Year 2022-23 onward

B. Tech. Programme Structure

Electronics and Communication Engineering [ECE]

NIST University
Institute Park, Pallur Hills, Berhampur, Odisha, INDIA. Pin: 761008.
Web: www.nist.edu

A. Structure of Undergraduate Engineering Program(as per AICTE Model)

Sl. No.	Category	Suggested Breakup Credit(Total of 167)
1	Humanities and Social Sciences including Management courses	16
2	Basic Science Courses	21
3	Engineering Science Courses including workshop, drawing, basic of electrical/ mechanical/computer etc.	30
4	Professional Core Courses	47
5	Professional Elective courses relevant to chosen specialization/ branch	18
6	Open Subjects – Electives from other technical and/or emerging subjects	18
7	Project work, seminar, and internship in industry or elsewhere	17
8	Mandatory Courses (Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge) like UHV I and II	-
TOTAL		**167**

B. Our Proposed Credit System for B.Tech Degree

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	PSI	TOTAL
I	3	7	7	-	-	-	-	**17**
II	-	7	11	-	-	-	-	**18**
III	3	3	8	8	-	-	1	**23**
IV	6	-	4	12	3	-	-	**25**
V	-	-	-	11	3	6	2	**22**
VI	2	4	-	8	6	3	2	**25**
VII	2	-	-	8	6	3	4	**23**
VIII	-	-	-	-	-	6	8	**14**
TOTAL	**16**	**21**	**30**	**47**	**18**	**18**	**17**	**167**

C. Abbreviations

HSMC : Humanities, Social Science and Management Courses

BSC : Basic Science Courses

ESC : Engineering Science Courses

PCC : Professional Core Courses

PEC : Professional Elective Courses

OEC : Open Elective Courses

PSI : Project, Seminar, and Internship

Fifth Semester					
Theory					
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**L-T-P**	**Credit**
1	PCC	22EC5PC01T	PCC-6: Digital Signal Processing	3-0-0	3
2	PCC	22EC5PC02T	PCC-7:Microcontroller and Applications	3-0-0	3
3	PCC	22EC5PC03T	PCC-8: Digital Communication Techniques	3-0-0	3
4	PEC	**Professional Elective-2:**			
		22EC5PE01T	Mobile Communication	3-0-0	3
		22EC5PE02T	Digital System Design		
		22EC5PE03T	Information Theory and Security		
		22EC5PE04T	Electronic Device Modeling		
5	OEC	**Open Elective-1 (For ECE Branch Students):**		3-0-0	3
		22CS5OE01T	Introduction to Python Programming		
		22EE5OE01T	Renewable Energy Systems		
		22EE5OE02T	Introduction to Electrical Properties of Materials		
		22ME5OE01T	Engineering Management		
		22ME5OE02T	Micro Electro-Mechanical System (MEMS)		
		22CE5OE01T	Building Services and Maintenance		
		22CE5OE02T	Green Technology		
		Open Elective-1 (To Other Branch Students):			
		22EC5OE01T	Introduction to Information Theory		
		22EC5OE02T	Fundamental of Digital System Design		
6	OEC	**Open Elective-2 (For ECE Branch Students):**			
		22CS5OE02T	Database Management System		
		22EE5OE03T	Smart Grid		
		22EE5OE04T	Sensor and Instrumentation		
		22ME5OE03T	Smart and Intelligent Materials		
		22ME5OE04T	Nano Science and Technology		
		22CE5OE03T	Geo-Environmental Engineering		
		22CE5OE04T	Fluid Mechanics		
		Open Elective-2 (To Other Branch Students):			
		22EC5OE03T	Embedded System Design		
		22EC5OE04T	Radar System Engineering		
7	MC	**Mandatory Course:**		3-0-0	0
		22CM5MC01T	Constitution of India		
		22CM5MC02T	Essence of Indian Tradition Knowledge		
Total Credit (Theory)					**18**

Practical					
1	PCC	22EC5PC01L	PCC Lab-5: Digital Signal Processing Laboratory	0-0-2	1
2	PCC	22EC5PC02L	PCC Lab-6: Microcontroller and Applications Laboratory	0-0-2	1
3	PCC	22EC5PC03L	PCC Lab-7: Digital Communication Techniques Laboratory	0-0-2	1
4	PSI	22CM5PS01L	Summer Internship / Summer Training / MOOC Certification	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**22**

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	Digital Signal Processing	
Course Type	Theory	
Course Code	**22EC5PC01T**	
Category	Professional Core Course	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Basics of Signal And System.	
Subject Description	This course in Digital Signal Processing (DSP) provides a comprehensive exploration of fundamental concepts and techniques essential for manipulating and analyzing signals in various applications. Students will delve into the theoretical foundations of signal processing, covering topics such as convolution, Z transform, DFT and filter design. Through hands-on lab experiments students will gain practical experience in implementing DSP algorithms using software tools and hardware platforms. By the end of the course, participants will have acquired the skills necessary to design and implement advanced signal processing solutions, making them well-equipped for roles in industries ranging from telecommunications to multimedia processing.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Analyze frequency domain characteristics of discrete-time signals. 2. Develop and apply mathematical models for digital filters. 3. Describe and implement the structural aspects of digital filters. 4. Understand and evaluate adaptive filter theory.	

<table>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Evaluate frequency domain characteristics using the Z-Transform and Discrete Fourier Transform (DFT).
2. Implement the Fast Fourier Transform (FFT) algorithm to develop efficient systems.
3. Design and analyze digital filters.
4. Apply adaptive filter theory to real-world signal processing applications.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. J.G.Proakis and D.G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, 4th Edition, PHI Learning Pvt. Ltd, 2007.
2. Tarun Kumar Rawat, Digital Signal Processing, 1st Edition,Oxford university press ,2015</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. S.Salivahanan, A.Vallavaraj, C. Gnanapriya, Digital Signal Processing, 2nd Edition, The McGraw-Hill, 2008.
2. Sanjit K. Mitra, Digital Signal Processing: A Computer - Based Approach, 4th Edition, TMH, 2013.</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2"><table>
<tr><td>Course Name</td><td>DIGITAL SIGFNAL PROCESSING</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/117/102/117102060/</td></tr>
<tr><td>Course Instructor</td><td>Prof. S.C. Dutta Roy, IIT Delhi</td></tr>
</table>
<table>
<tr><td>Course Name</td><td>DIGITAL SIGFNAL PROCESSING</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/117/105/117105144/</td></tr>
<tr><td>Course Instructor</td><td>Prof. Govind Sharma, IIT Kanpur</td></tr>
</table></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Evaluate frequency domain characteristics using the Z-Transform and Discrete Fourier Transform (DFT).	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO2	Implement the Fast Fourier Transform (FFT) algorithm to develop efficient systems.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO3	Design and analyze digital filters.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO4	Apply adaptive filter theory to real-world signal processing applications.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.

DETAILED SYLLABUS:

Module No. 1	**Z-Transform & its Applications**	**10 Hours**
Overview of Discrete time signals and systems. Z-Transform and Its Application to the Analysis of LTI Systems: Direct Z-Transform, Properties of the Z- Transform, Inverse Z-Transform by Power Series Expansion, and Partial-Fraction Expansion, Analysis of Linear Time Invariant Systems in the Z-Domain.		

Module No. 2	**Discrete Fourier Transform**	**10 Hours**
Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, DFT as a Linear Transformation, Relationship of DFT to other Transforms, Properties of DFT. Use of DFT in Linear Filtering: Sectional Convolution.		

Module No. 3	**Efficient Computation of DFT and Structural Implementation of FIR and IIR Filter.**	**8 Hours**

Efficient Computation of DFT: FFT Algorithms, Radix-2 FFT Algorithms, Decimation-In-Time (DIT), Decimation-In-Time (DIF). Structure of IIR Systems: Direct form – I realization Direct form – II realization, Cascade and Parallel Realization. Structure of FIR Systems: Direct- Form Structure, Cascade-Form Structure, and Frequency Sampling Structure.

Module No. 4	**Design of FIR Filter**	**4 Hours**
Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by Frequency-Sampling Method		

Module No. 5	**Design of IIR Filter and fundamentals of adaptive filter**	**4 Hours**
Design of IIR filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation. Fundamentals of an adaptive filter: Adaptive filter, structure of adaptive FIR filter, application of adaptive filter.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	**Microcontroller and applications**	
Course Type	Theory	
Course Code	**22EC5PC02T**	
Category	PCC (Professional Core Course)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge		
Subject Description	Microcontrollers are commonly used in various applications, such as robotics, automotive, consumer electronics, and medical devices. They are preferred over other processors due to their low cost, low power consumption, and small size. All this makes them an ideal choice for embedded systems. The **MSP430** is a mixed-signal microcontroller family from Texas Instruments. It is built around a 16-bit CPU, the MSP430 is designed for low cost and, specifically, low power consumption embedded applications. This course is designed to help users to get in-depth knowledge about the MSP430 microcontroller.	
Objectives and	**Objectives:** The course should enable the students to: 1. Understand the basics of Microprocessor and Microcontroller. 2. Describe the main components and working principle of the Intel 8086	

<table>
<tr><td rowspan="2">Outcomes</td><td colspan="2">microprocessor.
3. Explain industry standard microcontroller and its application.
4. Learn assembly language program in 8086 and MSP430.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Outline comprehensive knowledge on basics of microprocessor and microcontroller.
2. Explain the internal architecture, organization and Addressing modes of 8086 Microprocessors.
3. Describe the architectural features and instruction set of MSP430.
4. Investigate the design aspect and development of interfacing I/O devices with MSP430 microcontroller.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. A.K.Ray and K.M.Bhurchandi, “Advanced Microprocessors and Peripherals”,Tata McGrawHill, 3rd edition July 2017.
2. The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications, K. Uma Rao, Andhe Pallavi, Wiley Publication, 2019.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Barry B. Brey, The Intel Microprocessors, Architecture, Programming and Interfacing-, 8e, 2009, Pearson Education, ISBN 0-13-502645-8
2. Doughlas.V.Hall, “ Microprocessor and Interfacing : Programming and Hardware”, 2nd edition, McGraw Hill, 2012
3. John H. Davies, MSP430 microcontroller basics, 1st Edition, Newnes Publication , 2008, Oxford USA.</td></tr>
</table>

Digital Learning Resources	Course Name	Introduction to Embedded System Design
	Course Link	https://nptel.ac.in/courses/108/102/108102169/
	Course Instructor	Prof. Dhananjay V. Gadre, Prof. Badri Subudhi, Netaji Subhas University of Technology, IIT Jammu
	Course Name	Microcontrollers and Applications
	Course Link	https://nptel.ac.in/courses/117/104/117104072/
	Course Instructor	Dr. S.P. Das, Electronics & Communication Engineering, IIT Kanpur

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Outline comprehensive knowledge on basics of microprocessor and microcontroller.	PO1, PO3, PO6, PEO1, PEO3
CO2	Explain the internal architecture, organization and Addressing modes of 8086 Microprocessors.	PO1, PO3, PO6, PO9,PEO1, PEO3
CO3	Describe the architectural features and instruction set of MSP430.	PO1, PO2, PO3, PO12, PEO1, PEO3
CO4	Investigate the design aspect and development of interfacing I/O devices with MSP430 microcontroller.	PO1, PO2, PO3, PO4, PO6, PO7, PO9, PO12, PEO1, PEO3

DETAILED SYLLABUS:

Module No. 1	**Introduction to Microprocessors and Microcontrollers**	**06 Hours**
Overview of Microcomputer organization, Common Terminologies Associated with Computing Systems, Microprocessors and Microcontrollers, CISC and RISC Systems, Computing Languages, Computer Architecture: Harvard and Von-Neumann, Evolution of Microprocessors		

and Microcontrollers.

Module No. 2	**Intel 8086 Microprocessor**	**10 Hours**
Introduction, 8086 Programmer's model: Register organization, Hardware Architecture: Bus interface unit (BIU), Execution unit (EU), Pipelined operation, Memory banking, physical address generation and Memory segmentation. 8086 Pin description: Common, Minimum and maximum mode Pin and Signals, Bus cycle and System configuration (Minimum mode only). Interrupt. 8086 Addressing modes, Instruction sets Assembler directive and programming.		

Module No. 3	**MSP Microcontroller Introduction and Key Features**	**06 Hours**
Introduction, Low Power Applications, MSP430 RISC CPU Architecture and pin configuration, Details of 16-Bit RISC CPU, Clock System, Memory subsystem, Key differentiating factors between different families, Digital I/O Ports.		

Module No. 4	**Programming the MSP430**	**08 Hours**
Addressing Modes, Instruction Set of MSP430, Double Operand Core Instructions, Single Operand Core Instructions (Format II), Program Flow control, Emulated Instructions, Movement Instructions, Implementation of Decimal Arithmetic, Shift and Rotate Instructions, Programming in ALP.		

Module No. 5	**On Chip Peripherals, Interfacing and Applications of MSP430**	**06 Hours**
Watchdog Timer, Timers, Real Time Clock, Digital-to-Analog Conversion, ADC (Analog to digital converter), LCD controller, LED and external memory.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics & Communication Engineering)	
Semester	5^{th}	
Subject Name	Digital Communication Technique	
Course Type	Theory	
Course Code	22EC5PC03T	
Category	Professional Core Course	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Analog Communication Technique	
Subject Description	Student will learn the concept of digitization of analog signal, different modulation techniques. Apart from that the subject enables the students to realize the digital data transmission rate, error calculation during reception of digital signal.	
Objectives and Outcomes	**Objectives:** The objective of this course is to introduce students to 1. Basic concepts of analog to digital converter techniques like sampling, quantization in digital communication systems. 2. Principles and applications of various digital modulation techniques and analyze the error performance of digital modulation techniques. 3. Process of designing the optimum receivers for digital modulation techniques. 4. Analyze and design the digital communication systems using the performance constrain such as power, spectral and error.	

	Outcomes: On Completion of this Subject/ Course the students should be able to: 1. Evaluate the performance of various analog-to-digital conversion techniques in presence of noise and errors. 2. Analyze various digital modulation techniques and compare their generation, transmission and reception techniques. 3. Describe the effect of Inter Symbol Interference (ISI) and equalization techniques to overcome it. 4. Design and realize optimum filters for digital communication.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	2.5 %
	Quiz-Test-2	2.5 %
	Surprise Test	5 %
	Assignment-1	2.5 %
	Assignment-2	2.5 %
	Attendance	5 %
	End-Term Examination	50 %
Prescribed Text Book(s)	1. H. Taub, D. L Schilling, G. Saha, *Principles of Communication System*, 4th Edition, McGraw Hill, 2013, India. 2. B.P. Lathi, Z Ding and Gupta, *Modern Digital and Analogue Communication Systems*, 4th Edition, OxfordUniversity Press, 2010, New Delhi.	
Reference Book(s)	1. John G. Proakis, MasoudSalehi, *Digital Communications*, 5th Edition, McGraw Hill Education, 2014, India. 2. Bernard Sklar, P.K. Ray, *Digital Communications: Fundamentals & Applications*, 2nd Edition, Pearson Education, 2009, India.	
Digital Learning Resources		

Course Name	Digital Communication
Course Link	https://nptel.ac.in/courses/117/101/117101051/
Course Instructor	Prof. Bikash Kumar Dey, Electrical Engineering Department, IIT Bombay
Course Name	Modern Digital Communication Techniques
Course Link	https://nptel.ac.in/courses/117/105/117105144/
Course Instructor	Prof. Syrva Sekhar Das, G.S.Sanyal School of Telecommunication, IIT Khargapur

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Evaluate the performance of various analog-to-digital conversion techniques in presence of noise and errors	PO1, PO2
CO2	Analyze various digital modulation techniques and compare their generation, transmission and reception techniques	PO1, PO2, PO3
CO3	Describe the effect of Inter Symbol Interference (ISI) and equalization techniques to overcome it	PO1, PO2, PO3
CO4	Design and realize optimum filters for digital communication	PO1, PO2, PO3

DETAILED SYLLABUS:

Module No. 1	**Digital Representation of Analog Signal**	**8 Hours**
Differential PCM: Predictor, Linear predictor design, Delta Modulation: modulator and demodulator, errors in DM, Adaptive Delta Modulation, Comparison of PCM, DM and ADM.		

Module No. 2	**Noise in PCM & DM**	**06 Hours**

Calculation of Quantization Noise, Output Signal Power, and the Thermal Noise. Output SNR in PCM, Quantization noise in Delta Modulation, output signal power, output SNR, Comparison with PCM and DM

Module No. 3	**Digital Modulation Technique**	**08 Hours**
Generation, Transmission, Reception, Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, QASK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK).		

Module No. 4	**Principle of Digital Data Transmission**	**6 Hours**
Digital Communication Systems – Source, Line coder, PSD of various line codes, Multiplexer, Regenerative repeater; scrambling, T1 Digital System, Multiplexing T1 lines – The T2, T3 and T4 lines, Pulse shaping – ISI and effect, Nyquist first criterion for zero ISI; Equalizers, Eye Diagram		

Module No. 5	**Optimal Reception of Digital Signal**	**08 Hours**
A base band signal Receiver, Peak signal to RMS noise output voltage ratio, probability of error, optimum threshold, optimum receiver for both base band and pass band: calculation of optimum filter transfer function, optimum filter realization using Matched filter, Probability error of the matched filter, optimum filter realization using correlator. The Concept of amount of Information, Average Information, Entropy; Information rate.		

Professional Elective Courses

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	MOBILE COMMUNICATION	
Course Type	Theory	
Course Code	22EC5PE01T	
Category	PEC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Digital Communication.	
Subject Description	This Course is to expose the students to the most recent technological developments in Mobile communication systems. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course. This course deals with various methodologies to improve the received signal quality in mobile communication. The Course provides various multiple access techniques and Standards in Cellular mobile Communication. The objective of this course is to enable the student to understand the emerging technologies of wireless and mobile communications	
Objectives and	**Objectives:** The course should enable the students: 1. Basic cellular concepts and capacity enhancement techniques like	

<table>
<tr><td rowspan="2">Outcomes</td><td colspan="2">sectoring, cell splitting, microcell, picocell etc.
2. Analysis of various channel models and fading characteristics.
3. Various multiple access techniques and spread spectrum techniques.
4. Principles and applications of various cellular mobile communication systems.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Identify and discuss the fundamental operational and design problems of cellular mobile communication systems.
2. Analyze the Mobile radio propagation, fading, diversity concepts and the channel modeling
3. Explore various wireless mobile communication standards and analyze their system performance.
4. Analyze various multiple access techniques and compare their system performance in terms of capacity and spectral efficiency.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Wireless Communication and Networking, Essential Reading: V K Garg, Morgan Kaufman Publishers, 2008, India
2. Wireless Communications: T S Rappaport, 2nd Edition, Pearson Education, 2018, India.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Wireless Communications: T L Singhal, 1st Edition, Tata McGraw Hill, 2010, India.
2. Wireless communication: A Goldsmith, 1st Edition, Cambridge University Press, 2009, India</td></tr>
</table>

Digital Learning Resources	Course Name	Introduction to Wireless and Cellular Communication
	Course Link	https://nptel.ac.in/courses/106/106/106106167/
	Course Instructor	Prof. David Koilpillai, Department of Electrical Engineering , IIT Madras
	Course Name	Wireless communication
	Course Link	https://nptel.ac.in/courses/117102062
	Course Instructor	Prof. Ranjan Bose, IIT Delhi

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Identify and discuss the fundamental operational and design problems of cellular mobile communication systems.	PO1, PO2, PO3, PO4, PO5
CO2	Analyze the Mobile radio propagation, fading, diversity concepts and the channel modeling	PO1, PO2, PO3, PO5
CO3	Explore various wireless mobile communication standards and analyze their system performance.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze various multiple access techniques and compare their system performance in terms of capacity and spectral efficiency.	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Fundamentals of Cellular Communications**	**10 Hours**
Introduction, Cellular Systems: Hexagonal Cell Geometry, Frequency reuse, channel Assignment; Handoff Strategies; Interfaces and System Capacity-Co-channel Interference Ratio, Cellular System Design in Worst-Case Scenario with an Omni directional Antenna, Co-channel Interference Reduction, ACI, Cell Splitting; Sectoring, Directional Antennas in Seven-Cell		

Module No. 2	Radio Propagation Models	08 Hours
Large Scale Propagation: Introduction, Free Space Propagation Model; Basic propagation mechanisms, Free-space Attenuation, Attenuation over Reflecting Surfaces; Outdoor propagation Path Loss Models; Indoor Propagation Path Loss Model Small Scale Propagation: small scale multi path propagation; Characteristics of Wireless Channel, Parameters of multi path channels; types of multi path fading; Signal Fading Statistics.		

Module No. 3	Multiple Access Techniques	06 Hours
Introduction, Narrowband Channelized Systems, Comparisons of FDMA, TDMA and DS-CDMA, Comparison of DS-CDMA vs. TDMA; Spectral Efficiency, System Capacity, Capacity of a DS-CDMA System		

Module No. 4	Equalization, Diversity	06 Hours
- Fundamentals of equalization, General adaptive equalizer, types of equalizers, diversity techniques (space, polarization, time, frequency, RAKE receivers.,		

Module No. 5	Fourth Generation Systems and New Wireless Technologies	06 Hours
Next Generation Cellular Technology 4G: Evolution of technology to 4G wireless, 4G evolution, 4G technologies, 4G technologies, Orthogonal frequency-division multiplexing, 4G technologies **Wireless Local Area Networks**: WLAN topologies, wireless local area network standard IEEE 802.11, IEEE 802.11 architecture, WiMAX and IEEE 802.16, WiMAX architecture and Mechanism.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	Digital System Design	
Course Type	Theory	
Course Code	22PC5PE02T	
Category	Professional Elective Course	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	The present world is an era of digital technology, where we are surrounded by computations going all around and devices connected to each other. To meet this challenge digital systems play a crucial role for the development of societal needs. To understand the course students should have basic knowledge on digital electronics and circuits. Fundamentals of digital logic principles, including Boolean algebra, combinational and sequential logics will help the students to have a deep understanding of the subject and helps to synchronize with industry needs.	
Subject Description	The course starts with a review on some fundamental blocks of combinational and sequential logic. It touches different types of FSM blocks and state tables followed by the principles to design robust Synchronous Sequential Circuits with fundamental timing issues. It also covers the design of sequential networks with programmable devices.	
Objectives and	**Objectives:** The course should enable the students to: 5. To enhance the knowledge in Digital system design.	

<table>
<tr><td rowspan="2">Outcomes</td><td colspan="2">6. To study the capabilities of Finite State Machines.
7. To understand the design techniques and timing issues of synchronous sequential circuits.
8. To explore the sequential circuit design using programmable logic devices.</td></tr>
<tr><td colspan="2">Outcomes:

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

1. Understand the various types of FSMs and their capabilities
2. Synthesize different types of synchronous sequential logic circuits using Melay and Moore model
3. Analyze the timing issues to have an error free design
4. Develop the skill to design Sequential Networks using ROMs</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Charles H. Roth, Jr, Fundamentals of Logic Design, JPH, 4th Edition, 1999, Mumbai
2. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Tata McGraw-Hill, 1st Edition 2002, New Delhi</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. John Wakerley, Digital Design: Principles and Practices, Pearson Education, 4th Edition, 2006

2. Moris M. Mano, Digital Design, Pearson Education, 3rd Edition, 2002, Delhi</td></tr>
</table>

Digital Learning Resources	Course Name	**Digital System Design**
	Course Link	https://nptel.ac.in/courses/108/106/108106177/
	Course Instructor	Prof. Neeraj Goel, Department of Computer ScienceEngineering, IIT Ropar
	Course Name	**Digital System Design**
	Course Link	https://nptel.ac.in/courses/117/105/117105080/
	Course Instructor	Prof. D. Roychoudhury, Electronics & Communication Engineering, IIT Kharagpur

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Understand the various types of FSMs and their capabilities	PO1, PO2, PO3, PO4, PO6
CO2	Synthesize different types of synchronous sequential logic circuits using Melay and Moore model	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Analyze the timing issues to have an error free design	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Develop the skill to design Sequential Networks using ROMs	PO1, PO2, PO3, PO4, PO5, PO6, PO7

DETAILED SYLLABUS:

Module No. 1	**Combinational and Sequential Logic**	**10 Hours**
Review of Adders, Multipliers, Multiplexers, ROM, Triggering of flip-flops, Flip flop behavior for Synchronous and Asynchronous reset signal, Design procedure for sequential circuits, Design of synchronous counter for random sequence.		

Module No. 2	**Introduction to FSM and Reduction of State**	**07 Hours**

	Tables	
Finite state model, State graphs and tables, Capabilities and limitations of FSM, State reduction and assignment, One-Hot Encoding, Moore and Mealy state models		

Module No. 3	**Synchronous Sequential Circuits**	**06 Hours**
Analysis and Synthesis of Synchronous sequential circuits, Top down and Bottom up Approach to Design, Design of Serial Adder: using Mealy type FSM, using Moore type FSM		

Module No. 4	**Sequential Network Design with Programmable Logic Devices (PLDs)**	**10 Hours**
Static Random Access Memory (SRAM), SRAM blocks in PLDs, Design of Sequential Networks using ROMs		

Module No. 5	**Timings of Sequential Circuit**	**07 Hours**
Delay of combinational circuit. Set-up and hold time, Clock Synchronization: Clock skew, Asynchronous inputs to flip fops, Switch debouncing.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	Information Theory and Security	
Course Type	Theory	
Course Code	22EC5PE03T	
Category	PEC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Communication engineering	
Subject Description	Information theory is the science of measuring, maintaining, transmitting, and estimating information in random data. This course provides students with analytical skills to measure information, make inferences, and investigate the relationship between information and learning. The course discusses information measurements, source and channel coding theorems, and statistical inference.	
Objectives and Outcomes	**Objectives:** The course should enable the students: 1. To provide a clear understanding on the concept of information in communication theory and how it affects communication receiver design. 2. To explore in detail, the calculations of channel capacity to support error-free transmission and also, the most commonly used source coding and channel coding algorithms. 3. To develop the ability to analyze the error correcting codes used for reliable	

	transfer of data 4. To familiarize with various decoding techniques	
	Outcomes: Upon completion of this course, the student will be able to: 1. Acquire knowledge about concept of mutual information, entropy in information theory. 2. Implement the various types of source coding algorithms and analyze their performance. 3. Utilize the concept to design a communication model and evaluate its channel capacity 4. Understand and analyze various error correcting codes used for reliable transfer of data	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	2.5 %
	Quiz-Test-2	2.5 %
	Surprise Test	5 %
	Assignment-1	2.5 %
	Assignment-2	2.5 %
	Attendance	5 %
	End-Term Examination	50 %
Prescribed Text Book(s)	1. *Error Control Coding- Fundamentals and Applications*: Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc 2014. 2. *Information Theory, Coding and Cryptography*: Ranjan Bose, 2nd Edition, 2009, TMH.	
Reference Book(s)	1. *Elements of Information Theory*, Thomas M. Cover and Joy A. Thomas, 2nd edition, John Wiley, 2006. 2. *Digital Communications- Fundamentals and Applications*, Bernard Sklar, 2nd Edition, Pearson Education, 2016 3.	

Digital Learning Resources	Course Name	Information Theory and Coding
	Course Link	https://nptel.ac.in/courses/117101053
	Course Instructor	Prof. Prof. S.N. Merchant, IIT Bombay
	Course Name	Information Theory, Coding and Cryptography
	Course Link	https://nptel.ac.in/courses/108102117
	Course Instructor	Prof. Ranjan Bose, IIT Delhi

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Acquire knowledge about concept of mutual information, entropy in information theory.	PO1, PO2, PO3, PO4, PO5
CO2	Implement the various types of source coding algorithms and analyze their performance.	PO1, PO2, PO3, PO5
CO3	Utilize the concept to design communication models and evaluate the channel capacity	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Understand and analyze various error correcting codes used for reliable transfer of data	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Information Theory**	**6 Hours**
Introduction, Measure of information, Information content of message, Average Information, Entropy and Information rate. **Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Source coding theorem, Prefix Codes, Kraft McMillan Inequality.		

Module No. 2	Information Channels	06 Hours
Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, Binary Erasure Channel		

Module No. 3	Linear Block Codes	08 Hours
Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. Perfect Codes, Hamming Codes		

Module No. 4	Cyclic Codes	08 Hours
Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction **BCH Code:** Introduction, Primitive elements, minimum polynomials, Examples of BCH codes, Decoding of BCH codes		

Module No. 5	Convolution Codes	08 Hours
Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating function, Matrix Description, Viterbi Decoding. **Cryptography:** Introduction, encryption techniques, Symmetric cryptography, data encryption standard, Asymmetric Algorithm the RSA Algorithm..		

Degree	B. Tech.	
Level	Undergraduate	
Branch	Electronics Communication Engineering	
Semester	5th	
Subject Name	Electronic Device Modeling	
Course Type	Theory	
Course Code	22EC5PE04T	
Category	PEC	
Credit Point	3	
Time Commitment	Lecture	38 Hours
	Tutorial	06 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Physics of Semiconductor Devices	
Subject Description	This course provides an in-depth exploration of semiconductor devices and integrated circuit (IC) fabrication, emphasizing both theoretical principles and practical applications. The curriculum is designed to equip students with a comprehensive understanding of key electronic components and the processes involved in their design and manufacture.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. To understand the Operation and Modeling of Semiconductor Devices 2. To develop Skills in Device Simulation and Analysis 3. To explore Integrated Circuit Fabrication Techniques	
	Outcomes: Upon completion of this course, the student will be able to:	

<table>
<tr><td></td><td colspan="2">1. Evaluate and create models for various semiconductor devices' electrical characteristics.
2. Perform accurate simulations of semiconductor devices accounting for real-world conditions.
3. Grasp MOSFET operation principles and effects of scaling devices.
4. Explain key processes in IC fabrication and their impact on performance.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Giuseppe Massobrio and Paolo Antognetti, Semiconductor Device Modeling with SPICE, 2nd Edition, Tata McGraw-Hill Education, 2010.
2. Sze S.M. “ Semiconductor Physics” MacGraw Hill publication</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Richard S. Muller, Theodore I. Kamins and Mansun Chan, Device Electronics for Integrated Circuits, 3rd edn., John Wiley and Sons, New York, 2003.
2. Muhammad H. Rashid, Spice for circuits and Electronics using PSPICE, PHI Publication, 1994.
3. Trond Ytterdal, Yuhua Cheng , Tor A. Fjeldly and Wayne Wolf, Device Modeling for Analog and RF CMOS Circuit Design, John Wiley & Sons Ltd, 2003</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2"><table><tr><td>Course Name</td><td>Semiconductor device modeling and Simulation</td></tr><tr><td>Course Link</td><td>https://onlinecourses.nptel.ac.in/noc23_ee35/preview</td></tr><tr><td>Course</td><td>Prof. Vivek Dixit, IIT Kharagpur</td></tr></table></td></tr>
</table>

	Instructor	
	Course Name	Fundamentals of electronic device fabrication
	Course Link	https://onlinecourses.nptel.ac.in/noc21_mm26/preview
	Course Instructor	Prof. Parasuraman Swaminathan, IIT Madras

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Evaluate and create models for various semiconductor devices' electrical characteristics.	1, 2, 3,4,7, 9, 11,12
CO2	Perform accurate simulations of semiconductor devices accounting for real-world conditions.	1, 2, 3,4,7, 9, 11,12
CO3	Grasp MOSFET operation principles and effects of scaling devices.	1, 2, 3,4,7, 9, 11,12
CO4	Explain key processes in IC fabrication and their impact on performance.	1, 2, 3,4,5,6, 7, 9, 11,12

DETAILED SYLLABUS:

Module No. 1	**PN–Junction and Schottky Diode**	**8 Hours**
Current-Voltage Characteristics of pn, static and dynamic resistances, diode equivalent circuits, Tunneling, Small and Large Signal Model, Schottky Diode and its Implementation in SPICE2, Temperature and Area Effects on the Diode Model Parameters.		

Module No. 2	**Bipolar Junction Transistor (BJT)**	**8 Hours**

Breakdown in BJTs, Ebers-Moll Model, Gummel-Poon Model, SPICE model of BJT, Simulation of BJT, Temperature and Area Effects on the BJT Model Parameters.

Module No. 3	**MOSFET Device Physics**	**8 Hours**
Basic operation of MOSFET, N-channel, P-channel MOS characteristics and features, Enhancement and depletion mode, Body effect, CMOS latch up, MOS parasitic capacitance and resistance.		

Module No. 4	**Modeling of MOSFETs**	**8 Hours**
Scaling theory related to MOS circuits, Channel length modulation, Sub-threshold conduction, DIBL, Hot carrier effect, Mobility degradation, Velocity saturation, SPICE models of MOS transistors: LEVEL 1, LEVEL 2, LEVEL 3, BSIM.		

Module No. 5	**Basic Processes of IC Fabrication**	**6 Hours**
Oxidation, Diffusion, Ion Implantation, Photolithography, Etching, Physical and Chemical Vapor Deposition.		

Open Elective-1 (For Other Branch Students)

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5th	
Subject Name	Introduction to Information Theory	
Course Type	Theory	
Course Code	22EC5OE01T	
Category	OEC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Communication engineering	
Subject Description	Information theory is the science of measuring, maintaining, transmitting, and estimating information in random data. This course provides students with analytical skills to measure information, make inferences, and investigate the relationship between information and learning. The course discusses information measurements, source and channel coding theorems, and statistical inference.	
Objectives and Outcomes	**Objectives:** The course should enable the students: 1. To provide a clear understanding on the concept of information in communication theory and how it affects communication receiver design. 2. To explore in detail, the calculations of channel capacity to support	

<table>
<tr><td></td><td colspan="2">error-free transmission and also, the most commonly used source coding and channel coding algorithms.
3. To develop the ability to analyze the error correcting codes used for reliable transfer of data
4. To familiarize with various decoding techniques</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Acquire knowledge about concept of mutual information, entropy in information theory.
2. Implement the various types of source coding algorithms and analyze their performance.
3. Utilize the concept to design a communication model and evaluate its channel capacity
4. Understand and analyze various error correcting codes used for reliable transfer of data</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Error Control Coding- Fundamentals and Applications: Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc 2014.
2. Information Theory, Coding and Cryptography: Ranjan Bose, 2nd Edition, 2009, TMH.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Elements of Information Theory, Thomas M. Cover and Joy A. Thomas, 2nd edition, John Wiley, 2006.
2. Digital Communications- Fundamentals and Applications, Bernard Sklar, 2nd Edition, Pearson Education, 2016</td></tr>
</table>

Digital Learning Resources	Course Name	Information Theory and Coding
	Course Link	https://nptel.ac.in/courses/117101053
	Course Instructor	Prof. Prof. S.N. Merchant, IIT Bombay
	Course Name	Information Theory, Coding and Cryptography
	Course Link	https://nptel.ac.in/courses/108102117
	Course Instructor	Prof. Ranjan Bose, IIT Delhi

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Acquire knowledge about concept of mutual information, entropy in information theory.	PO1, PO2, PO3, PO4, PO5
CO2	Implement the various types of source coding algorithms and analyze their performance.	PO1, PO2, PO3, PO5
CO3	Utilize the concept to design communication models and evaluate the channel capacity	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Understand and analyze various error correcting codes used for reliable transfer of data	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Information Theory**	**8 Hours**
Introduction, Measure of information, Information content of message, Average Information, Entropy and Information rate. **Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Source coding theorem, Prefix Codes, Kraft McMillan Inequality.		

Module No. 2	Information Channels	07 Hours
Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, Binary Erasure Channel		

Module No. 3	Linear Block Codes	06 Hours
Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. Perfect Codes, Hamming Codes		

Module No. 4	Cyclic Codes	10 Hours
Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction **BCH Code:** Introduction, Primitive elements, minimum polynomials, Examples of BCH codes, Decoding of BCH codes		

Module No. 5	Convolution Codes	07 Hours
Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating function, Matrix Description, Viterbi Decoding, Distance bounds, Turbo Codes, Turbo Decoding.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	Fundamental of Digital System Design	
Course Type	Theory	
Course Code	22EC5OE02T	
Category	Open Elective Course	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	The present world is an era of digital technology, where we are surrounded by computations going all around and devices connected to each other. To meet this challenge digital systems play a crucial role for the development of societal needs. To understand the course students should have basic knowledge on digital electronics and circuits. Fundamentals of digital logic principles, including Boolean algebra, combinational and sequential logics will help the students to have a deep understanding of the subject and helps to synchronize with industry needs.	
Subject Description	The course starts with a review on some fundamental blocks of combinational and sequential logic. It touches different types of FSM blocks and state tables followed by the principles to design robust Synchronous Sequential Circuits with fundamental timing issues. It also covers the design of sequential networks with programmable devices.	
Objectives and	**Objectives:** The course should enable the students to: 5. To enhance the knowledge in Digital system design.	

<table>
<tr><td rowspan="2">Outcomes</td><td colspan="2">6. To study the capabilities of Finite State Machines.
7. To understand the design techniques and timing issues of synchronous sequential circuits.
8. To explore the sequential circuit design using programmable logic devices.</td></tr>
<tr><td colspan="2">Outcomes:

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

5. Understand the various types of FSMs and their capabilities
6. Synthesize different types of synchronous sequential logic circuits using Melay and Moore model
7. Analyze the timing issues to have an error free design
8. Develop the skill to design Sequential Networks using ROMs</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">3. Charles H. Roth, Jr, Fundamentals of Logic Design, JPH, 4th Edition, 1999, Mumbai
4. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Tata McGraw-Hill, 1st Edition 2002, New Delhi</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">3. John Wakerley, Digital Design: Principles and Practices, Pearson Education, 4th Edition, 2006

4. Moris M. Mano, Digital Design, Pearson Education, 3rd Edition, 2002, Delhi</td></tr>
</table>

Digital Learning Resources	**Digital System Design** https://nptel.ac.in/courses/108/106/108106177/ Prof. Neeraj Goel, Department of Computer ScienceEngineering, IIT Ropar
	Digital System Design https://nptel.ac.in/courses/117/105/117105080/ Prof. D. Roychoudhury, Electronics & Communication Engineering, IIT Kharagpur

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Understand the various types of FSMs and their capabilities	PO1, PO2, PO3, PO4, PO6
CO2	Synthesize different types of synchronous sequential logic circuits using Melay and Moore model	PO1, PO2, PO3, PO4, PO6, PO7
CO3	Analyze the timing issues to have an error free design	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Develop the skill to design Sequential Networks using ROMs	PO1, PO2, PO3, PO4, PO5, PO6, PO7

DETAILED SYLLABUS:

Module No. 1	Combinational and Sequential Logic	10 Hours
Review of Adders, Multipliers, Multiplexers, ROM, Triggering of flip-flops, Flip flop behavior for Synchronous and Asynchronous reset signal, Design procedure for sequential circuits, Design of synchronous counter for random sequence.		

Module No. 2	Introduction to FSM and Reduction of State Tables	07 Hours

Finite state model, State graphs and tables, Capabilities and limitations of FSM, State reduction and assignment, One-Hot Encoding, Moore and Mealy state models

Module No. 3	**Synchronous Sequential Circuits**	**06 Hours**
Analysis and Synthesis of Synchronous sequential circuits, Top down and Bottom up Approach to Design, Design of Serial Adder: using Mealy type FSM, using Moore type FSM		

Module No. 4	**Sequential Network Design with Programmable Logic Devices (PLDs)**	**10 Hours**
Static Random Access Memory (SRAM), SRAM blocks in PLDs, Design of Sequential Networks using ROMs		

Module No. 5	**Timings of Sequential Circuit**	**07 Hours**
Delay of combinational circuit. Set-up and hold time, Clock Synchronization: Clock skew, Asynchronous inputs to flip fops, Switch debouncing.		

Open Elective-2 (For Other Branch Students)

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5th	
Subject Name	Embedded System Design	
Course Type	Theory	
Course Code	22ECIOE03T	
Category	**Open Elective Course**	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Microprocessor and Microcontroller	
Subject Description	An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is designed for a specific function or for specific functions within a larger system. Industrial machines, agricultural and process industry devices, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines and toys as well as mobile devices are all possible locations for an embedded system.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. To enhance the knowledge in Embedded System 2. To study the controller architecture. 3. To explore the knowledge of interfacing of external devices.	

<table>
<tr><td></td><td colspan="2">4. To understand the design techniques of embedded system.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Able to acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware,
2. Able to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system
3. Able to practically apply gained theoretical knowledge in order to design, analyze and implement embedded systems, e.g. integrating embedded subsystems
4. Able to get detail knowledge of MSP430 Launchpad embedded board</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X

2. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X</td></tr>
</table>

Digital Learning Resources	**Embedded System Design** By Prof. Dhananjay V. Gadre, Prof. Badri Subudhi | Netaji Subhas University of Technology, IIT Jammu
	https://onlinecourses.nptel.ac.in/noc20_ee98/preview

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	To enhance the knowledge in Embedded System	
CO2	To study the controller architecture.	
CO3	To explore the knowledge of interfacing of external devices.	
CO4	To understand the design techniques of embedded system.	

DETAILED SYLLABUS:

Module No. 1	Introduction to Embedded Systems	08 Hours
Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.		

Module No. 2	Fundamentals of Physical Interfacing	06 Hours
Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD), OLED.		

Module No. 3	Programming the MSP430	06 Hours
Installing and using Code Composer Studio (CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.		

Module No. 4	MSP430 Clock and Reset System	10 Hours
MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR). Introduction to MSP430 Timer Module and its Modes of Operation. Timer Capture Modes. Measuring frequency and time period of external signals and events. Generating Pulse Width Modulation (PWM) using Timer Capture Mode.		

Module No. 5	Interfacing and Serial Data Communication	10 Hours
Interfacing Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. ADC operation in MSP430. Interfacing analog inputs. Adding DAC to MSP430. Custom Waveform generation using MSP430. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication.		

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	Radar System Engineering	
Course Type	Theory	
Course Code	**22EC5OE04T**	
Category	**Open Elective Course**	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Basics of Communication Engineering	
Subject Description	The "Radar System Engineering" course offers an in-depth exploration of radar systems, focusing on their principles, types, and applications. Students will study continuous wave (CW), frequency modulated (FM-CW), moving target indication (MTI), and pulse Doppler radar systems, as well as their components and functionalities. The course emphasizes radar signal processing, tracking methods, and the influence of environmental factors on detection. Through lectures and tutorials, students will develop skills to analyze radar signals, understand system limitations, and apply radar technologies in real-world scenarios, preparing them for advanced studies or careers in electronics and communication engineering.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Identify basic radar systems and their fundamental components. 2. Explain radar equations and principles of radar signal analysis. 3. Use radar concepts to solve detection and range estimation problems. 4. Analyze radar system performance and limitations in different scenarios.	
	Outcomes: Upon completion of this course, the student will be able to: 1. Demonstrate an understanding of radar fundamentals and factors that influence the detection process.	

<table>
<tr><td></td><td colspan="2">2. Differentiate radar types based on their operational principles and fields of application.
3. Familiarize with radar displays and their applications in real-time scenarios.
4. Analyze radar signals and system components, applying tracking principles to enhance detection accuracy.</td></tr>
<tr><td rowspan="8">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Merrill I. Skolnik, Introduction to Radar Systems, Third Edition, Tata McGraw-Hill, 2001, New Delhi.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Byron Edde, Radar Principles, Technology, Applications, First Edition, Pearson Education, 2007, New Delhi.
2. Nathanson, Radar Design Principles, Second Edition, Mc-Graw Hill, 1991, New York.
3. Peyton Z. Peebles, Radar Principles, First Edition, Wiley, 1998, New York.
4. Mark A. Richards, James A. Scheer, William A. Holm. Yesdee, Principles of Modern Radar: Basic Principles, First Edition, Scitech Publishing, 2013, Raleigh, North California</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2"><table><tr><td>Course Name</td><td>Radar System Engineering</td></tr><tr><td>Course Link</td><td>https://nptel.ac.in/courses/108/105/108105154/</td></tr><tr><td>Course Instructor</td><td>Prof. Amitabha Battacharya, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur</td></tr></table></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Demonstrate an understanding of radar fundamentals and factors that influence the detection process	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO2	Differentiate radar types based on their operational principles and fields of application	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO3	Familiarize with radar displays and their applications in real-time scenarios	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO4	Analyze radar signals and system components, applying tracking principles to enhance detection accuracy	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.

DETAILED SYLLABUS:

Module No. 1	**Introduction to Radar**	**10 Hours**
Introduction to Radar: Basic radar, maximum unambiguous range, building blocks of radar, simple form of radar equation, Block diagram of Radar transmitter, Radar frequencies. Applications to radar. **Radar equation:** Prediction of Range performance, minimum detectable signal, receiver noise, SNR. Radar Cross Section, transmitter power, PRF, range ambiguities, and system losses.		

Module No. 2	**CW and FM-CW Radar**	**8 Hours**
CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-		

zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.

FM-CW Radar:

Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets).

Module No. 3	**MTI and Pulse Doppler Radar**	**6 Hours**

MTI and Pulse Doppler Radar:

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Staggered PRFs. MTI Radar Parameters, Limitations to MTI Performance. MTI versus Pulse Doppler Radar.

Module No. 4	**Tracking Radar**	**6 Hours**

Tracking Radar:

Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse. Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range.

Module No. 5	**Radar Receiver and Modern Radars**	**6 Hours**

Radar Receiver:

Block Diagram of Radar Receiver & Radar Displays- A-scope and PPI.

Modern Radars:

Height Finding Radars, Synthetic Aperture Radar.

Practical

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	**Digital Signal Processing Laboratory**	
Course Type	Laboratory	
Course Code	**22EC5PC01L**	
Category	**Professional Core**	
Credit Point	1	
Time Commitment	Lecture	05 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	25 Hours
Recommended Background Knowledge/Course Pre-requisites	MATLAB, CODECOMPOSER STUDIO	
Subject Description	The course will introduce the students to solve and simulate problems in the areas of communications and signal processing using MATLAB environment and programming aspects as well as programming of DSP hardware for real-time signal processing applications.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Learn to use MATLAB for digital signal processing simulations. 2. Gain familiarity with the architecture of the DSP Processor (TMS 320C6748) and its applications.	

<table>
<tr><td></td><td colspan="2">3. Implement FIR and IIR filters using both hardware and software.
4. Apply adaptive filter theory to real-time signal processing applications.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:
1. Learn MATLAB and DSP kit fundamentals for lab experiments and applications.
2. Sketch the magnitude and phase response of DFT, Inverse DFT and FFT of discrete time signals.
3. Design and analyze digital filters for processing of discrete time signals using MATLAB and DSP kit.
4. Simulate various signals processing algorithm in both hardware and software.</td></tr>
<tr><td rowspan="7">Assessment/ Evaluation</td><td>Lab Experiments</td><td>20%</td></tr>
<tr><td>Record Writing</td><td>10%</td></tr>
<tr><td>Behavior/ Attitude</td><td>05%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>05%</td></tr>
<tr><td>Final Lab Test</td><td>30%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>20%</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">J.G.Proakis and Vinay K.Ingle Digital Signal Processing A MATLAB Based Approach, 3rd Edition, CENGAGE Learning Pvt. Ltd, 2008.</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2"></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Learn MATLAB and DSP kit fundamentals for lab experiments and applications.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO2	Sketch the magnitude and phase response of DFT, Inverse DFT and FFT of discrete time signals.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO3	Design and analyze digital filters for processing of discrete time signals using MATLAB and DSP kit.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO4	Simulate various signals processing algorithm in both hardware and software.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments (AT LEAST 10 EXPERIMENTS SHOULD BE DONE)	Duration in Hrs
1	Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)	2
2	Generation of different types of signals (SIN, COS, RAMP, TRAINGULAR, RANDOM) using DSK 6748 KIT.	2
3	Linear convolution of sequences using DSP 6748 KIT.	
4	To find DFT / IDFT of given DT signal using MATLAB and DSK 6748 KIT.	2
5	Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP 6748 kit.	2
6	Program to obtain Linear Convolution of Long duration sequences using Overlap Add and Overlap Save using MATLAB.	2

7	Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.	2
8	Design and implementation of FIR Low Pass Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.	2
9	Design and implementation of FIR High Pass Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.	2
10	Implementation of Low Pass IIR filters for a given sequence using MATLAB and DSK 6748 KIT.	2
11	Implementation of High Pass IIR filters for a given sequence using MATLAB and DSK 6748 KIT.	
12	Implementation of LMS algorithm using MATLAB and DSP 6748 kit.	

BEYOND SYLLABUS (EXPERIMENTS):

Sl. No.	**Name of Experiments** **(AT LEAST 10 EXPERIMENTS SHOULD BE DONE)**	**Duration in Hrs**
1	Implementation of Decimation Process using MATLAB and DSK 6748 KIT.	2
2	Implementation of Interpolation Process using MATLAB and DSK 6748 KIT.	2
3	Design and implementation of Adaptive noise cancellation.	2
4	To write a C- program to compute power density spectrum of given one – dimensional signal and plot.	2
5	Image sharpening using DSP Processor.	2

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	5^{th}	
Subject Name	**Microcontroller and Applications Laboratory**	
Course Type	Laboratory	
Course Code	22EC5PC02L	
Category	Professional Core Course	
Credit Point	1	
Time Commitment	Lecture	12 Hours
	Tutorial	Nil
	Practice	18 Hours
	Total	30 Hours
Recommended Background Knowledge/ Course Pre-requisites	Digital Electronics, basics of C programming	
Subject Description	Concepts of assembly language and the machine representation of instructions and data of a modern digital computer are presented. Students will have the opportunity to study get in-depth knowledge about the MSP430 microcontroller. It is very easy to develop applications quickly and reduce time to market with simplified tools and software available for MSP430. The course started from the basic knowledge on assembly language programming on 16-bit microprocessor and advanced microcontroller. This course covers the fundamental skills needed when designing a system based on the Texas Instruments (TI) MSP430 microcontroller (MCU). This course explains TI's integrated development environment (IDE) which is named Code Composer Studio (CCS). Embedded C language is used for all the	

<table>
<tr><td></td><td colspan="2">interfacing programs and they are executed using in MSP 430 board.</td></tr>
<tr><td rowspan="2">Objectives and Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Understand the basics of assembly programming based on 8086 Microprocessor.
2. Learn 8086 microprocessor based assembly program with logical, string, bit manipulation operations.
3. Understand the assembly language programming using MSP 430 microcontroller.
4. Provide practical hands on with I/O interfacing skills using MSP 430 microcontroller in code composer studio.</td></tr>
<tr><td colspan="2">Outcomes:

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

1. Develop assembly language programs for various applications using 8086 Microprocessor.
2. Distinguish the use of different logical, shifting, string, branch instructions to apply in 8086 assembly language programming.
3. Impart the knowledge on assembly language programming using MSP 430 microcontroller in code composer studio.
4. Analyze usage of various resources and I/O interface with MSP 430 in code composer studio.</td></tr>
<tr><td rowspan="7">Assessment/ Evaluation</td><td>Lab Experiments</td><td>15%</td></tr>
<tr><td>Record Writing</td><td>10%</td></tr>
<tr><td>Behavior/ Attitude</td><td>05%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>10%</td></tr>
<tr><td>Final Lab Test</td><td>30%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>20%</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. A.K.Ray and K.M.Bhurchandi, “Advanced Microprocessors and Peripherals”,TataMcGrawHill, 3rd edition July 2017.</td></tr>
</table>

	2. The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications, K. Uma Rao, Andhe Pallavi, Wiley Publication, 2019.	
Digital Learning Resources	**Course Name**	Introduction to Embedded System Design
	Course Link	https://nptel.ac.in/courses/108/102/108102169/
	Course Instructor	Prof. Dhananjay V. Gadre, Prof. Badri Subudhi, Netaji Subhas University of Technology, IIT Jammu
	Course Name	Microcontrollers and Applications
	Course Link	https://nptel.ac.in/courses/117/104/117104072/
	Course Instructor	Dr. S.P. Das, Electronics & Communication Engineering, IIT Kanpur

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Develop assembly language programs for various applications using 8086 Microprocessor.	PO1, PO2, PO3, PO4, PO6, PO9, PEO1, PEO3
CO2	Distinguish the use of different logical, shifting, string, branch instructions to apply in 8086 assembly language programming.	PO1, PO2, PO3, PO4, PO6, PO7, PO9, PO12, PEO1, PEO3
CO3	Impart the knowledge on assembly language programming using MSP 430 microcontroller in code composer studio.	PO1, PO2, PO3, PO4, PO6, PO9, PEO1, PEO3
CO4	Analyze usage of various resources and I/O interface with MSP 430 in code composer studio.	PO1, PO2, PO3, PO4, PO6, PO7, PO9, PO12, PEO1, PEO3

DETAILED SYLLABUS:

SL NO.	EXPERIMENT DEATILS	Hours
Programs involving signed and unsigned Arithmetic operations using 8086. (Any three)		
1	**a)** ASM Programs for 16 bit addition, subtraction, multiplication and division operations. **b)** Write an ASM program to find the factorial of a given number. **c)** Write an ALP program to find squares of numbers in an array. **d)** Write an ASM program to find the sum of series of 8-bit numbers. **e)** Write an ASM program to find summation of 1+2+3+…..+n. **f)** Program for decimal arithmetic operation using 8086.	**3 Hours**
Programs involving string and code conversion operation using 8086. (Any three)		
2	**a)** Program for string transfer. **b)** Program for string comparisons. **c)** Program for scan string. **d)** Write an ALP program to convert from BCD to ASCII code. **e)** Write an ALP program to convert from binary to BCD code.	**2 Hours**
Programs involving logical and Bit manipulation operation using 8086. (Any one)		
3	**a)** Write an 8086 ASM program to separate odd and even numbers. **b)** Write an 8086 ASM program for finding out the number of positive, negative and zeros from the given data set. **c)** Write an 8086 ASM program to find number of 1's and 0's in a given 16-bit data.	**2 Hours**
Programs involving Branch/ Loop instructions using 8086. (Any two)		
4	**a)** Programs for searching (Largest or Smallest). **b)** Programs for Sorting (Ascending or Descending).	**2 Hours**
5	Introduction to MSP430 launch pad and Programming Environment. (Study Experiment)	**2 Hours**
MSP 430 assembly language programming using code composer studio. (Any three)		
6	**a)** Program for signed and unsigned addition operation. **b)** Program to find the sum of integer arrays. **c)** Counter program using MSP 430. **d)** Data transfer program using MSP430. **e)** Program to count the number of appearance of a character from the string of character. **f)** Program to blink the LED on the MSP430 board.	**2 Hours**

Interfacing experiment (Any Four)		
7	Program to control LED (to ON/OFF) using code composer studio.	**2 Hours**
8	Interfacing the 7-segment display to MSP430 using code composer studio.	
9	Interfacing a 16*2 LCD with MSP430 using code composer studio.	**2 Hours**
10	Program to ADC module of MSP430.	**2 Hours**
11	Read input from switch and Automatic control/flash LED (soft-ware delay).	**1 Hours**
12	Enabling serial communication with UART on MSP 430 board using code composer studio.	**2 Hours**
Beyond syllabus Experiments		
12	PWM Generator	**2 Hours**
13	Interfacing the stepper motor to MSP430	**2 Hours**
14	DAC programming with MSP 430.	**2 Hours**

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics & Communication Engineering)	
Semester	5th	
Subject Name	Digital Communication Techniques Laboratory	
Course Type	Laboratory	
Course Code	22EC5PC03L	
Category	Professional Core	
Credit Point	1	
Time Commitment	Lecture	05 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	25 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics of CRO operation, signal analysis and measurement. Theoretical modulation and demodulation techniques.	
Subject Description	Student will learn the concept of digitization of analog signal, different modulation techniques. In addition to the theory in the corresponding labs students become familiar in hardware as well as MATALB simulation of the concept.	
Objectives and Outcomes	**Objectives:** 1. Make acquainted the students with basic analog-to-digital communication techniques. 2. Familiarize students with various digital modulation and demodulation techniques **3.** To get acquainted with various digital data communication network	

	Outcomes: On completion of the course the student will learn to; 1. To analyze and perform various analog to digital conversion technique 2. To be able to understand and analyze different digital modulation techniques in time as well as in frequency domain. 3. To get in hand exposure in understanding the data transmission in various digital networks.	
Assessment/ Evaluation	Lab Experiments	20%
	Record Writing	10%
	Behavior/ Attitude	05%
	Quiz	10%
	Attendance	05%
	Final Lab Test	30%
	Final Viva/ Final Lab Quiz Test	20%
Prescribed Text Book(s)	1. H. Taub, D. L Schilling, G. Saha, *Principles of Communication System*, 4th Edition, McGraw Hill, 2013, India. 2. B.P. Lathi, Z Ding and Gupta, *Modern Digital and Analogue Communication Systems*, 4th Edition, OxfordUniversity Press, 2010, New Delhi.	

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	To analyze and perform various analog to digital conversion technique	PO1, PO2
CO2	To be able to understand and analyze different digital modulation techniques in time as well as in frequency domain	PO1, PO2, PO3
CO3	To get in hand exposure in understanding the data transmission in various digital networks	PO1, PO2, PO3

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Duration in Hrs
1	Design and analysis of Delta modulation and demodulation	2
2	Design and analysis of Adaptive Delta modulation and demodulation	2
3	To study Time division multiplexing	2
4	To study the different channel coding and decoding technique	2
5	Generation and reception of different types of signals like ASK, PSK, FSK	2
6	Experimentally compare different forms of QPSK modulation	2
7	Generation and reception of Differential Phase shift keying (DPSK).	2
8	Generation and reception of Minimum shift keying (MSK)	2
9	Experimentally compare different forms modulation by analyzing their spectrum using spectrum analyzer	2
10	Simulate and compare ASK, PSK and FSK modulation using MATLAB	2
11	Simulate and compare QPSK, OQPSK and DPSK modulation using MATLAB	2