demonstrate a clear understanding of CMOS fabrication flow and technology scaling

Unit I : Digital Design Fundamentals: Review of techniques of using a truth table, canonical forms to develop the AND/OR orOR/AND combinational circuit models, minimization techniques, Hazards and Hazard free circuits. Difference between combinational and sequential circuits. General model of sequential machine, timing and triggering considerations (10Hrs)

Unit II : Basic HDL Constructs: VLSI Design flow, Overview of different modelling styles in VHDL, Data types and data objects in VHDL, Dataflow Modelling, Behavioural Modelling, using VHDL for combinational Circuits and sequential Circuits. (10Hrs)

Unit III : Hardware Description Language: Structural Modelling, Subprograms, Packages and Libraries, Generics, Configurations, attributes. Comparison of various Hardware Description Languages. (10Hrs)

Unit IV : Programmable Logic Devices: Introduction to CPLDs: Function block architecture, input/output block, switch matrix, Study of architecture ofCPLDs of Altera /Xilinx. Introduction to FPGAs: Configurable logic block, input/output block and interconnect, Study of architecture of FPGAs of Xilinx/Actel/Altera. (10Hrs)

Unit V: CMOS Circuits: Different logic families, MOS Transistor, MOS as an inverter, propagation delay, power consumption/dissipation issues, simple circuits using CMOS. (10Hrs)

Unit VI: CMOS Processing & Digital Circuit Verification: CMOS Fabrication: Different steps of fabrication, CMOS p- well, n-Well and twin tub processes, CMOS Layout and

Design rules. Simple Test Bench, Simulation and Synthesis issues, case study of ALU/ Sequence Detector. (10Hrs)

Text Books:

1) Neil H.Weste and Kamran Eshraghin, "Principles of CMOS VLSI design".
2) J Bhasker," VHDL Primer". Addison Wesley
3) Douglas Perry," VHDL" Tata McGraw HILL
4) William I. Fletcher "An Engineering approach to Digital Design", Prentice Hall India.5) Digital Integrated Circuit Design, K.Martin, Oxford University Press

Reference Books:

1) Stephen Brown and Zvonko Vranesic, *"Fundamentals* of Digital Logic with VHDL
2) Design". Tata McGRAW HILL3) Wayne Wolf: "VLSI Technology"
3) Allen & Homberg : "CMOS design"
4) Basics of CMOS cell design by Sicord & Bhendiya*5)* John Yarbrough, BROOKS /COLE, "Digital Logic Applications andDesign".

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4AE4 AEC-4 on DSC-14

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Design digital circuits with various data modelling styles.

Basic HDL Constructs: VLSI Design flow, Overview of different modelling styles in VHDL, Data types and data objects in VHDL, Dataflow Modelling, Behavioural Modelling, using VHDL for combinational Circuits and sequential Circuits.

Hardware Description Language: Structural Modelling, Subprograms, Packages and Libraries, Generics, Configurations, attributes. Comparison of various Hardware Description Languages. (10Hrs)

4AE5 Digital Communication DSC-15

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand basic building blocks of digital communication system and formatting of digital signal.
2. Illustrate information theory and channel coding
3. Analyze performance of different digital modulation techniques.
4. Implement different error control coding schemes for the reliable transmission.
5. Understand base band transmission.
6. Explain modern techniques of communication

Unit I : DIGITAL COMMUNICATION SYSTEM

Comparison of analog and digital communication System, advantages- disadvantages of digital communication System, block diagram of digital communication System, source encoder, decoder, Channel encoder, decoder, modulator, demodulator and their important parameters, Concepts of synchronization. (10Hrs)

Unit II : INFORMATION THEORY AND CHANNEL CODING

Digital Signal, Bits, bit rate and baud rate, Probability, laws of probability, joint and conditional probability, information content, rate of information, entropy, joint entropy & conditional entropy, Theoretical Concepts of Binary communication channel, discrete communication channel, Channel capacity, Shannon's theorem on channel capacity, Hartley's law, Source coding, Huffman coding algorithm, and simple numerical. (10Hrs)

Unit III : DIGITAL MODULATION TECHNIQUES

Digital carrier modulation Schemes, fundamental concepts of coherent Amplitude Shift Keying (ASK), Frequency shift keying (FSK), Phase shift keying (PSK), their

transmitter and receiver block diagram and working, bandwidth and probability of errors (only theoretical concepts), comparison of digital modulation systems, block diagram of Differential Phase shift keying (DPSK) transmitter - receiver and working. (10Hrs)

Unit IV: **ERROR CONTROLLING AND CODING**

Introduction to error controlling and coding, Methods of controlling errors, type of errors and codes, linear block codes, Matrix description of linear block code, error detection and error correction capabilities of linear block code and simple numerical. (10Hrs)

Unit V : **BASE BAND TRANSMISSION**

Concept of Base band signals, Sampling process, Nyquist sampling theorem, Base band PAM system, inter symbol interference, Nyquist criterion, pulse shaping, eye diagram (Theoretical concepts only), scrambler and unscramble concepts and design. (10Hrs)

Unit VI : **MODERN TECHNIQUES OF COMMUNICATION**

Access techniques: Need of Multiplexing, Time Division Multiple Access (TDMA) and Frequency Division multipleAccess (FDMA), Code Division Multiple access (CDMA), comparison of TDMA, FDMA, CDMA. Introduction to spread spectrum (SS), Pseudo Noise (PN) sequence: definition, generation, Model of Spread Spectrum digital Communication system, D.S. spread spectrum transmitter, receiver and frequency hopping spread spectrum transmitter, receiver, **Theoretical concepts only** (10Hrs)

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Text Books:

1) Shanmugam K.S. Digital & analog Communication Systems, John Willey & Sons, New York
2) Lathi B. P. Modern Digital and Communication Systems, Oxford University Press

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4AE6X Professional Elective : DSE-3
4AE61 Artificial Intelligence

COs (Course Outcomes):

Upon completion of this course satisfactorily, students would be able to:

1. Understand artificial intelligence
2. Solve problems by searching
3. Analyse machine learning systems
4. Represent the knowledge in learning
5. Apply deep learning for problem solving
6. Classify images and detect objects using computer vision

Unit I : Introduction, What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art , Risks and Benefits of AI , Intelligent Agents, philosophy, ethics and safety of AI, limits of AI, future of AI: AI components, AI architectures (10Hrs)

Unit II : Solving Problems by Searching, Problem-Solving Agents, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search and Optimization Problems, Hill climbing search, simulated annealing, local beam search (10Hrs)

Unit III: Machine Learning, Learning from Examples, Forms of Learning, Supervised Learning, Learning Decision Trees, Model Selection and Optimization, Linear Regression and Classification, Nonparametric Models, Ensemble Learning, Developing Machine Learning Systems (10Hrs)

Unit IV: Knowledge Representation, Ontological Engineering, Categories and Objects, Events,

Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information . (10Hrs)

Unit V: Deep Learning, Simple Feedforward Networks, Computation Graphs for Deep Learning, Convolutional Networks, Learning Algorithms, Generalization, Recurrent Neural Networks, Unsupervised Learning and Transfer Learning, Applications (10Hrs)

Unit VI: Computer Vision: Introduction, Image Formation, Simple Image Features, Classifying Images, Detecting Objects, The 3D World, Using Computer Vision (10Hrs)

Text book:
Artificial Intelligence: A Modern Approach, Fourth Edition, Global Edition by Stuart J. Russell and Peter Norvig, Pearson, 2022

Reference Books:

1. Artificial Intelligence by John Paul Mueller and Luca Massaron, John Wiley & Sons, Inc, 2018
2. Introduction to Artificial Intelligence, Second Edition by Wolfgang Ertel, Springer, 2017

4AE62 Biomedical Engineering

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand the importance and association of engineering with medical field.
2. Measure the biomedical parameters.
3. Explain the medical imaging system
4. Illustrate therapeutic equipment
5. Understand the conceptualization of patient care & safety requirements and its importance
6. Explain computerized biomedical systems..

UNIT-I: INTRODUCTION TO BIOMEDICAL ENGINEERING

Physiological system of heart, Man instrument system, Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Biopotential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory : skin contact impedance measurement of skin con tact impedance, motion artifacts, nearest equation Nernst Equation . (10Hrs)

UNIT-II : BIOMEDICAL RECORDER AND MEASUREMENT

Biomedical recorders for EEG, ECG, EMG, Blood pressure variation as a function of time, relationship of heart sounds to a function of the cardio vascular system, Measurement of Blood Pressure (Direct & Indirect), Blood flow, Heart sound. (10Hrs)

UNIT-III : MEDICAL IMAGING SYSTEM

Instrumentation for diagnostics X-ray , X- ray basics properties , X-ray machine , Special imaging technique. Ultrasonicimaging system : Physics of Ultrasound, Biological effect of ultrasound. Ultrasonic A-scan, M-scan,B-scan, Real-time ultrasonic imaging systems. (10Hrs)

UNIT-IV : THERAPEUTIC EQUIPMENTS

Need of Physiological and electrotherapy equipment. Cardiac pacemaker machine, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy : short wave, microwave, ultrasonic. (10Hrs)

UNIT-V : PATIENT CARE AND MONITORING AND SAFETY

System concepts, Bedside patient monitors, central monitors, Average reading heart monitor, Intensive care monitoring, Ambulatory monitoring. Biotelemetry: Single channel and Multichannel biotelementry, telephonic data transmission. PATIENT SAFETY : Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to

minimize electric shock hazards. Telemedicine. (10Hrs)

UNIT-VI : COMPUTERS IN BIOMEDICAL ENGINEERING

Computerized Axial Tomography (CAT) Computerized Aided ECG analysis Computerized patient monitoringsystem. Computerized Catheterization. (10Hrs)

TEXT BOOKS:

1. Khandpur R.S. : "Handbook of Biomedical Instrumentation", Tata Mc-Graw Hill, New Delhi.
2. Cromwell L. & Weibell F.J. : "Biomedical Instrumentation and Measurement", Prentice Hall ofIndia.

REFERENCE BOOKS:

1. Dr. Lele R.D. : "Computer Applications of Medicine", Tata Mc-Graw Hill, New Delhi.
2. Webstar J.G. : "Medical Instrumentation", III ed., John Wiley & Sons.
3. Carr and Brown : Biomedical Equipment Technology.

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4AE63 Computer Networks

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand the network architectures and models
2. Demonstrate an understanding of the Channel Allocation Problem.
3. Understand Network layers.
4. Explain transport layer
5. Explain Application layer
6. Illustrate the role of cryptography in ensuring confidentiality, integrity, and authenticity of data

Unit I — Introduction
Uses of computer networks, Network Architectures, The OSI Reference model, TCP/IP reference model, Network examples, Data communication network examples. (10Hrs)

Unit II — The Medium Access Control Sublayer, The Channel Allocation Problem, Multiple Link Layer Switching (10Hrs)

Unit III — The Network Layer
Network layer design issues, Routing Algorithm, Congestion control algorithm, internet working, the network layer in the internet (10Hrs)

Unit IV — The transport layer: Services provided to the session layer,
Quality of service, Transport service primitives, transport protocol, elements of transport- protocols, the internet transport protocols, UDP, TCP, performance issues (10Hrs)

Unit V — Application layer: Application Layer design issues, DNS, e-mail, www, multimedia (10Hrs)

Unit VI — Network security, cryptography, symmetric key algorithms,
public key algorithms, digital signatures, management of public keys, communication security, authentication protocols, e-mail security, web security (10Hrs)

Text Book:

Andrew S. Tanenbaum: Computer Networks, 8th Edition, Pearson Education, 2022

Reference Book

Computer Networking: A Top-Down Approach, **by** James Kurose and Keith Ross , **8th** Global Edition**,** Pearson Education, 2021

4AE7 Microwave Engineering and Optical Fiber Communications (DSC-12 & DSC-13) Laboratory

Minimum 12-15 experiments based on the syllabus of 4AE1 and 4AE2,that are preferably uniformly distributed over the syllabi of both the subjects.

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4AE8, (3AE9) Project and Seminar

Seminar Course Outcomes

After completion of the course the students will be able to:

4. Study research papers for understanding of a new field, in the absence of textbooks/reference books, to summarize and review them.
5. Identify promising new directions of various cutting edge technologies
   Impart skills in preparing detailed report describing the project and results
6. Communicate effectively by making an oral presentation before an evaluation committee

Project Course Outcomes:

After completion of the course the students will be able to:

6. Demonstrate a sound technical knowledge of their selected project topic.
7. Undertake problem identification, formulation, objectives and solution.
8. Design the system incorporating hardware or software or a hybrid approach
9. Analyse and synthesize the results of the detailed studies conducted, lay down validity and design criteria, interpret the result for application/solution to the problem, develop the concept and detailed design solution and to effectively communicate the Project Report rationale
10. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Project (including 3AE8). The project work should be either hardware and/or software based. A project report should be submitted in three copies. Every student has to submit seminar report and deliver a seminar on advance state-of-the-art topics.

Credits of Project and Seminar (3AE9) have been carried forward and added to the Fourth Semester in 4AE8, so that the Total Credits for Project and Seminar add up to 6 (3 +3)

4AE9 #Internship/Field Work/Work Experience@

4AE9# includes its equivalent predecessors **1AE11/2AE10/3AE12** and it denotes the **Internship/Field Work/Work Experience** undertaken and completed by students in the preceding semesters' vacations, viz., First OR Second OR Third Semester

4AE10 Open elective/ GIC/Open skill course/MOOC*

Optional