Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M.Tech., Sem I
Course Code	6EN501
Course Name	Research Methodology for Electronics Engineers
Desired Requisites:	None

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Practical	-	Nil			
Interaction	2 Hrs/week	**Credits: 2**			

Course Objectives

1	To develop a research orientation among the students and to acquaint them with fundamentals of research methods.
2	To develop understanding of the basic framework of research process and techniques
3	To identify various sources of information for literature review and data collection.
4	To develop an understanding of the ethical dimensions of conducting applied research.
5	To develop understanding about patent process.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Classify** various methods to solve research problem.	Apply
CO2	**Construct** a research problem in respective engineering domain.	Apply
CO3	**Investigate** various data analysis techniques for a research problem.	Analyze
CO4	**Identify** various Intellectual Property Rights procedures	Apply

Module	**Module Contents**	**Hours**
I	**Research Fundamentals** What is research, types of research, the process of research, Literature survey and review , Formulation of a research problem.	4
II	**Research Methods** Research design- Meaning, Need and Types , Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment	5
III	**Analysis Techniques** Quantitative Techniques, Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation, Uni-variate and bi-variate analysis of data, testing of hypotheses, t-test, Z-test, chi-square test, anova test.	5
IV	**Research Communication** Writing a conference paper, Journal Paper, Technical report, dissertation/thesis writing. Presentation techniques, software used for report writing such as WORD, Latex etc. Types of journal/conference papers	4

V	**Intellectual Property Rights** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	5
VI	**Patents and Patenting Procedures** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Text Books	
1	C. R. Kothari, Research Methodology, New Age international
2	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi

References	
1	E. Philip and Derek Pugh, How to get a Ph. D. – a handbook for students and their supervisors, open university press
2	Stuart Melville and Wayne Goddard, Research Methodology: An Introduction for Science & Engineering Students

Useful Links	
1	NPTEL Lectures

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		1												
CO2					2	2									
CO3				2											
CO4		2													

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	20
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	50

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2022-23					
Course Information					
Programme	M.Tech. (Electronics Engineering)				
Class, Semester	First Year M.Tech., Sem I				
Course Code	6EN502				
Course Name	Advanced Digital Signal Processing				
Desired Requisites:	Signals and Systems, Digital Signal Processing				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives	
1	To illustrate the concepts of Advanced Signal Processing
2	To explain the different techniques for design of filters and multirate systems
3	To enable the students for the design and development of Adaptive DSP systems

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Explain the basic and advanced signal processing concepts	Discuss
CO2	Design FIR and IIR filters with given specifications	Design, Solve
CO3	Analyse the various algorithms related with multi-rate DSP	Analyze
CO4	Illustrate adaptive signal processing algorithms	Demonstrate

Module	Module Contents	Hours
I	**Review of Digital Signal Processing** Discrete Time Signals and systems, LTI Systems, Basic Signal Processing Operations, Discrete Time Systems-Classification, impulse and step responses, phase and group delays. Time domain and frequency domain characterization of LTI discrete time systems, Z Transform, Transfer function	8
II	**DSP Structures** Block Diagram Representation, Equivalent Structures, Basic FIR Digital Filter Structures, Basic IIR Digital Filter Structures, All pass Filters, Tuneable IIR Digital Filters, IIR Tapped Cascaded Lattice Structures, FIR Cascaded Lattice Structures, Parallel All pass Realization of IIR Transfer Functions	6
III	**DFT Computation Techniques** DFT-Definition and properties, symmetry properties, Circular convolution, Computation of DFT, Decimation in time (DIT) and Decimation in Frequency (DIF) Fast Fourier transform (FFT) algorithms , Linear filtering using FFT- overlap add, overlap save methods, Goertzel Algorithm	6

IV	**Filter Design Technique** Bilinear Transformation Method of IIR Filter Design, Design of Low pass IIR Digital Filters, Design of High pass, Band pass and Band stop IIR Digital Filters, Spectral Transformations of IIR Filters, FIR Filter Design Based on Windowed series, Design of Digital Filters with Least-Mean-Square Error, Constrained Least-Square Design of FIR Digital Filters	8
V	**Multi-rate Signal Processing** The Basic Sample Rate Alteration Devices, Filters in Sampling Rate Alteration Systems, Multistage Design of Decimator and Interpolator, The Poly phase Decomposition, Arbitrary-Rate Sampling Rate Converter, Digital Filters Banks, Two-Channel Quadrature-Mirror Filter bank	6
VI	**Introduction to adaptive signal processing** Introduction to Adaptive Filters, Steepest descent technique, LMS algorithm-Convergence analysis, Learning curve, SVD	6

Text Books	
1	Sanjit K. Mitra, "Digital Signal Processing – A Computer based approach", Tata McGraw-Hill, 4th Edition , 2013
2	Bernard Widrow, Samuel D. Stearns "Adaptive Signal Processing,", Prentice-Hall, Englewood Cli, NJ, 1985
References	
1	J. G. Proakis, Dimitris K Manolakis, "Advanced Digital Signal Processing Principals, Algorithms and Applications,", Pearson,2007
Useful Links	
1	NPTEL Lectures

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2												
CO2						1									
CO3				2											
CO4															

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE, ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem. I
Course Code	6EN503
Course Name	Embedded System Design
Desired Requisites:	Microprocessors / Microcontrollers, Computer Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	Understand ARM processor core architecture with several features of peripherals available on various embedded Cortex- M processors
2	Understand interrupts and its programming with peripherals
3	Develop small embedded system by using the ARM processor core based systems and application software for it.
4	Use EDA tools to design embedded system.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Illustrate** Cortex M3 / M4 processor architecture and its features	Understand
CO2	**Apply** programming skills to develop algorithm for peripherals and interrupts	Apply
CO3	**Develop** embedded system software.	Create
CO4	**Design** and develop embedded systems based applications	Create

Module	**Module Contents**	**Hours**
I	**ARM Cortex –M Architecture and Programming** ARM Cortex M3 / M4 Architecture, Registers, CPU status, Clock generation, Memory organization, Instruction Set, Programming model – Registers, Operation Modes, Embedded C Programming	6
II	**Cortex M CPU Interrupts** Nested Vectored Interrupt Controller (NVIC), Vector table, Interrupt priorities, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency, Start-up files, initialization of peripherals interrupts, Interrupt routines programming	8
III	**ARM Peripherals and Programming** On chip peripherals, GPIO, RTC, Watchdog, ADC, DAC, Timer, PWM, Memory, DMA programming, External Peripheral Interfacings and their programming.	8
IV	**Communication and Programming** Communication Peripherals: UART, I2C, I2S, and SPI , CAN BUS programming, LIN bus programming, Drivers for serial port communication	8
V	**Algorithm Designing and Debugging**	6

	State Machine based Embedded Programming, Writing initialisation programs, Debugging techniques, Debugging with JTAG, Debugging with UART port, open source tools for software development	
VI	**Embedded System Implementation** Development Environment, Debugging Techniques, Designing, Manufacturing and Testing steps and issues.	4
Text Books		
1	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes; 3rd edition	
2	Frank Vahid and Tony Givargis, "Embedded System Design", Wiley	
3	Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC	
References		
1	Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication	
2	Steve furber, "ARM System-on-Chip Architecture", Pearson Education	
3	Frank Vahid and Tony Givargis, "Embedded System Design", Wiley	
4	Technical references and user manuals of respective controller	
Useful Links		
1	https://nptel.ac.in/	
2	https://in.coursera.org/	
3	https://www.ti.com/	
4	https://www.nxp.com/	
5	https://www.arm.com/	

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1	2					
CO2	2					
CO3				2		2
CO4			2			2
1:Low, 2:Medium, 3:High						

Assessment
The assessment is based on MSE, ISE, ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem. I
Course Code	6EN546
Course Name	Embedded System Design Lab
Desired Requisites:	Microprocessors / Microcontrollers, Computer programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./week	-			
Interaction	-	**Credits: 1**			

Course Objectives

1	To use ARM Cortex M3 / M4 controller architecture and its features
2	To learn ARM Cortex –M Architecture and Programming
3	Write, simulate, download and test C programs for ARM Cortex M3 / M4 processor
4	Develop a program for implementing given or required system operation.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Apply** programming skills to integrate hardware peripherals of ARM Cortex M3 / M4 based controller	**Apply**
CO2	**Debug** programs for ARM Cortex M3 / M4 based controller	**Analyze**
CO3	**Develop** small embedded systems using ARM C programming and hardware peripherals for ARM Cortex M3 / M4 based controller	**Design**
CO4	**Demonstrate** the developed embedded system	**Create**

List of Experiments / Lab Activities

List of Experiments:
1. Experiment 1 : Introduction of the development tools and kit
2. Experiment 2 : Simple assembly language, embedded C program and study of startup.s file
3. Experiment 3 : GPIO Programming
4. Experiment 4 : Interrupt programming
5. Experiment 5 : Programming Timer as Timer and Timer as Counter
6. Experiment 6 : Programming PWM and application of it
7. Experiment 7 : Programming ADC and DAC
8. Experiment 8 : Programming UART
9. Experiment 9 : Programming RTC and WDT
10. Experiment 10 : Programming demonstration SPI, I2C, CAN bus Protocol
11. Experiment 11 : Programming for interfaces like LCD, DC Motor, DHT22 Sensor
12. Experiment 12 : Hands-on / Demonstration : Temperature sensing unit / Light sensing unit
13. Experiment 13 : Demonstration : Embedded Artificial Intelligence Design
14. Mini-Projects and Demonstration

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	Marks Submission at the end of Week 6	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Text Books

1	Joseph Yiu, “The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors”, Newnes; 3rd edition
2	Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
3	Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C”, E-Man Press LLC

References

1	Sloss Andrew N, Symes Dominic, Wright Chris, “ARM System Developer's Guide: Designing and Optimizing”, Morgan Kaufman Publication
2	Steve furber, “ARM System-on-Chip Architecture”, Pearson Education
3	Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
4	Technical references and user manuals of respective controller

Useful Links

1	https://nptel.ac.in/
2	https://in.coursera.org/
3	https://www.ti.com/
4	https://www.nxp.com/
5	https://www.arm.com/

CO-PO Mapping

Programme Outcomes (PO)						
	1	**2**	**3**	**4**	**5**	**6**
CO1	2					
CO2				2		
CO3					2	2
CO4					2	2

1: Low, 2: Medium, 3: High

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6EN545
Course Name	Advanced Digital Signal Processing Lab
Desired Requisites:	Digital Signal Processing

Teaching Scheme (Hrs)		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.
2	
3	

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Apply signal processing to various areas such as speech and	Applying
CO2	audio processing, image processing, biomedical signal processing, array signal processing etc.	Creating
CO3	Design digital filters to suit specific requirements for specific applications	Creating

List of Experiments / Lab Activities

List of Experiments:

Experiments using MATLAB :

1. Generation and analysis of different signals in time and frequency domains.
2. Study and applications of different transforms
3. Design of Digital Filter: IIR, FIR.
4. Design of multi rate signal system
5. Introduction to DSK 6713 kit and CCS environment
6. Study of input/output, architecture of C6x processor
7. Digital filter design using DSK 6713
8. Implementation of DSP applications using DSK 6713

Text Books

1	Sanjit K. Mitra, “Digital Signal Processing – A Computer based approach”, Tata McGraw-Hill, 4th Edition , 2013
2	Bernard Widrow, Samuel D. Stearns “Adaptive Signal Processing,”, Prentice-Hall, Englewood Cli, NJ, 1985
3	
References	
1	J. G. Proakis, Dimitris K Manolakis, “Advanced Digital Signal Processing Principals, Algorithms and Applications,”, Pearson,2007
2	User manual of TMS320C6713
3	
Useful Links	
1	
2	
3	
4	

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6									
CO1			2												
CO2				2											
CO3						2									
1:Low, 2:Medium, 3:High															

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2022-23					
Course Information					
Programme	M.Tech. (Electronics Engineering)				
Class, Semester	First Year M.Tech., Sem I				
Course Code	6EN511				
Course Name	Professional Elective 1-Embedded Linux Programming				
Desired Requisites:	Nil				
Teaching Scheme	**Examination Scheme (Marks)**				
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives	
1	To make students familiar with installation and use of the embedded Linux operating system
2	To facilitate the students to learn the fundamentals of Linux as applied to embedded hardware
3	To give exposure to system design using embedded Linux as per the industry trends

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Apply the understanding of Linux OS for Linux administration	Apply
CO2	Write, compile, debug multi-file, multi-threaded programs under Linux using utilities like make, gdb etc.	Evaluate
CO3	Write programs for peripherals such as GPIO/Keyboard/ Serial port using EL board such as Raspberry pi	Apply

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction to Linux, Linux Distributions, Open source Software, GPL, Facilities in Embedded Linux Boards used in Industry/Market, Important Accessories of Linux boards available/used in industry, Care to take in handling the Linux boards, Development Setup for EL, OS installation, init process, initrd, boot loaders, lilo and GRUB boot loaders, Case studies of Embedded Linux Based Systems	5

II	**Linux file system and commands** Linux File System, Permissions, CLI and Linux Shells, Linux Commands, Linux concepts, Shell Script, Basic Linux system administration tasks on the RPi. Linux commands for file and process management. Linux Programming, Multi-file C programming Using make utility, Makefile, GNU debugger. Transferring Files Between Systems**,** Kernel, building kernel image	7
III	**Multithreading and Hardware Access** Threads and processes, Multithreaded C programming. EL hardware design issues, Logic-level translation circuitry. Case studies of hardware of frequently used interfaces, Communication with EL board through network, EL GPIO control using sysfs, wiringPi and python. Python libraries	7
IV	**Hardware Interfacing and Programming-I** Using onboard I2C, SPI, and UART capabilities. Circuits to the RPi that interface to its I2C bus, Linux I2C-tools. Communicate between UART devices using both Linux tools and custom C or Python code. Interface to sensors using a serial communication protocol.	7
V	**Hardware Interfacing and Programming-II** Using Interrupt functionality on devices. Increasing the number of available serial UART devices on the RPi using low-cost USB-to-TTL devices. USB Bluetooth adapter for the RPi and connect to it from a mobile device for the purpose of building a basic remote-control application. Using Wi-Fi and Xigbee along with EL board.	7
VI	**Basic Image Processing on Embedded Linux** Camera interfacing to EL board, Capture image and video uing OpenCV to perform basic image processing on the RPi. Use OpenCV to perform a computer vision face-detection task.	6

Text Books	
1	Christopher Hallinan, *"Embedded Linux Primer: A Practical Real-World Approach",* Prentice Hall; 1st edition (September 28, 2006), ISBN 978-0137017836
2	Richard Stones, Neil Matthew, *"Beginning Linux Programming"*, Wiley; Fourth edition (2008)
3	Felix Alvaro, "LINUX: Easy Linux For Beginners", Amazon.com
References	
1	P. Raghavan, Amol Lad, Sriram Neelakandan, *"Embedded Linux System Design and Development",* Auerbach Publications; 1 edition (December 21, 2005), ISBN: 978-0849340581 http://crashcourse.ca/introduction-Linux-kernel-programming-2nd-edition
2	http://crashcourse.ca/introduction-Linux-kernel-programming-2nd-edition
	Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, Philippe Gerum, "Building Embedded Linux Systems", O'Reilly Media; Second Edition (August 22, 2008) ISBN: 978-0596529680
Useful Links	
1	
CO-PO Mapping	
	Programme Outcomes (PO)

	1	2	3	4	5	6								
CO1			2											
CO2				2										
CO3						2								
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.														

Assessment
The assessment is based on MSE, ISE, ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year B. Tech., Sem II
Course Code	6EN512
Course Name	Professional Elective 1 : Optical Communication
Desired Requisites:	Communication Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives

1	To understand the different kind of losses, signal distortion in optical wave guides and other signal Degradation factors. Design optimization of SM fibers, RI profile and cut-off wave length.
2	To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
3	To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
4	To learn fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Relate light waves into small optical components with high precision	Remember
CO2	Determine the attenuation and signal degradation due to intermodal and intramodal distortion	Evaluate
CO3	Determine power coupling losses due to connectors, splices, source output pattern and fiber numerical aperture	Evaluate
CO4	Identify the modes in step index fiber and graded index fiber	Apply

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction**,** Ray theory transmission, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Electromagnetic mode theory of optical propagation, EM waves, modes in Planar guide, phase and group velocity, cylindrical fibers, SM fibers.	6

II	**Transmission characteristics of optical fibers:** Attenuation, Material absorption losses in silica glass fibers, Linear and Non linear Scattering losses, Fiber Bend losses, Midband and farband infra red transmission, Intra and inter Modal Dispersion, Over all Fiber Dispersion, Polarization, non linear Phenomena. Optical fiber connectors**,** Fiber alignment and Joint Losses, Fiber Splices, Fiber connectors, Expanded Beam Connectors	6
III	**Optical Sources :** Semiconductor Physics background, Light emitting diode (LEDs)- structures, materials, Figure of merits, characteristics & Modulation. Laser Diodes -Modes & threshold conditions, Diode Rate equations, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, Spectral width , temperature effects, and Light source linearity.	4
IV	**Optical Detectors**: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance, Photo detector noise -Noise sources , Signal to Noise ratio , Detector response time	4
V	**Transmission Systems :** Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation.	3
VI	**Optical Receiver Operation :** Receiver operation, Preamplifier types, receiver performance and sensitivity, Eye diagrams, Coherent detection, Specification of receivers	3

Text Books	
1	Gerd Keiser, “Optical Fiber Communications”, 4th Edition , Tata Mc Graw Hill , 2013, ISBN: 9781259006876
2	Jamro, M. Yousif, and Senior, John M.. Optical Fiber Communications: Principles and Practice. United Kingdom, Financial Times/Prentice Hall, 2009, ISBN: 9780130326812
3	
4	
References	
1	Singal, T. L.. “Optical Fiber Communications: Principles and Applications”, India, Cambridge University Press, 2016, ISBN: 9781316610046
2	Agrawal, Govind P.. Fiber-Optic Communication Systems. Germany, Wiley, 2012, ISBN: 9780470922828,
3	
4	
Useful Links	
1	http://nptel.ac.in/
2	
3	
4	
Assessment	

The assessment is based on MSE, ISE, ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6EN551
Course Name	Professional Elective 1 Lab -Embedded Linux Lab
Desired Requisites:	Basic Computer Programming, Embedded System Design

Teaching Scheme (Hrs)		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To facilitate the students to learn the fundamentals of Linux.
2	To learn system Architecture, configuration and Programming for Embedded Linux Based System.
3	To facilitate the complete a mini-project involving embedded Linux hardware control/access industrial problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Write programs using Linux operating systems**.**	*Apply*
CO2	Write programs / scripts to configure and use internal / external peripherals of Embedded Linux Boards	*Apply*
CO3	Develop and Demonstrate small Embedded Linux based system	*Create*

List of Experiments / Lab Activities

List of Experiments:

Experiments to revise an Embedded System Design
Experiment to study Linux distribution installation, configuration and basic commands of it.
Experiment to study Linux distribution installation, configuration for an Embedded Linux Board.
Experiment to configure and use network setup of an Embedded Linux Board
Experiment to access GPIO of an Embedded Linux Board to control components / devices interfaced to it.
Mini project implementation and demonstration.

Text Books

1	"Mastering Embedded Linux Programming", Second Edition, Chris Simmonds.
2	"Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux" first Edition, Derek Molloy
3	"Exploring Beagle Bone: Tools and Techniques for Building with Embedded Linux" Derek Molloy

References

1	https://www.engineersgarage.com/embedded-linux-tutorial-basics/

2	https://www.geeksforgeeks.org/web-technology/
3	https://www.w3schools.com/
Useful Links	
1	https://www.linux.org/
2	https://www.raspberrypi.org/
3	https://www.raspberrypi.com/
4	https://www.coursera.org/

CO-PO Mapping															
	Programme Outcomes (PO)														
	1	2	3	4	5	6									
CO1			2												
CO2				2											
CO3						2									
1:Low, 2:Medium, 3:High															

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First M. Tech., Sem I
Course Code	6EN552
Course Name	Professional Elective 1 - Optical Communication Lab
Desired Requisites:	Communication Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/Week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2	To understand the different kind of losses, signal distortion, SM fibers.
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber	
CO2	Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers	
CO3		
CO4		

List of Experiments / Lab Activities

List of Experiments :

1. Measurement of numerical aperture of a fiber after preparing the fiber ends.
2. Study of losses in optical fiber
3. Setting up of fiber optic digital link
4. Preparation of splice joint and measurement of splice loss
5. Power vs. current (P-I) characteristics and measure slope efficiency of laser diode.
6. Voltage vs. current(V-I) characteristics of laser diode
7. Power vs. current (P-I)characteristics and measure slope efficiency of
8. Voltage vs. current(V-I) characteristics of LED
9. Characteristics of photodiode and measure the responsivity
10. Characteristics of avalanche photodiode [APD] and measure the responsivity.

Text Books

1	Gerd Keiser, “Optical Fiber Communications”, 4th Edition , Tata Mc Graw Hill , 2013, ISBN: 9781259006876
2	Jamro, M. Yousif, and Senior, John M.. Optical Fiber Communications: Principles and Practice. United Kingdom, Financial Times/Prentice Hall, 2009, ISBN: 9780130326812
3	
4	

References	
1	Singal, T. L.. “Optical Fiber Communications: Principles and Applications”, India, Cambridge University Press, 2016, ISBN: 9781316610046
2	Agrawal, Govind P.. Fiber-Optic Communication Systems. Germany, Wiley, 2012, ISBN: 9780470922828,
3	
4	

Useful Links	
1	http://nptel.ac.in/
2	
3	
4	

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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Course Information

Programme	MTech. (Electronics engineering)
Class, Semester	First Year MTech., Sem I
Course Code	6EN514
Course Name	Professional Elective 2 : Digital VLSI Design
Desired Requisites:	Digital Techniques

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	60	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To explain the relevance of CMOS technology in implementing digital circuits
2	To discuss in details various logic styles (static, dynamic) in implementing CMOS circuits and the effect of choosing a particular style on device performance from delay, power and area point of view.
3	To develop the architectures of few data-path designs (system building blocks) and an insight into extracting the functionality of displayed CMOS circuit
4	To motivate the students to develop lifelong/self-learning attitude

Course Outcomes (CO) with Bloom's Taxonomy Level

After the completion of the course the student should be able to

CO1	**Apply** the analytical expressions involving physical parameters, process parameters and electrical parameters to characterize the MOS transistors	Illustrate
CO2	**Analyze** static CMOS circuits numerically to compute the various device parameters and circuit performance parameters.	Develop
CO3	**Analyze** dynamic CMOS circuits numerically to compute the various device parameters and circuit performance parameters	Analyze
CO4	**Select** an appropriate logic style to design submicron MOS transistor based circuits using logical, analytical and computational skills.	Design

Module	**Module Contents**	**Hours**
I	**MOS Transistor** MOS transistor theory, MOS under static conditions, Secondary effects, Technology Scaling	4
II	**CMOS Inverter** CMOS inverter, Static and Dynamic behaviour of CMOS inverter, Power and Energy-Delay, Impact of technology scaling on inverter	6
III	**Combinational Static Logic Design** Combinational static logic designs in CMOS, CMOS (Inverter and Complex gates), pseudo-nmos, pass-transistor logic, transmission gate logic and design aspects for optimizing the performance	8

IV	**Combinational Dynamic Logic Design** Combinational dynamic logic designs using pre-charge evaluate logic, domino logic, np-CMOS logic , design aspects for optimizing the performance, Comparison of static and dynamic designs	
V	**Sequential Logic Design** Timing metrics of sequential circuits, Sequential logic designs in CMOS, Static and dynamic latches and registers	8
VI	**Timing Issues in Digital Circuits** Timing Classification, Synchronous Design (Clock skew, Jitter, Clock Distribution), Self-Timed Circuits Design, Synchronizers and arbiters, Using PLL for clock synchronization	7

Text Books	
1	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "*Digital Integrated Circuits, A System Perspective*", Pearson Education, Second Edition, First Indian Reprint, 2003.
2	Neil Weste, Kamran Eshraghian "*Principles of CMOS VLSI Design*", Addison Wesley/Pearson Education, 2010
References	
1	Kamran Eshraghian, Pucknell and Eshraghian "*Essentials of VLSI Circuits and Systems*", , Prentice-Hall (India), 2008
2	Sung-Mo Kang, Yusuf Leblebici "*CMOS Digital Integrated Circuits: Analysis and Design*", McGraw Hill Education (India), Third Edition, 2003
3	Neil Weste, David Harris, Ayan Banerjee "*CMOS VLSI Design*", Pearson Education, 2008
Useful Links	
1	NPTEL Lectures

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				2											
CO2						1									
CO3						1									
CO4			2												

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE, ESE.MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage onmodules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	6EN513
Course Name	PE 2- Mobile Communication
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	60	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives	
1	To introduce the concepts and techniques associated with Wireless Cellular Communication systems.
2	To familiarize with state of art standards used in wireless cellular systems.
3	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Apply fundamentals of cellular system design to improve performance of cellular network	Apply
CO2	Distinguish between different multiple access technology	Analyze
CO3	Study evolution of mobile communication generation standards	Analyze
CO4	Analyze the different internetworking challenges to provide solutions in wireless mobile networks.	Analyze

Module	**Module Contents**	
I	**The Cellular Concept** – System Design Fundamentals Introduction of Cells, Channel Reuse, SIR Calculations, Traffic Handling Capacity: Erlang Performance, Cellular system design, Co channel interference ratio, Co channel interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment, concepts of cell splitting, handover in cellular system.	**5**
II	**Multiple Access Technologies**- Frequency Division Multiple access (FDMA), Time Division Multiple access (TDMA), Code Division Multiple access (CDMA), spectral efficiency calculations, comparison of T/F/CDMA technologies based on their signal separation techniques, advantages, disadvantages and application areas.	**3**

III	**GSM Architecture and Interfaces** -Introduction to GSM subsystems, GSM Interfaces, GSM architecture, details of following blocks in GSM (Mobile station, Base station systems, Switching subsystems, Home location registers, Visiting location registers, Equipment identity register, Echo canceller), Mapping of GSM layers onto OSI layers, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM. Mobile Management: Handoff, Location and Paging, Evolution of mobile technologies 1G to 4G.	**5**
IV	**Overview of 5G technology**- An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G, Channel modeling requirements, Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM)	**4**
V	**Mobile Ad-hoc Network (MANET)**- Introduction, properties, applications, architecture, routing in MANET, proactive and reactive routing protocols, hybrid protocol	**4**
VI	**Mobile Security** - Introduction, security in wireless network, information security, security techniques and algorithms, Security protocols.	**5**

1	T.S.Rappaport,"Wireless Communications Principles and Practice", II Ed. PHI, Publications, 1995
2	Prashant Kumar Patra, Sanjit Kumar Dash, "Mobile Computing", 2nd Edition, Scitech, 2014
3	V.K.Garg, J.E.Wilkes, "Principle and Application of GSM" Pearson Education, 1999.

References

1	William C. Y. Lee, "Mobile Communication Engineering: Theory and Applications",2nd Edition, McGraw Hill Publication, 1997
2	Mischa Schwartz, "Mobile Wireless Communication", 1st Edition, Cambridge University Press, 2009.
3	

Useful Links

1	https://www.coursera.org/
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)													
	1	2	3	4	5	6								
CO1		2												
CO2			2										2	
CO3		2				2								
CO4			1										2	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE, ESE.MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage onmodules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	MTech. (Electronics engineering)
Class, Semester	First Year MTech., Sem I
Course Code	6EN554
Course Name	Professional Elective 2 : Digital VLSI Design Laboratory
Desired Requisites:	Digital Techniques

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week	Nil			
Interaction	-	**Credits: 2**			

Course Objectives

1	Demonstrate the use of EDA tools for designing digital circuits
2	Demonstrate Cadence flow (Schematic entry to simulation) for implementing CMOS digital circuits
3	Prepare the students for executing an individual or group problem of medium complexity
4	To explain the relevance of CMOS technology in implementing digital circuits

Course Outcomes (CO) with Bloom's Taxonomy Level

After the completion of the course the student should be able to

CO1	Design and Simulate MOSFET circuits using Cadence tools	Illustrate
CO2	Design and Simulate CMOS circuits using Cadence tools	Develop
CO3	Formulate a research a problem, design, build and simulate either a researched problem or assigned by the supervisor in Digital VLSI Design area independently.	Create

List of Experiments / Lab Activities

A: Using cadence Design Tools:
1. NMOS and PMOS characterization
2. Implementation of CMOS inverter and its characterization for VTC and power
3. Implementation of 2-inpout NAND and NOR
. Finding out rise time, fall time of the output and propagation
4. Implementation of 1-bit full adder using carry-out of the stage to drive the sum output (28 transistor implementation)
5. Implementation of 2-input NAND and NOR gates using different logic styles and compare the performance parameters with complementary CMOS logic style a. Pseudo logic style b. Pass Transistor logic style c. Transmission gate logic style d. Differential cascade voltage switch logic e. Dynamic (pre-charge and evaluate) logic style
6. Implementation of transmission gate based full adder circuit
7. Implementation of four bit Manchester carry chain
8. Implementation of 4-bit barrel shifter using pass transistors

B. Task/miniproject/research problem: For the last lab session which students will have to carry out a task for a period of at least six weeks it is recommended that: 1. Student can search or teacher can assign a course related medium complexity task to a group of student not exceeding two by defining the problem statement suitably

Text Books	
1	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "*Digital Integrated Circuits, A System Perspective*", Pearson Education, Second Edition, First Indian Reprint, 2003.
2	Neil Weste, Kamran Eshraghian "*Principles of CMOS VLSI Design*", Addison Wesley/Pearson Education, 2010
References	
1	Kamran Eshraghian, Pucknell and Eshraghian "*Essentials of VLSI Circuits and Systems*", , Prentice-Hall (India), 2008
2	Sung-Mo Kang, Yusuf Leblebici "*CMOS Digital Integrated Circuits: Analysis and Design*", McGraw Hill Education (India), Third Edition, 2003
3	Neil Weste, David Harris, Ayan Banerjee "*CMOS VLSI Design*", Pearson Education, 2008
Useful Links	
1	NPTEL Lectures

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				2											
CO2						1									
CO3						1									
CO4			2												

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First B. Tech., Sem I
Course Code	6EN553
Course Name	Professional Elective 2 - Mobile Communication Engineering Lab
Desired Requisites:	Communication Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	3 Hrs/Week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To introduce the concepts and techniques associated with Wireless Cellular Communication systems
2	To familiarize with state of art standards used in wireless cellular systems.
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Analyze the performance of different mobile generation standards in terms of different performance measure	Analyse
CO2	Estimate the performance of different mobile ad-hoc networks and security standards	Evaluate
CO3		
CO4		

List of Experiments / Lab Activities

List of Experiments :

1. Study of GSM system
2. Understanding 3G communication system
3. Understanding 4G/ LTE communication system.
3. Introduction to NetSim
4. Modeling and Simulation of simple network using NetSim
5. Study of GSM network for different performance measure parameters
6. Study how the throughput of LTE network varies as distance between ENB and UB varies.
7. Study how the throughput of LTE network varies as the channel bandwidth changes.
8. Analysis of LTE handover
9. Analyzing the performance of MANET

Text Books

1	T.S.Rappaport,"Wireless Communications Principles and Practice", II Ed. PHI, Publications, 2010.
2	Prashant Kumar Patra, Sanjit Kumar Dash, "Mobile Computing", 2nd Edition, Scitech.2013.
3	V.K.Garg, J.E.Wilkes, "Principle and Application of GSM" Pearson Education, 2007
4	
References	
1	William C. Y. Lee, "Mobile Communication Engineering: Theory and Applications",2nd Edition, McGraw Hill Publication. 2014
2	Mischa Schwartz, "Mobile Wireless Communication", 1st Edition, Cambridge University Press, 2009.
3	NetSim online resources
4	
Useful Links	
1	
2	
3	
4	

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	6EN521
Course Name	Design and Analysis of Algorithm
Desired Requisites:	Data Structure and Algorithms

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	60	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To provide different algorithm approaches like static, dynamic, iterative and recursive techniques.
2	To explain Comparative features of algorithms on the basis of space, time computational complexities,
3	To explain the selection criteria for identifying, formulating and applying a typical algorithm for given problem.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Interpret different algorithm approaches like static, dynamic, iterative and recursive techniques.	Apply
CO2	Compare the different algorithms on the basis of space, time computational complexities	Analyze
CO3	Identify the optimum algorithm for given problem.	Analyze
CO4	Explore and learn about categories of problems	Analyze

Module	**Module Contents**	
I	**Introduction-** Static and dynamic structures, stacks, queues, dynamic memory allocation and pointers, linked stacks and queues, trees and recursion, Hashing:- Sparse-table, hash function, collision resolution with open addressing and collision resolution by chaining	**4**
II	**Searching and Sorting Algorithms -**Sequential search, Binary search, Comparison of trees, Insertion sort, Selection sort (Heap sort), Shell sort. Computational Complexity, lower bound, & comparison of searching and sorting algorithm	**4**
III	**Divide and Conquer -**Merge sort, quick sort (portioning), Matrix multiplication algorithm, Limitation of divide and conquer. Computational complexity of divide and conquer algorithms.	**4**

IV	**Dynamic Programming & Greedy Approach-** Binomial Coefficients, Floyd's algorithm for shortest path, Chain matrix multiplication, optimal binary search trees and the traveling salesperson problem, Dynamic programming approach to 0-1 knapsack problem, Minimum spanning traces algorithms and their Comparison.	**5**
V	**Back Tracking & Branch and Bound-**Back tracking techniques, the n-queens problem, Back tracking algorithm's efficiency using Monte Carlo algorithm. Graph coloring, the Hamiltomnian circuits' problem. Backtracking Algorithm for 0-1 Knapsack problem and its comparison	**5**
VI	**Theory of NP** -The three general categories of problems. The sets P & NP. NP complete problems, NP-Hard, NP-easy, NP – Equivalent problems, NP Hard problems	**4**

1	"Fundamentals of Computer Algorithms", Ellis Horowitz, Sartaj Sahani, Sangutherar Rajasekaran., Galgotia Pubication Ltd, 2010
2	"Design and Analysis of Algorithms", I. Chandra Mohan, PHI Publication, 20127
3	"Analysis of Computer Algorithms", Horowitz and Sahni, Galgotia Publishers., 200

References

1	Foundation of Algorithms", Richard E. Neapolita & Kumarss Naimipour (Northeastern Illinois University), D.C. Heath and Company, Publication, 1996.
2	"Data Structures and Program Design in C", Robert L. Kruse & Brunce P. Leung et. Al, PHI Publication, 1984.
3	"Introduction to Algorithms" Coremn, Leiserson, Rivest, PHI Publication, 2012.

Useful Links

1	https://www.coursera.org/
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6							1	2
CO1		1												
CO2	2													2
CO3		2				2								

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE, ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	6EN522
Course Name	Wireless Sensor Networks and IoT
Desired Requisites:	None

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To explain the Wireless Sensor Network and its applications
2	To develop understanding of the Sensor node architecture
3	To understand WSN connectivity with Internet
4	To compare various MAC protocols for Wireless Sensor Network
5	To explain in a concise manner how the general Internet as well as Internet of Things work.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Identify** various challenges and applications of Wireless Sensor Network	Apply
CO2	**Develop** knowledge about Wireless Sensor Network Architecture	Apply
CO3	**Investigate** various MAC protocols for Wireless Sensor Networks	Analyze
CO4	**Explore** and learn about Internet of Things and Cloud	Apply

Module	**Module Contents**	**Hours**
I	**Module 1 : Introduction of WSN** Overview of Wireless Sensor Networks, Applications and Challenges, Mobile ad hoc networks and wireless sensor networks	4
II	**Module 2 Wireless Sensor Node Architecture** Hardware components, Energy consumption , Operating systems and execution environments , examples of sensor nodes	5
III	**Module 3 Wireless Sensor Network Architecture** Types of sources and sinks, Optimization Goals and Figures of Merit, Design principles for WSNs, Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling	5
IV	**Module:4 WSN (Medium access control)** Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC – BMAC, Traffic-adaptive medium access protocol (TRAMA), The IEEE 802.15.4 MAC protocol.	5
V	**Module 5 IoT** IoT definitions: overview, applications, potential & challenges, and architecture. M2M Protocols for Sensor Networks. IoT CASE Study.	5

VI	**Module 6 Cloud and SDN** Introduction to Cloud Computing including benefits, challenges, and risks Cloud Computing Models. SDN: Introduce software defined networking: the background, the development, and the challenges.	4
Text Books		
1	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks Technology Protocols and Applications", John Wiley & Sons Inc. Publication ,2007	
2	"Internet of Things Applications and Protocols ", Wiely publication 2nd Ed.	
References		
1	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols" ,CRC Press, August 2003	
2	Akyildiz, Mehmet Can Vuran**,"**Wireless Sensor Networks" ,John Wiley & Sons Ltd. 2010	
3	William Stallings "Foundations of Modern Networking : SDN, NFV, QoE, IoT and Cloud" Pearson Education	
Useful Links		
1	https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/	
2	https://onlinecourses.nptel.ac.in/noc21_cs17/preview	

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2	3											
CO2				1		3									
CO3			3			2									
CO4				2		2									

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE, ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	6EN591
Course Name	Design and Analysis of Algorithm Laboratory
Desired Requisites:	Data Structure and Algorithms

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To provide different algorithm approaches like static, dynamic, iterative and recursive techniques.
2	To explain Comparative features of algorithms on the basis of space, time computational complexities,
3	To explain the selection criteria for identifying, formulating and applying a typical algorithm for given problem.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Interpret different algorithm approaches like static, dynamic, iterative and recursive techniques.	Apply
CO2	Compare the different algorithms on the basis of space, time computational complexities	Analyze
CO3	Identify the optimum algorithm for given problem.	Analyze
CO4		

List of Experiments / Lab Activities/Topics

Experiment List:	
Quick sort	Graph traversals
Merge sort	Sum of sub sets problem
Warshall's algorithm	Travelling sales person problem
Knapsack problem	Minimum cost spanning tree
Shortest paths algorithm	All pairs shortest paths
Minimum cost spanning tree	N queens problem
Tree travesrsals	

1	"Fundamentals of Computer Algorithms", Ellis Horowitz, Sartaj Sahani, Sangutherar Rajasekaran., Galgotia Pubication Ltd, 2010
2	"Design and Analysis of Algorithms", I. Chandra Mohan, PHI Publication, 20127
3	"Analysis of Computer Algorithms", Horowitz and Sahni, Galgotia Publishers., 200

References	
1	Foundation of Algorithms", Richard E. Neapolita & Kumarss Naimipour (Northeastern Illinois University), D.C. Heath and Company, Publication, 1996.
2	"Data Structures and Program Design in C", Robert L. Kruse & Brunce P. Leung et. Al, PHI Publication, 1984.
3	"Introduction to Algorithms" Coremn, Leiserson, Rivest, PHI Publication, 2012.
Useful Links	
1	https://www.coursera.org/
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6							1	2
CO1		1												
CO2	2													2
CO3		2				2								

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE, ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)The assessment is based on 2 in-semester evaluations (ISE) of 10 marks each, 1 mid-sem examination (MSE) of 30 marks and 1 end-sem examination (ESE) of 50 marks.

MSE is based on the modules taught till MSE (typically Module 1-3) and ESE is based on all modules with 30-40% weightage on modules before MSE and 60-70% weightage on modules after MSE.

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	6EN592
Course Name	Wireless Sensor Networks and IoT Lab
Desired Requisites:	None

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week	Nil			
Interaction	-	**Credits: 1**			

Course Objectives

1	To understand the Product Development Process through Mini Project.
2	To understand budgeting through Mini project
3	To use Wireless Sensor Network protocols
4	To learn IoT sensors interfacing
5	To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Identify** various challenges and applications of Wireless Sensor Network	Apply
CO2	**Develop** knowledge about Wireless Sensor Network Architecture	Apply
CO3	**Investigate** various MAC protocols for Wireless Sensor Networks	Analyze
CO4	**Explore** and learn about Internet of Things and Cloud	Apply

List of Experiments / Lab Activities/Topics

Experiments based on :

WSN simulations in cisco packet tracer /Netsim

1. Network Implementation in Cisco Packet tracer involving switch, router and gateway
2. Wireless Sensor Network Implementation in Cisco Packet tracer
3. Temperature, humidity and pressure detection using WSN sensors
4. Level detection using WSN sensors
5. Distance /Proximity detection using WSN sensors
6. Smoke/fire detection using WSN sensors
7. Hardware Mini project based on above list

Text Books	
1	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks Technology Protocols and Applications", John Wiley & Sons Inc. Publication ,2007
2	"Internet of Things Applications and Protocols ", Wiely publication 2nd Ed.
References	
1	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols" ,CRC Press, August 2003
2	Akyildiz, Mehmet Can Vuran**,"**Wireless Sensor Networks" ,John Wiley & Sons Ltd. 2010
3	William Stallings "Foundations of Modern Networking : SDN, NFV, QoE, IoT and Cloud" Pearson Education
Useful Links	
1	https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/
2	https://onlinecourses.nptel.ac.in/noc21_cs17/preview

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2	3											
CO2				1		3									
CO3			3			2									
CO4				2		2									
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.															

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	6EN631
Course Name	Professional Elective 3 - Embedded Linux System Design
Desired Requisites:	Embedded Linux Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To facilitate students to learn the web technology on embedded Linux platform.
2	To help the students to design static and dynamic website for solving social problems using embedded Linux and web framework.
3	To help the students to develop embedded Linux based system

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Design** a website using a frontend, backend languages/ scripts and framework.	Understand
CO2	**Connect** embedded system with front end / back end using Embedded Linux	Apply
CO3	**Design** and **develop** web based solution for social problems using the Embedded Linux.	Create
CO4	**Implement** solution for social problems using the Embedded Linux.	Create

Module	**Module Contents**	**Hours**
I	**Introduction to web technology: -** Fundamentals of Web technology, Web server, Web Client, Server and client side scripting. Installation of Web server on EL boards and accessing them over intranet.	4
II	**Web Programming: -** Frontend design, using HTML and CSS, Backend design using PHP, Python, SQL; Using web server for static / dynamic content, Responsive site basics and design.	8
III	**Web Design Framework: -** PHP Frameworks Code igniter / Python Frameworks Flask, Basics of database and updating database directly from Embedded Linux based system, dynamic webpage for web based system.	8
IV	**System Configuration: -** Configure Network Setup & Remote access, Controlling GPIOs, Installing required packages / libraries, Interfacing various peripherals, Sensors, Camera etc. to Embedded Linux Board, accessing / handling hardware using Python.	8
V	**System Design: -** Design steps to implement system using Embedded Linux platform, Web based system design for real world problem, Introduction to device driver, architecture, types of it and programming example.	8
VI	**Applications: -** Case study on embedded Linux system design for web based Applications, IoT Applications, Image Processing based Applications.	4

Text Books	
1	Robin Nixon, *Learning PHP, MySQL & JavaScript*, O'Reilly publication, 4th Edition, 2015,ISBN: 9789352130153
2	Kogent Learning Solutions Inc, *Web Technologies: HTML, JAVASCRIPT, PHP*, Dreamtech Press(2009) ISBN: 978-8177229974
3	Carlos de la Guardia , "*Python Web Framework*", O'Reilly Media, Inc.
4	John Madieu, *"Linux Device Drivers Development",* Ed. 1 2017, ISBN: 9781785280009
References	
1	"Web Technology", https://www.geeksforgeeks.org/web-technology/#beginning
2	Dr. Sudip Misra, NPTEL Course: "Introduction to Internet of Things", IIT Kharagpur.
Useful Links	
1	https://www.edx.org/
2	https://www.udacity.com/
3	https://www.coursera.org/
4	https://www.kernel.org/
5	https://www.raspberrypi.org/

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1	2					
CO2	2					
CO3				2		2
CO4			2			2
1:Low, 2:Medium, 3:High						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	6EN632
Course Name	Professional Elective 3-Advanced Embedded Programming
Desired Requisites:	Embedded System Design

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	To illustrate Real Time operating system with multi-tasking
2	To illustrate task synchronization of various tasks
3	To develop student in latest Buses Like USB, Ethernet
4	To develop student to design GUI Applications

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Develop** RTOS concepts and multitasking to embedded systems	Apply
CO2	**Distinguish** RTOS based systems with Process Synchronization using semaphore, mutex , flags, messages etc.	Analyze
CO3	**Design** embedded GUI based system	Create

Module	**Module Contents**	**Hours**
I	**RTOS Programming:-** Need and Requirements of RTOS, Concept of Multitasking, Priority inversion, RTOS structure, TCB block design, Repetitive Timer Requirement, Memory Requirement for each Task	6
II	**RTOS Process Synchronization:-** System events and interrupts. Task synchronization with Flags, Semaphore, Mutex. Inter process communication with Messages queue/ Mail Box	6
III	**Multi core processors:-** Programming on Multi core processors, inter-core communication, interrupts handling, software architecture for multi core processors.	7
IV	**GUI and USB :-** Graphical Display Interface, Touch Screen Interface, Graphic Display drivers, GUI API calls for Windows, USB Programming**:** USB 2.0 specifications, USB block diagram, Device , Host Interface, concept of endpoint, Data transfer on USB bus	7
V	**Embedded Software Development Process and Tools** : Introduction, Host and Target machines, Getting embedded software into the target System, Issues in Hardware Software Design	6
VI	**Case study of Program Modelling and RTOS:** Design Examples, case Study of RTOS Applications	6

Text Books	
1	The Real-Time Kernel by Micrium
2	Real-time Operating Systems: Book 1 - The Theory (The engineering of real-time embedded systems) by Jim Cooling
3	Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers , Fifth Edition (Volume 1) by Jonathan W Valvano
References	
1	http://www2.keil.com/mdk5/cmsis/
2	User Guide and Reference Guide of LPC 2148, LPC 1768, STM32F7
3	www.usb.org › Developers › Documents
4	https://www.segger.com/
Useful Links	
1	https://www.edx.org/ https://www.udacity.com/
2	https://www.coursera.org/ https://www.kernel.org/
3	https://community.arm.com/

CO-PO Mapping																
	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6										
CO1			2													
CO2				2												
CO3						2										
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.																

Assessment
The assessment is based on MSE, ISE, ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem. I
Course Code	6EN571
Course Name	PE3 Lab - Embedded Linux System Design Lab
Desired Requisites:	Embedded Linux Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./week	-			
Interaction	-	**Credits: 1**			

Course Objectives

1	To use Embedded Linux.
2	To learn system Architecture, configuration and Programming for Embedded Linux Based System.
3	To facilitate the students to learn the fundamentals of Linux as applied to embedded hardware.
4	To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Apply** programming skills to integrate hardware peripherals for Embedded Linux Board	Apply
CO2	**Write** programs / scripts to configure and use internal / external peripherals of Embedded Linux Boards	Apply
CO3	**Develop** and demonstrate small Embedded Linux based system	Create

List of Experiments / Lab Activities/Topics

List of Experiments:

1. Experiment 1 : Introduction to the development tools and kit
2. Experiment 2 : Web Page design using HTML and CSS
3. Experiment 3 : Responsive Web page design
4. Experiment 4 : Web page design using PHP
5. Experiment 5 : Configure web server for an Embedded Linux board
6. Experiment 6 : Implement and access dynamic web page / web site
7. Experiment 7 : Database configuration and updating
8. Experiment 8 : Control / read GPIO pins through web page
9. Experiment 9 : Control LCD / DC Motor through web page
10. Experiment 10 : IOT based application implementation
11. Experiment 11 : Image / Video based application implementation / demonstration
12. Experiment 12 : Program to demonstrate device driver
13. Mini-Projects and Demonstration

Text Books	
1	Robin Nixon, *Learning PHP, MySQL & JavaScript*, O'Reilly publication, 4th Edition, 2015,ISBN: 9789352130153
2	Kogent Learning Solutions Inc, *Web Technologies: HTML, JAVASCRIPT, PHP*, Dreamtech Press(2009) ISBN: 978-8177229974
3	Carlos de la Guardia , "*Python Web Framework*", O'Reilly Media, Inc.
4	John Madieu, *"Linux Device Drivers Development",* Ed. 1 2017, ISBN: 9781785280009
References	
1	"Web Technology", https://www.geeksforgeeks.org/web-technology/#beginning
2	Dr. Sudip Misra, NPTEL Course: "Introduction to Internet of Things", IIT Kharagpur.
Useful Links	
1	https://www.edx.org/
2	https://www.udacity.com/
3	https://www.coursera.org/
4	https://www.kernel.org/
5	https://www.raspberrypi.org/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2					
CO2				2		
CO3					2	2

1: Low, 2: Medium, 3: High

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal		During Week 1 to Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	Marks Submission at the end of Week 6	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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Course Information

Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6EN572
Course Name	Advanced Embedded Linux Programming Lab
Desired Requisites:	Embedded System Design

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To understand the Product Development Process through Mini Project.
2	To understand budgeting through Mini project
3	To design RTOS based systems
4	To learn GUI based system design
5	To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Design** RTOS based systems with Process Synchronization using semaphore, mutex , flags, messages etc.	Apply
CO2	**Explain** Advanced multi-core processing systems and inter processor communication.	Apply
CO3	**Design** embedded GUI based system, API for USB	Create
CO4	**Create** embedded system using various IO peripheral	Create

List of Experiments / Lab Activities/Topics

List of Experiments:

1. Demonstration of RTOS based application for creating desired signals on digital I/O.
2. Writing of RTOS based application for creating given signals on digital I/O.
3. Proving that uCOS-II is a pre-emptive RTOS
4. Semaphore for managing shared resource and task synchronization
5. Assigning Mini-project problems. Demonstration of Clock tick and its effect of event timing in RTOS based systems.
6. Semaphore for event synchronization
7. Using mail box facility in RTOS
8. Using queue facility in RTOS
9. Avoiding dead-lock in RTOS
10. Building a small embedded application using an RTOS (Mini-Project) (Solving given problem by writing relevant program, Simulation, documentation, Demonstration, Period is around 3 weeks as a part of Lab ESE)

Text Books	
1	The Real-Time Kernel by Micrium
2	Real-time Operating Systems: Book 1 - The Theory (The engineering of real-time embedded systems) by Jim Cooling
3	Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers , Fifth Edition (Volume 1) by Jonathan W Valvano
References	
1	http://www2.keil.com/mdk5/cmsis/
2	User Guide and Reference Guide of LPC 1768, STM32F7
3	www.usb.org › Developers › Documents
4	https://www.segger.com/
Useful Links	
1	https://www.edx.org/ https://www.udacity.com/
2	https://www.coursera.org/ https://www.kernel.org/
3	https://community.arm.com/

CO-PO Mapping																
	Programme Outcomes(PO)															
	1	2	3	4	5	6										
CO1			2													
CO2			2													
CO3			2													
CO4				2												
CO5				2		2										
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.																

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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Course Information	
Programme	M. Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	6EN633
Course Name	Professional Elective – 4 Image Processing and Pattern Recognition
Desired Requisites:	Signal Processing

Teaching Scheme		**Examination Scheme (Marks)**			
ISE2	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
10	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives	
1	To imparts knowledge in the area of image and image processing
2	To learn the fundamentals of Pattern recognition and to choose an appropriate feature
3	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Use foundational techniques of image processing and analysis such as filtering, segmentation and local features to solve image processing problems of real world application	Apply
CO2	Apply image processing and pattern recognition techniques to detect objects and activities in images	Apply
CO3	Compare and parameterize different learning algorithms.for pattern recognition	Analyze
CO4		

Module	**Module Contents**	
I	**Fundamentals of Image Processing:** Pixel brightness transformation, position dependent brightness correction, gray scale transformation; geometric transformation, local pre-processing image smoothening, edge detectors, zero-crossing, scale in image processing, canny edge detection, parametric edge models, edges in multi spectral images, local pre-processing and adaptive neighbourhood pre-processing; image restoration	**5**
II	**Image Segmentation:** Threshold detection methods, optimal thresholding, multispectral thresholding, thresholding in hierarchical data structures; edge based image segmentation- edge image thresholding, edge relaxation, border tracing, border detection	**3**

III	**Mathematical Morphology:** Basic morphological concepts, four morphological principles, binary dilation, erosion, Hit or miss transformation, opening and closing; thinning and skeleton algorithms; Morphological segmentation –particles segmentation and watersheds, particle segmentation	**5**
IV	**Image Textures:** statistical texture description, methods based on spatial frequencies, co-occurrence matrices, edge frequency, and texture recognition method, applications Image representation and description-representation, boundary descriptors, regional descriptors	**4**
V	**Fundamentals of Pattern Recognition:** Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model	**4**
VI	**Pattern Classification Algorithms:** Pattern classification by distance function: Measures of similarity. Clustering criteria. K means algorithm. Pattern classification by like hood function: Pattern classification as a Statistical decision problem. Bayes classifier for normal patterns	**5**

Text Books	
1	Earl Gose and Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", PHI publication.
2	Sing Tze Bow, M. Dekker, "Pattern Recognition and Image Processing", Springer, 1992
3	

References	
1	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addinson – Wesley.
2	M. A. SID – AHMED, "Image Processing Theory Algorithms and Architecture", McGraw Hill Inc.
3	

Useful Links	
1	https://www.coursera.org/
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)													
	1	2	3	4	5	6								
CO1	3													
CO2			2											
CO3						2								
CO4														

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE, ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)The assessment is based on 2 in-semester evaluations (ISE) of 10 marks each, 1 mid-sem examination (MSE) of 30 marks and 1 end-sem examination (ESE) of 50 marks. MSE is based on the modules taught till MSE (typically Module 1-3) and ESE is based on all modules with 30-40% weightage on modules before MSE and 60-70% weightage on modules after MSE.

Walchand College of Engineering, Sangli
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AY 2022-23

Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year MTech., Sem II
Course Code	6EN634
Course Name	Professional Elective 4-Biomedical Signal Processing
Desired Requisites:	Signals and Systems, Digital Signal Processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	To study origins and characteristics of some of the most commonly used biomedical signals including ECG, EEG, evoked potentials, and EMG
2	To explore application of established engineering methods to complex biomedical signals problems

Course Outcomes (CO) with Bloom's Taxonomy Level

After the completion of the course the student should be able to

CO1	Apply signal processing techniques to biomedical signals	Applying
CO2	Analyze ECG and EEG signal with characteristic feature points	Analyzing
CO3	Model a biomedical system	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to Biomedical Signals** Introduction to Biomedical Signals, The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis, Signal Conversion Systems, Conversion requirements for biomedical signals, Signal conversion circuits. Application areas of Bio -Signal analysis – EEG, ECG, Phonocardiogram, Spiro Gram, Evoked Signals	7
II	**Signal Averaging and Data Compression Techniques** Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding	6
III	**Adaptive Noise Cancellation** Adaptive interference / Noise cancellation: Types of noise in biosignals; Digital filters - IIR and FIR - Notch filters - Optimal and adaptive filters. Weiner filters - steepest descent algorithm - LMS adaptive algorithm - Adaptive noise canceller - cancellation of 50 Hz signal in ECG - Cancellation of maternal ECG in foetal electrocardiography	6

IV	**Cardiological signal processing** Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.	7
V	**Neurological signal processing** Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection	6
VI	**Modeling of Biomedical Systems** Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modeling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients	8

Text Books	
1	Reddy D C. "Modern Biomedical Signal Processing – Principles and Techniques", TMH, New Delhi, 2005
2	Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling", A Wiley-Interscience Publication JOHN WILEY & SONS, INC

References	
1	1. Akay M. "Biomedical Signal Processing", Academic press, California,1994.
2	Bronzino J D "The Biomedical Engineering handbook", CRC and Free press, Florida, 1995.

Useful Links	
1	NPTEL LECTURES

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2												
CO2				2											
CO3						1									
CO4															
CO5															
CO6															

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE, ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)The assessment is based on 2 in-semester evaluations (ISE) of 10 marks each, 1 mid-sem examination (MSE) of 30 marks and 1 end-sem examination (ESE) of 50 marks. MSE is based on the modules taught till MSE (typically Module 1-3) and ESE is based on all modules with 30-40% weightage on modules before MSE and 60-70% weightage on modules after MSE.

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AY 2022-23

Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	6EN573
Course Name	Professional Elective 4 Image Processing and Pattern Recognition Lab
Desired Requisites:	Digital Image Processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/week	Nil			
Interaction	-	**Credits: 1**			

Course Objectives

1	To understand the Product Development Process through Mini Project.
2	To understand budgeting through Mini project
3	To use Image Processing and Pattern Recognition Algorithms
4	To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Describe different techniques used for image analysis	Understanding
CO2	Apply both supervised and unsupervised clasification methods to detect and characterize patterns in real-world data	Applying
CO3	Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.	Creating

List of Experiments / Lab Activities/Topics

1. The students must should learn following concepts before planning Mini Project
   a. Basic point processing operations in MATLAB
   b. Image Transformation Methods
   c. Spatial Filtering on images
   d. Edge detection algorithms
   e. Morphological image processing algorithms and its applications
   f. Object Detection Algorithms
   g. Classification and Clustering Algorithms
   h. Introduction to Computer Vision Toolbox

2. In discussion with the concerned faculty during Laboratory hours Student should plan the Mini project and prepare synopsis

3. The progress of work and discussion must be documented.

4. Testing of final system, Preparation, Checking & Correcting be done in discussion with faculty

5. The Student must submit a brief project report(25-30 pages) that must include the following
   a. Introduction
   b. Literature survey
   c. Hardware & Software Requirements
   d. System Design Architecture
   e. Implementation (screenshots to be included)
   f. Testing
   g. Conclusion
   h. Future enhancements.
   j. Bibliography

Text Books	
1	Earl Gose and Richard Johnsonbaugh Steve Jost, “Pattern Recognition and Image Analysis”, PHI publication
2	Sing Tze Bow, M. Dekker, “Pattern Recognition and Image Processing”, Springer, 1992
3	

References	
1	Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Addinson – Wesley.
2	C.M.Bishop, “Pattern Recognition & Machine Learning”, Springer, 2006
3	

Useful Links	
1	https://www.coursera.org/
2	
3	
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CO-PO Mapping

	Programme Outcomes (PO)						**PSO**
	1	2	3	4	5	6	
CO1	3						
CO2							
CO3				2		3	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First M. Tech., Sem II
Course Code	6EN574
Course Name	Professional Elective 4 – Biomedical Signal Processing Lab
Desired Requisites:	Communication Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/Week				
Interaction	-	**Credits: 1**			

Course Objectives

1	To gain the practical knowledge about the various bio signals and its characteristics
2	
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Use knowledge of math, engineering and science to understand the principle of biomedical signal processing.	
CO2	Apply specific mathematical techniques to solve problems in the areas of biomedical signals	
CO3		
CO4		

List of Experiments / Lab Activities/Topics

1. Acquire and Obtain the Limb Lead ECG Signal and Display
2. Design a Notch Filter of 50 Hz to Remove the Power Line Interference in Acquired ECG Signal
3. Design a Low Pass Filter of Defined Cut-Off Frequency to Remove the High Frequency Noises in Acquired ECG Signal
4. Design a High Pass Filter of Defined Cut-Off Frequency to Remove the Low Frequency Noises in Acquired ECG Signal
5. Compare Different Types of FIR Filter for LPF of ECG Signal
6. Compare Different Types of IIR Filter for LPF of ECG Signal
7. To Perform a Spectral Analysis of ECG Signal
8. Detection of R Peak and R-R Interval from Acquired ECG Signal
9. Acquire and Obtain the 20-20 Lead ECG Signal and Display
10. To Perform a Spectral Analysis of ECG Signa

Text Books	
1	Reddy D C. “Modern Biomedical Signal Processing – Principles and Techniques”, TMH, New Delhi, 2005
2	Eugene N. Bruce, “Biomedical Signal Processing and Signal Modeling”, A Wiley-Interscience Publication JOHN WILEY & SONS, INC.
3	
4	
References	
1	Akay M. “Biomedical Signal Processing”, Academic press, California,1994.
2	Bronzino J D “The Biomedical Engineering handbook”, CRC and Free press, Florida, 1995.
3	
4	
Useful Links	
1	
2	
3	
4	

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6EN593
Course Name	Pre-dissertation Work and Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical					
Interaction	1 Hr/Week	**Credits: 1**			

Course Objectives

1	To understand industrial problems.
2	To suggest engineering solutions to the defined problem.
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Chose, Formulate a clear problem.	Apply
CO2	Carry out detail literature review in the area of the problem	Create
CO3	Select and apply appropriate engineering methods and tools for solving the problem.	Evaluate
CO4	Present the results of work done.	Analyze

List of Experiments / Lab Activities/Topics

Pre-dissertation Work :

The Industry project will involve the selection of appropriate real time industry problem by understanding the working of particular industry application. Formulate the problem, select design and methodology to find the solution. Construct an electronic system by using appropriate hardware software tools. Each student should conceive, design and develop the idea leading to a project/product. The student should submit a soft bound report at the end of the semester. The final product as a result of Industry project should be demonstrated in phases at the time of examination.

This will help student to understand structured management in industry , sustainable development, with consideration to both scientific and ethical aspects and its presentation with technical report.

Text Books

1	To be used based on selected project
2	
3	
4	

References

1	Industry 4.0 : fourth Industrial Revolution guide to Industry 4.0
2	
3	
4	
Useful Links	
1	
2	
3	
4	

CO-PO Mapping							
	Programme Outcomes (PO)						**PSO**
	1	2	3	4	5	6	
CO1	3	2					
CO2				2		2	
CO3			2				
CO4		2					
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.							

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Pre-dissertation work, Seminar/Demo	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Pre-dissertation work, Seminar/Demo	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Pre-dissertation work, Seminar/Demo, Report	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments..				

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Course Information

Programme	M.Tech. (Electronics Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	6OE508
Course Name	Open Elective - Introduction to Embedded Systems
Desired Requisites:	None

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
Practical	-	Nil			
Interaction	-	**Credits: 2**			

Course Objectives

1	To introduce Embedded Systems and their applications
2	To develop understanding about Microcontrollers
3	To introduce hardware components of Embedded Systems
4	To explain fundamentals of Arduino
5	To explore Arduino based applications and programming

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Understand** Embedded Systems and Identify their applications	Apply
CO2	**Develop** knowledge about hardware and software of Embedded Systems	Apply
CO3	**Analyze** Arduino based systems and their programming	Analyze
CO4	**Explore** and learn Arduino based systems applications	Apply

Module	**Module Contents**	**Hours**
I	**Module 1 Introduction** Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems Characteristics and Applications of embedded systems: operational and non-operational quality attributes. Embedded Systems Applications-Application specific – washing machine, domain specific - automotive	4
II	**Module 2 Core of embedded systems** Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components.	5
III	**Module 3 Embedded Hardware** Memory map, i/o map, interrupt map, processor family, external peripherals, memory – RAM , ROM, types of RAM and ROM, memory testing, CRC ,Flash memory. **Peripherals:** Control and Status Registers, Device Driver, Timer Driver - Watchdog Timers	5

IV	**Module 4 Introduction to Arduino** Arduino device,Features of Arduino, Components of Arduino board,Description of Microcontrollers, Installation of Arduino IDE on Ubuntu Linux OS Run the arduino executable file, Using IDE to prepare Arduino sketch, Uploading and running the sketch,Program notation: variables, functions, control flow, Arduino conventions.The concept of a program variable.Numerical values and basic numerical operators.if/then/else Iteration using for loops.Real world timing and the delay() function	5
V	**Module 5 Input/Ouput Progrmming** Sensor Inputs:- Definition, Types. Interfacing arduino to different sensors- light sensor, temperature sensor, humidity sensor, pressure sensor sound sensor, distance ranging sensor, water/detector sensor, smoke, gas, alcohol sensor, ultrasonic range finder Displays: Basics of LED's and LCD's. Interfacing arduino to LED's- blinking single LED, blinking multiple LED's, 7 segment display , traffic light ,LED flashes ,LED dot matrix ,pulsating lamp. Interfacing to LCD's- Basic LCD control, LCD temperature control, display a message on LCD screen, scrolling of text Touch screens, Reading and writing to SD card	5
VI	**Module 6 Arduino Applications** Case studies : Arduino based robot car , Arduino based PLC, industrial application	4

Text Books	
1	Shibu K V , "Introduction to embedded systems", Tata Mcgraw-Hill, 1st edition
2	"Arduino Cookbook,"Michael Margolis
References	
1	"Embedded Systems", Rajkamal, Tata Mcgraw-Hill
2	"Beginning Arduino", Michal Mc Roberts, Second Edition
3	Michal Mc Roberts "Beginning Arduino" Second Edition, Technology in Action
Useful Links	
1	NPTEL Lectures
2	

CO-PO Mapping		
	Programme Outcomes (PO)	**PSO**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2										3		
CO2						3								3	
CO3			3			2							3		
CO4				2		2								3	
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