DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & MANAGEMENT, KOLKATA

UNIVERSITY OF ENGINEERING & MANAGEMENT, KOLKATA, JAIPUR

B.Tech ECE

7th Semester Structure and Detailed Syllabi

1. Curriculum Structure

7th Semester Structure

Sl. No.	Type	Subject Code	Subject Name	L	T	P	Total	Credit
1.	ECEL	PEEC701	Program Elective-3 A. Computer Architecture B. Microwave Theory and Techniques	3	0	0	3	3
2.	ECEL	PEEC702	Program Elective-4 A. Wireless Communication B. Electronic Measurement and Instrumentation	3	0	0	3	3
3.	ECEL	PEEC703	Program Elective-5 A. Digital Image and Video Processing B. Satellite Communication C. Embedded System	3	0	0	3	3
4.	OEC	OEEC704	Open Elective-2 A. Natural Language Processing with Large Language Models B. Web Technology	3	0	0	3	3
5	ECEL	PEEC791	A. Computer Architecture Laboratory B. Microwave Theory and Techniques Laboratory	0	0	2	2	1
6.	GSC	ESP702	ESP VII	1	0	0	1	0.5
7.	GSC	SDP782	SDP VII	0	0	1	1	0.5
8.	ECP	PRJEC781	Project Work - I	-	-	-	5	4
9.	Mandatory	Internship I	Internship					4
10.	Mandatory Course	MAR781	Mandatory Additional Requirement (MAR)	0	0	0	0	0
11.		IFC	Industry and Foreign Certification	0	0	0	0	0
Total Credit Points =								**22**

2. Seventh Semester Detailed Syllabi

PEEC701A: Computer Architecture

Subject Name	Computer Architecture
Subject Code	PEEC701A
Category	Engineering Sciences
Semester	7th
L-T-P	3-0-0
Credit	3
Pre-Requisites	Digital System Design, Microprocessors and Microcontrollers

Course Objective:

1. To learn how computer systems work & the basic principles.
2. To learn instruction level architecture and instruction execution.
3. To acquire knowledge the current state of art in memory system design.
4. To learn how I/O devices are accessed and its principles.
5. To impart the knowledge on micro programming.
6. To learn the principles of pipelining techniques, hazards, super-pipelines, interconnection networks.

Course Outcomes:

Sl. No.	Description	Blooms Level
PCCEC503.1	Understand basic structure of digital computer, concept of instruction sets and principles of computer's working.	Understand (L2)
PCCEC503.2	Explain numerous instruction formats, the various arithmetic operations for computers and concepts of micro-programmed control.	Understand (L2)
PCCEC503.3	Identify the fundamentals of memory system.	Understand (L2)
PCCEC503.4	Describe the concepts of I/O system and describe the concepts of parallel processing architecture and interconnection network.	Understand (L2)

Detailed Syllabus:

Module No.	Description of Topic	Contact Hours
1	Basic structure of computers: Computer organization and architecture overview, Basic functional units - hardware and software stack interfaces, Harvard and Von Neumann architecture, Performance issues in systems software, Machine instructions and applications programs, Types of instructions, and Instruction sets: Instruction formats, Assembly language, Stacks, Queues, Subroutines.	6
2	Processor organization: Information representation, number formats. Multiplication & division, ALU design, Floating point arithmetic, IEEE 754 floating point formats Control design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Micro-programmed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Micro-programmed computers - CPU control unit. CISC vs RISC CPU architecture	10
3	Memory organization: Memory system overview, Hierarchical memory technology, Device characteristics, RAM, ROM, Memory management, Concept of cache & associative memories, Virtual memory organization.	8
4	Input output systems and parallel processing: Standard I/O interfaces, Programmed I/O, Interrupt-driven I/O, DMA. Pipelining, pipeline hazards (data, control and structural hazards), techniques for handling hazards, Flynn's classification of computer architectures, overview of VLIW and superscalar processors, SIMD and vector processors, array processing, GPU Architecture, Symmetric multiprocessors (SMP), NUMA-MPs, Massively parallel processors (MPPs), interconnection networks, multiprocessing, multiplexing, multithreading.	12

Learning Resources:

Text Books:

7. William Stallings: “Computer Organization and Architecture”, 10th Ed., Pearson.
8. A. S. Tanenbum, “Structured Computer Organisation”, 6th Ed., Pearson.
9. V. Carl Hammacher, et al.: “Computer Organisation and Embedded Systems”, 6th Ed., McGraw Hill India.
10. M. Morris Mano, “Computer System Architecture”, Revised 3rd Ed., Pearson.
11. David A. Patterson and John L. Hennessy: “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by, Elsevier.
12. John L. Hennessy, David A. Patterson: “Computer Architecture: A Quantitative Approach”, 5th Ed., Morgan Kaufmann/Elsevier-India.
13. John Hayes: “Computer Architecture and Organization”, McGraw Hill Education; 3rd edition.
14. Kai Hwang, Naresh Jotwani: “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill Education; 3rd edition.

Mapping of CO with PO (Detailed; High: 3; Medium: 2; Low: 1):

Sl. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	1	1	-	-	-	-	-	-	-	-	-
2	2	1	1	-	-	-	-	-	-	-	-	-
3	2	1	1	-	-	-	-	-	-	-	-	-
4	2	1	1	-	-	-	-	-	-	-	-	-

PEEC701B: Microwave Theory and Techniques

Subject Code: PEEC701B	**Category:** Program Elective-3
Subject Name: Microwave Theory and Technique	**Semester:** 7th
L-T-P: 3-0-0 (Total Contact Hrs. 36)	**Credit:** 3
Pre-Requisites: Mathematics, Electromagnetic Waves	

COURSE OBJECTIVES:

- Understand the fundamentals of microwave engineering, microwave frequency bands, electromagnetic wave propagation, and microwave transmission media.
- Analyze microwave transmission structures, waveguides, microwave passive components, and scattering (S-) parameters for microwave circuit analysis.
- Apply the principles of microwave active devices, microwave design techniques, and impedance matching for microwave communication systems.
- Understand microwave measurement techniques, microwave instrumentation, antenna measurements, and the role of microwave systems in modern communication and EMI/EMC applications.

COURSE OUTCOMES

At the end of this course, the students should be able to:
CO1: Explain microwave fundamentals, electromagnetic wave propagation, microwave frequency bands, and applications of microwave engineering.
CO2: Analyze microwave transmission lines, waveguides, resonators, microwave passive components, and evaluate microwave networks using S-parameters.
CO3: Design and analyze microwave circuits using microwave active devices, impedance matching techniques, filters, oscillators, amplifiers, and mixers.
CO4: Perform microwave measurements using microwave instruments, analyze antenna parameters, evaluate microwave systems, and understand EMI/EMC considerations.

Module number	Topic	Sub-Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
Module 1:	Introduction to Microwaves:	Introduction to Microwaves: History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Brief introduction of EM waves: wave equations, solution of wave equation, time harmonic fields. Distortion and Condition for minimum attenuation.	International Academia: (https://www.tue.nl/studeren/professional-education/cursus-aanbod/microcredentials/microwave-engineering-antennas) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) Industry Mapping: software: Matlab	8	Experiment 1: Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω−β Plot].

Module II:	Microwave Transmission Modes, Waveguides, Transmission Lines: AND Microwave Passive Components and their S-matrix Representation:	**Microwave Transmission Modes, Waveguides, Transmission Lines:** Concept of Mode, Features of TEM, TE and TM Modes, Brief introduction of transmission lines, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission. Coaxial line, Rectangular Waveguide, Cavity Resonator, Circular waveguide, Strip line, Micro strip line. **Microwave Passive Components and their S-matrix Representation:** Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters. Isolator, Circulator, Gyrator, Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator.	International Academia: (https://www.tue.nl/studeren/professional-education/cursus-aanbod/microcredentials/microwave-engineering-antennas) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) NPTEL - Microwave Theory and Techniques (IIT Bombay): https://nptel.ac.in/courses/108101112 NPTEL - Microwave Engineering (IIT Guwahati): https://onlinecourses.nptel.ac.in/noc20_ee91/preview Industry Mapping: software: Matlab	10	Experiment 2: Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench.
Module III:	Microwave Vacuum Tubes:	**Microwave Vacuum Tubes:** Klystron, Reflex Klystron, TWT, and Magnetron. **Microwave Semiconductor Devices:** Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. **Microwave Design Principles:** Overview of Impedance Matching, Microwave Filter, RF and Microwave Amplifier, Microwave Power Amplifier, Low Noise Amplifier, Microwave Mixer, Microwave Oscillator.	International Academia: (https://www.tue.nl/studeren/professional-education/cursus-aanbod/microcredentials/microwave-engineering-antennas) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) NPTEL - Microwave Theory and Techniques (IIT Bombay): https://nptel.ac.in/courses/108101112 NPTEL - Microwave Engineering (IIT Guwahati): https://onlinecourses.nptel.ac.in/noc20_ee91/preview Industry Mapping: software: Matlab	10	Experiment 3: Study of the characteristics of a Reflex Klystron Oscillator. Experiment 4: Study of Gunn-oscillator Characteristics using X-band waveguide test bench.
Module IV:	Microwave Measurements:	**Microwave Measurements:** VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Power, Frequency and impedance measurement at microwave frequency. Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters. **Microwave Systems:** Introduction to EMI & EMC.	International Academia: (https://www.tue.nl/studeren/professional-education/cursus-aanbod/microcredentials/microwave-engineering-antennas) AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) NPTEL - Microwave Theory and Techniques (IIT Bombay): https://nptel.ac.in/courses/108101112 NPTEL - Microwave Engineering (IIT Guwahati): https://onlinecourses.nptel.ac.in/noc20_ee91/preview Industry Mapping: software: Matlab	8	Experiment 5: Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up. Experiment 6: Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band. Experiment 7: Measurement of phase shift of a microwave phase shifter

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson
2. Monojit Mitra, Microwave Engineering, Publisher: Dhanpat Rai

Reference Books:

3. R.E. Collins, Microwave Circuits, McGraw Hill
4. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech House
5. Kulkarni M, Microwave and Radar Engineering, UMESH Publications
6. David, M. Pozar, Microwave Engineering, Wiley India

CO–PO MAPPING (High = 3, Medium = 2, Low = 1)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	-	–	–	–	–	–	–	1
CO2	3	3	2	2	2	–	–	–	–	–	–	1
CO3	3	3	3	2	2	–	–	–	–	–	-	2
CO4	2	2	2	3	3	1	–	–	2	-	–	2

PEEC702A: Wireless Communication

Subject Name	Wireless Communication
Subject Code	PEEC702A
L-T-P	3-0-0
Credit	3

Lecture Hours: 36

Pre-requisite: Signals and Systems, Analog and Digital Communication, Mathematics.

Coursera link: https://www.coursera.org/learn/wireless-communications?

Linked link: https://www.linkedin.com/learning/iot-foundations-low-power-wireless-networking

NPTEL link: https://nptel.ac.in/courses/117104115

COURSE OBJECTIVE:

1. An understanding on functioning of different mobile communication system and evolution of different mobile communication systems and of different mobile communication systems and standards.
2. An ability to explain the architecture, functioning, protocols, capabilities and applications of various mobile communication networks.

COURSE OUTCOMES:

1. Demonstrate their understanding on functioning of wireless mobile communication system and evolution of different mobile communication systems and standards.
2. Explain the architecture and application of various mobile communication networks.
3. Demonstrate an ability to evaluate design challenges, constraints and security issues associated with wireless networks. Demonstrate an ability to explain multiple access techniques for Wireless mobile communication.

   Apply the concept of GSM in real time applications

4. Explain the wireless propagation channel modelling and their application.

Module number	Topic	Sub-Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignments	Text Books/ Study Material
1	**Introduction**	Cellular Mobile Wireless Networks: Systems and Design Fundamentals: Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.	***International Academia:https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus/, https://www.mit.edu.au/study-with-us/units/ME602/ME602%20-%20Mobile%20Communication%20Systems*** ***AICTE-prescribed syllabus:*** (https://www.aicte.gov.in/sites/default/files/Final_ECE.pdf) ***Industry Mapping:*** MATLAB/ Simulink applications designs and real time implementation.	5	1. Design, Simulation and implementation of wireless networks using MATLAB/NS2. 2. Design, Simulation and implementation of various modulation and demodulation using MATLAB. 3. Evaluation of co-channel interference using MATLAB.	Ref: Rappaport "Wireless communications-principles and practice", 2nd edition, Pearson pub: Chapter 1 and 2

2	**Propagation Channel modelling**	Characteristics of wireless channel and propagation path loss models: Different Multi-path propagation mechanisms, Multi-path effects on mobile communication, Fading, different types of fading, small and large scale fading, slow and fast fading, narrowband and wideband fading, Inter symbol interference, fast fading model, Doppler effect due to velocity of mobiles, Rayleigh envelop, free space propagation model, two ray ground reflection model, log distance path loss model, log normal shadowing model, macro and micro cell propagation models, types of base stations and mobile station antennas.	***International Academia*: *https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus/*, *https://www.mit.edu.au/study-with-us/units/ME602/ME602%20-%20Mobile%20Communication%20Systems*** ***AICTE prescribed syllabus:*** (https://www.aicte.gov.in/sites/default/files/Final_ECE.pdf) ***Industry Mapping:*** MATLAB/ Simulink applications designs and real time implementation of various channels.	4	Study of SNR calculation over various channel using MATLAB.	Ref: Rappaport "Wireless communications-principles and practice", 2nd edition, Pearson pub: Chapter 3, 4 and 6.

3	**Multiple access Techniques**	Multiple Access Technologies in cellular communication Time division multiple access (TDMA), narrowband and wideband TDMA, synchronous and asynchronous TDMA, Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA), Direct sequence CDMA, spread spectrum technique, spectral efficiency of different wireless access technologies: Spectral Efficiency in FDMA system, Spectral Efficiency in TDMA system, Spectral Efficiency for DS-CDMA system	***International Academia*: *https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus/*, *https://www.mit.edu.au/study-with-us/units/ME602/ME602%20-%20Mobile%20Communication%20Systems*** ***AICTE prescribed syllabus:*** (https://www.aicte.gov.in/sites/default/files/Final_ECE.pdf) ***Industry Mapping:*** MATLAB/Simulink applications designs to realize multiple access techniques.	7	Study of Modulation and Demodulation various Keying techniques along with various multiple access approach using MATLAB.	Ref: Rappaport "Wireless communications-principles and practice", 2nd edition, Pearson pub: Chapter 8.

4	**Mobile communication network architecture**	Path of evolution of cellular communication system architecture-1G, 2G, 3G, 4G and 4G beyond. Cellular Communication Networks and Systems Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multi-frame, Control (Signaling) Channel Multi-frame, Frames, Multi-frames, Super frames and Hyper-frames, GSM Call Set up Procedure, Location Update Procedure, Routing of a call to a Mobile Subscriber.	***International Academia*: *https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus/*, *https://www.mit.edu.au/study-with-us/units/ME602/ME602%20-%20Mobile%20Communication%20Systems*** ***AICTE prescribed syllabus:*** (https://www.aicte.gov.in/sites/default/files/Final_ECE.pdf) ***Industry Mapping:*** MATLAB/Simulink applications designs for transmitter and receivers.	8		Detailed study of frequency of operation, call establishment, channel strength, channel condition, spectrum access etc. through MATLAB/NS2.	Ref: Rappaport "Wireless communications-principles and practice", 2nd edition, Pearson pub: Chapter 1, 9 and 10.

Text Books:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI/Pearson education.
2. J. Schiller, Mobile communications, Addison-Wesley.

Reference Books:

1. William C. Y. Lee, Mobile cellular telecommunication–analog and digital systems, Mc Graw Hill, 2nd ed.
2. Wang, Wireless communication System, Pearson Education
3. Talukdar, Mobile computing, TMH
4. J. W. Mark, W. Zhuang, Wireless Communication and Networking, PHI
5. Stallings, Wireless Communication & Networks, Pearson Education
6. K. Feher, Wireless digital communications, Prentice Hall of India.
7. Roy Blake, Wireless communication technology, Thomson Delmer.

PEEC702B: Electronic Measurement and Instrumentation

Subject Name	Electronic Measurement and Instrumentation
Subject Code	PEEC702B
Credit	3
Lecture Hours	36
Prerequisites	Basic knowledge about components, Resistors, Inductors, Capacitors; Network Theorems; Basic knowledge about the operation of Semiconductor devices (Transistor, Diode etc.); Analog Electronics.

Course Objective:

The course aims to provide students with a solid foundation in the principles and practices of electronic measurements, enabling them to select and utilize appropriate instruments for various electrical and non-electrical parameters and to analyze and interpret measurement data accurately.

Course Outcomes:

- CO1: Classify the instrumentation and measurement system, identify performance characteristics, and analyze various measurement errors.
- CO2: Choose appropriate analog and digital instruments for the measurement of electrical quantities (voltage, current, power, energy, frequency).
- CO3: Evaluate different resistance, inductance, and capacitance measuring methods using various AC and DC bridges and the Q-meter.
- CO4: Analyze the fundamental operation and applications of oscilloscopes (CRO, DSO).

Relevant Links:

- Coursera: https://www.coursera.org/learn/sensors-circuit-interface
- Coursera: https://www.coursera.org/specializations/sensor-technologies-for-biomedical-applications
- LinkedIn Learning: https://www.linkedin.com/learning/electronics-foundations-fundamentals/the-fundamentals-of-electronics
- Study Material: https://docs.google.com/document/d/1ddSllqH4QdT-WaNGpzAOAx14gIh_InQF/edit?usp=drive_link&ouid=116508199826018918971&rtpof=true&sd=true
- NPTEL: https://onlinecourses.nptel.ac.in/noc26_ee29/preview
- NPTEL: https://onlinecourses.nptel.ac.in/noc26_ee01/preview
- NPTEL: https://onlinecourses.nptel.ac.in/noc26_bt07/preview
- Infosys Springboard: https://infyspringboard.onwingspan.com/web/en/page/lex_auth_01398121720035737617

Detailed Syllabus:

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Fundamentals of Measurement and Analog Instruments	Generalized measurement system, static and dynamic characteristics, types of errors and their statistical analysis. Analog measuring instruments; PMMC, MI, electrodynamometer; extension of range of instruments.	As per International Standards: https://explorecourses.stanford.edu/print?q=EE&descriptions=on&academicyear=&catalog=	6	No Lab
2	AC & DC Bridges and Impedance Measurement	DC bridges (Wheatstone, Kelvin double bridge), AC bridges (Maxwell's, Hay's, Schering, Wien	As per International Standards: https://explorecourses.stanford.edu/print?q=EE&descriptions=on&academicyear=&catalog=	6	No Lab

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
		bridges), Q-meter and impedance measurement methods.			
3	Cathode Ray Oscilloscope (CRO) and Signal Generators	Block diagram of CRO, time base circuits, deflection systems, probes, measurement of voltage, current, frequency and phase. Signal generators and function generators.	As per International Standards: https://explorecourses.stanford.edu/print?q=EE&descriptions=on&academicyear=&catalog=	6	No Lab
4	Digital Instruments and Signal Analysis	Advantages of digital over analog instruments, digital voltmeters (ramp, dual-slope integration, successive approximation), digital frequency meters, digital LCR meter, spectrum analyzer.	As per International Standards: https://explorecourses.stanford.edu/print?q=EE&descriptions=on&academicyear=&catalog=	6	No Lab
5	Transducers and Data Acquisition	Classification and selection criteria for transducers (active/passive), working principles and applications of temperature, pressure, displacement and strain transducers; data acquisition systems.	As per International Standards: https://explorecourses.stanford.edu/print?q=EE&descriptions=on&academicyear=&catalog=	5	No Lab
6	Application of GEN AI Tools for Analysis and Design of Simple Measuring Instrument	Introduction of GEN AI; Use of GEN AI for Analysis of Electronic Instruments; Use of GEN AI for Design of Simple Measuring Instruments.	https://in.mathworks.com/solutions/artificial-intelligence.html	3	No Lab

Learning Resources:

Text Books:

15. A Course in Electrical and Electronic Measurements and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co, Reprint, 2013.
16. Electronic Instrumentation, H. S. Kalsi, 3rd Edition, TMH.
17. Electronic Instrumentation & Measurements, David A. Bell, 3rd Edition, Oxford University Press.

Reference Books:

18. Modern Electronic Instrumentation and Measurement Techniques, Helfrick & Cooper, 2nd Edition, PHI.
19. Elements of Electronic Instrumentation and Measurement, Joseph J. Carr, 3rd Edition.
20. V. R. Moorthi, “Power Electronics”, Oxford University Press.

PEEC703A: Digital Image and Video Processing

Subject Name	Digital Image and Video Processing Systems
Subject Code	PEEC703A
L-T-P	3-0-0
Credit	3
Semester	7th (source screenshot: 8th)
Pre-Requisites	Signals and systems

Coursera: https://www.coursera.org/learn/digital

NPTEL: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee178dd

Course Objective:

21. To understand the basic representation of image and enhancement procedure.
22. To comprehend the concepts of color image processing and segmentation technique.
23. To describe different compression techniques and multi-resolution technique.
24. To illustrate quantitative models of video processing and video segmentation.

Course Outcomes:

Sl. No.	Description	Blooms Level
PEEC703A.1	Mathematically represent the various types of images and apply a proper image enhancement technique for given a set of noisy images.	Understand (L2), Level 3 (Apply)
PEEC703A.2	Understand color image processing technique and different segmentation techniques.	Understand (L2)
PEEC703A.3	Apply algorithms for image compression and coding.	Understand (L2), Level 3 (Apply)
PEEC703A.4	Comprehend different methods and models for video processing and motion estimation.	Understand (L2)

Detailed Syllabus:

Module No.	Description of Topic	Contact Hrs.
1	Overview: Digital Image Fundamentals - Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels - neighbourhood, adjacency, connectivity, distance measures. Image Enhancements: Image enhancements and filtering; gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters - linear and order-statistics, pixel-domain sharpening filters - first and second derivative, two-dimensional DFT and its inverse, frequency domain filters - low-pass and high-pass.	10
2	Color Image Processing: Color models - RGB, YUV, HSI; color transformations - formulation, color complements, color slicing, tone and color corrections; color image smoothing and sharpening; color segmentation. Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding - global and adaptive, region-based segmentation.	10
3	Wavelets and Multi-resolution Image Processing: Uncertainty principles of Fourier Transform, time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and sub-band filter banks, wavelet packets. Image Compression: Redundancy - inter-pixel and psycho-visual; lossless compression - predictive and entropy; lossy compression - predictive and transform coding; Discrete Cosine Transform; still image compression standards - JPEG and JPEG-2000.	10
4	Fundamentals of Video Coding: Inter-frame redundancy, motion estimation techniques - full search, fast search strategies, forward and backward motion prediction, frame classification - I, P and B; video sequence hierarchy - group of pictures, frames, slices, macro-blocks and blocks; elements of a video encoder and decoder; video coding standards - MPEG and H.26X.	10

Module No.	Description of Topic	Contact Hrs.
	Video Segmentation: Temporal segmentation - shot boundary detection, hard-cuts and soft-cuts; spatial segmentation - motion-based; video object detection and tracking.	

Learning Resources:

Text Books:

25. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education, 3rd edition, 2008.
26. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2nd edition, 2004.
27. Murat Tekalp, Digital Video Processing, Prentice Hall, 2nd edition, 2015.

Mapping of CO with PO (Detailed; High: 3; Medium: 2; Low: 1):

S.No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEEC703A.1	3	3	1	1	2							
PEEC703A.2	3	3	1	1	2							
PEEC703A.3	3	3	1	1	2							
PEEC703A.4	3	3	1	1	2							

PEEC703B: Satellite Communication

Subject Name	Satellite Communication
Subject Code	PEEC703B
Category	Program Elective-5
Semester	7th
L-T-P	3-0-0 (Total Contact Hrs. 31)
Credit	3
Pre-Requisites	Mathematics, Communication

Course Objective:

28. To learn about brief architecture and various roles of subsystems in satellite communication.
29. To learn about orbital equations to solve numerical problems related to orbital motion.
30. To obtain knowledge on various signal modulation schemes used in satellite communication.
31. To learn about various satellite communication phenomena and signal power calculation process.

Course Outcomes:

- CO1: Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- CO2: State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- CO3: Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Detailed Syllabus:

Module No. and CO Mapping	Description	Hours	Bloom's Level	PO Mapping
Module 1: (PEEC703B.1)	Introduction to Satellite Communication: Principles and architecture of satellite communication, brief history of satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.	3	2	1, 2
Module 2: (PEEC703B.2)	Orbital Mechanics: Orbital equations, Kepler's laws, apogee and perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of solar day and sidereal day.	4	2, 4	1, 2, 3
Module 3: (PEEC703B.2)	Launch Vehicles: Launch vehicles - principles of rocket propulsion, powered flight, launch vehicles for communication satellites.	3		1, 2, 3

Module No. and CO Mapping	Description	Hours	Bloom's Level	PO Mapping
Module 4: (PEEC703B.2)	Satellite Sub-systems: Satellite sub-systems, redundancy of sub-system, bathtub curve and satellite link design - AOCS, TT&C, power system, spacecraft antenna, transponder.	5	2	1, 2, 3
Module 5: (PEEC703B.3)	Typical Phenomena in Satellite Communication: Solar eclipse on satellite, its effects, remedies for eclipse, sun transit outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.	5	2	1, 3
Module 6: (PEEC703B.3)	Flux Density and Received Signal Power Equations: RF link, Friis transmission equation, G/T ratio of earth station, drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, calculation of system noise temperature for satellite receiver, noise power calculation.	6	2, 4	2, 3, 5
Module 7: (PEEC703B.2)	Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, meaning of multiple access, multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.	5	1, 2	1, 3, 5

Learning Resources:

Text Books:

32. Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications, Wiley India, 2nd edition, 2002.
33. Tri T. Ha: Digital Satellite Communications, Tata McGraw Hill, 2009.
34. Dennis Roddy: Satellite Communication, 4th Edition, McGraw Hill, 2009.

Mapping of CO with PO (Detailed; High: 3; Medium: 2; Low: 1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	1	-	1	-	-	-	-	-	-	-
2	3	3	3	-	3	-	-	-	-	-	-	-
3	3	3	3	-	2	-	-	-	-	-	-	-
4	3	2.67	2.33	-	2	-	-	-	-	-	-	-

PEEC703C: Embedded System

Subject Name	Embedded System
Subject Code	PEEC703C
Credit	3
Lecture Hours	36
Pre-requisites	Digital Electronics, Microprocessors and Microcontrollers, C and C++ Programming.

Pre-requisites:

Digital Electronics, Microprocessors and Microcontrollers, C and C++ Programming.

Course Objectives:

1. To introduce the fundamental concepts and architecture of embedded systems, including microcontrollers and processors.
2. To develop the ability to design and implement embedded hardware and software systems for real-world applications.
3. To provide knowledge of real-time operating systems (RTOS) and their role in embedded system development.
4. To foster analytical skills to evaluate design trade-offs in hardware-software co-design and system optimization.

Course Outcomes:

1. Understand advanced concepts of Embedded System Architecture.
2. Design systems for various embedded applications.
3. Design software systems such as RTOS using embedded controllers.
4. Analyze Hardware Software co-design trade-off.

Relevant Links:

Coursera: https://www.coursera.org/learn/introduction-embedded-systems
NPTEL: https://nptel.ac.in/courses/108102045
Linkedin Learning: https://www.linkedin.com/learning/c-programming-for-embedded-applications-14537235
Infosys Springboard: https://infyspringboard.onwingspan.com/web/en/login
Study Material: https://drive.google.com/drive/folders/1HLaNGtv3XoIp46j32LbMwh43PeStc9Xl?usp=sharing

Module Number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Introduction to Embedded Systems**	Definition of Embedded System and its features, Embedded Systems vs General Computing Systems, Classification of Embedded Systems, Embedded Hardware Units, Embedded Software, Applications and examples of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1* ***AICTE-prescribed syllabus*:** *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:*** *https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html* *https://mu.microchip.com/page/embedded-system-design*	6	-

2	**Embedded Processors**	Generic structure and features, choice of microcontroller, ARM microcontroller Structure, Instruction Set (ARM, THUMB), exceptions, digital signal processors with examples, field-programmable gate arrays (FPGAs), and application-specific integrated circuits (ASICs). Embedded memories Choosing the appropriate embedded hardware platform.	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1* ***AICTE prescribed syllabus:*** *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:*** *https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html* *https://mu.microchip.com/page/embedded-system-design*	5	-
3	**Interfacing**	Understanding serial peripheral interface (SPI), inter-integrated circuits (I2C), RS-232C series, Universal Serial Bus (USB), infrared communication (IrDA), and Controller Area Network (CAN). Bluetooth, ADCs and DACs. subsystem interfacing. User interfaces.	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1* *AICTE prescribed syllabus:* *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:***	6	-

			https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html *https://mu.microchip.com/page/embedded-system-design*		
4	**Real-Time System Design and RTOS**	Real-time task periodicity, scheduling, and scheduling algorithms, Resource sharing and priority inheritance protocols, Examples of Real Time Operating Systems (RTOS).	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1* ***AICTE prescribed syllabus:*** *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:*** *https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html* *https://mu.microchip.com/page/embedded-system-design/*	6	-
5	**Embedded programming**	Features of embedded programming languages, comparison between such languages, Choosing a language, Embedded C overview.	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1*	5	-

			AICTE prescribed syllabus: *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:*** *https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html* *https://mu.microchip.com/page/embedded-system-design*		
6	**Hardware-Software Co-Design**	Co-simulation and partitioning techniques. Optimization methods such as integer linear programming, Kernighan-Lin heuristic, genetic algorithms, and particle swarm optimization. Power-aware partitioning and functional partitioning.	***International Standards:*** *https://web.stanford.edu/class/cs240e/* *https://pll.harvard.edu/subject/embedded-systems-1* ***AICTE prescribed syllabus:*** *https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf* ***Industry Mapping:*** *https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html* *https://mu.microchip.com/page/embedded-system-design*	8	-

Text Books:

1. Raj Kamal, “Embedded Systems: Architecture, Programming and Design”, Second Edition, Tata McGraw-Hill.
2. Shibu, K. V. “Introduction to embedded systems”, Second Edition, Tata McGraw-Hill Education.

CO-PO Mapping Matrix — Embedded System (PEEC703C)												
Correlation levels: 1 = Slight/Low · 2 = Moderate/Medium · 3 = Substantial/High · – = No significant correlation												
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	–	–	1	–	–	–	–	–	–	1
CO2	3	2	3	1	3	–	–	–	–	–	–	1
CO3	3	2	3	2	3	–	–	–	–	–	–	1
CO4	3	3	2	3	2	–	1	–	–	–	–	1
Avg.	**3**	**2**	**2.67**	**2**	**2.25**	**–**	**1**	**–**	**–**	**–**	**–**	**1**

OEEC704A: Natural Language Processing with Large Language Models

Subject Name	Natural Language Processing with Large Language Models
Subject Code	OEEC704A
L-T-P	3-0-0
Credit	3

Lecture Hours: 36

Pre-Requisites

1. Deep Learning with Generative AI (OEEC604A)
2. Basic concepts from Mathematics & Statistics (Linear Algebra, Statistics and Probability, Calculus)
3. Programming in Python using SciKit-Learn and PyTorch, and other libraries
4. The objectives of this course are to:

CO#	**Objective**	**Module**
CO1	Introduce students to the foundational concepts of Natural Language Processing (NLP), including linguistic levels, text processing challenges, and corpora construction	Module 1
CO2	Develop understanding of tokenization, N-gram language models, Part-of-Speech tagging, and sequence models including Hidden Markov Models	Module 2
CO3	Teach vector semantics, word embeddings (Word2Vec, GloVe, CBOW, Skip-gram), and their applications in text classification and sentiment analysis	Module 3
CO4	Provide in-depth exposure to Transformer architectures, attention mechanisms, masked language models (BERT), and Large Language Models (LLMs) including prompting and fine-tuning	Module 4
CO5	Enable students to apply NLP and LLM techniques to downstream tasks such as Named Entity Recognition, Machine Translation, Automatic Speech Recognition, Text-to-Speech, Summarization, Question Answering, RAG, and Dialog Systems	Module 5

NPTEL Coursera LinkedIn Study Material

Module number	**Topic**	**Sub-topics**	**Mapping with Industry and**	**Lecture Hours**	**Project Mapping**

			International Academia		
1	**Introduction** **Words and Tokens**	**<u>Introduction to Natural Language (NL)</u>**: Why is it hard to process a natural language? Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms, Language, Thought, and Understanding, The State of the Art; Levels of Language Processing, Linguistic Fundamentals for NLP Problems and perspectives, Information Extraction and Named Entity Recognition, Text processing, Corpora and their construction. **<u>Textbook:</u>** **Ch.1 & 2: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition, Pearson, 2023**	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** *Scikit-Learn, PyTorch, Spacy, TextBlob, OpenAI, Stanford CoreNLP*	2	

2	**Words and Tokens;** **N-gram Language Models**	**Words and Tokens:** Words, Morphemes: Parts of Words, Unicode, Subword Tokenization: Byte-Pair Encoding, Corpora, Regular Expressions, Rule-based tokenization, Minimum Edit Distance **N-gram Language Models** N-Grams, Evaluating Language Models: Training and Test Sets, Evaluating Language Models: Perplexity, Sampling sentences from a language model, Generalizing vs. overfitting the training set, Smoothing, Interpolation, and Backoff and Part-of-speech tagging Finite and Named Entities; Sequence Models: Hidden-Markov. **Textbook:** **Ch.2 & 3: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition, Pearson, 2023**	***International Standards*** : **(1) Stanford University** NLP-LLM Syllabus (CS224N): Natural Language Processing with Large Language Models http://web.stanford.edu/class/cs224n/ **(2) Carnegie Mellon University:** https://www.cs.cmu.edu/~ehn/11-611/ **(4) Virginia Tech:** https://people.cs.vt.edu/~barnette/grad/courses/Fall2021/NLP5984_Syllabus.pdf (**5) IIT Madras:** https://study.iitm.ac.in/ds/course_pages/BSDA5005.html	8	
3	**Embeddings, Semantics**	**Embeddings:** Lexical Semantics, Homographs, and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Thesaurus – WordNet Vector Semantics: The Intuition, Simple count-based embeddings, Cosine for measuring similarity, Word2vec, GloVE, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models, Introduction to Lexical Semantics, Distributional Semantics, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; Word Embedding, Text Classification, Sentiment Analysis, Term Frequency, Inverse Document Frequency based ranking	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** *Scikit-Learn, PyTorch, Spacy, TextBlob,*	8	

		Textbook: **Ch.5: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition, Pearson, 2023**	*OpenAI, Stanford CoreNLP* ***International Standards*** : **(1) Stanford University** NLP-LLM Syllabus (CS224N): Natural Language Processing with Large Language Models http://web.stanford.edu/class/cs224n/ **(2) Carnegie Mellon University:** https://www.cs.cmu.edu/~ehn/11-611/ **(4) Virginia Tech:** https://people.cs.vt.edu/~barnette/grad/courses/Fall2021/NLP5984_Syllabus.pdf (**5) IIT Madras:** https://study.iitm.ac.in/ds/course_pages/BSDA5005.html		
4	**Transformers & LLM**	**Large Language Models:** Three architectures for language models, Conditional Generation of Text: The Intuition, Prompting, Generation and Sampling, Training Large Language Models, Evaluating Large Language Models, Ethical and Safety Issues with Language Models **Transformers:** Attention, Transformer Blocks , Parallelizing computation using a single matrix X, The input: embeddings for token and position, The Language Modeling Head , More on Sampling, Training, Dealing with scale, Interpreting the Transformer **Masked Language Models:** Bidirectional Transformer Encoders, Training Bidirectional Encoders, Contextual Embeddings, Fine-Tuning for Classification, Fine-Tuning for Sequence Labeling: Named Entity Recognition **Post-training: Instruction Tuning, Alignment, and Test-Time Compute** Instruction Tuning, Learning from Preferences, LLM Alignment via Preference-Based Learning Test-time Compute **Textbook:** **Ch.7,8,9,10: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition, Pearson, 2023**		12	

5	**NLP applications**	**NLP applications**: Natural Language Generation, Machine Translation, Summarization, Parsing, Sentiment Analysis, Topic modelling, Recommendation System, Fact-checking, Question Answering, etc., example Chatbots and Coreference Resolution, and applications to ChatGPT, Bard, etc.**Pre-trained Language Models (PLMs): BERT, GPT, etc. Fine-tuning and transfer learning** (Code demo: Transformers). Information Retrieval and Retrieval Augmented generation (RAG) **Textbook:** 1. **Ch. 11, 12, 14, 15, 16: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition, Pearson, 2023** 2. **Classnotes**		6	

Text Books:

For NLP with Deep Learning - LLM (Transformers)
1. Ch. 1, 2, 3, 5 to 12, 14 to 16 - of: Jurafsky, Dan and Martin, James: Speech and Language Processing, 3rd Edition (Draft of January 6, 2026)

Reference Books – for Theory:

For TRANSFORMERS & LLM:

(1) **Ch. 23 & 24 of: Stuart Russell and Peter Norvig**: "Artificial Intelligence - A Modern Approach", (Pearson,4th edition, 2022)

(2) **Ch. 12 of: C.M. Bishop with H.Bishop**: "Deep Learning – Foundations and Concepts", (Springer, November, 2023)

(3) **Ch. 12 of: Charu C. Aggarwal**: "Neural Networks and Deep Learning" (Springer, 2nd edition, July, 2024)
(*NOTE: Dr. Charu C. Aggarwal is a US-based award-winning Distinguished Senior AI Research Scientist at IBM T.J.Watson Research Center, Yorktown Heights, New York, USA, with a PhD in AI from MIT*)

(4) **Ch. 11 of: Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola**: Dive into Deep Learning (Cambridge University Press, December 2023). can be freely accessed online at: https://d2l.ai/

Reference Books – for Theory Textbooks + Hands-On Implementation:

(1) **Ch. 15 of: Aurelien Geron:** Hands-On Machine Learning with Scikit-Learn and PyTorch: Concepts, Tools, and Techniques to Build Intelligent Systems – (O'REILLY – Shroff Publishers and Distributors India, December, 2025)

Course Outcomes (COs)

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

CO#	Course Outcome	Bloom's Level	Mapped POs
CO1	**Explain** the challenges and levels of natural language processing, including ambiguity, corpora construction, and rule-based text processing using standard NLP tools	L2 – Understand	PO1, PO12
CO2	**Apply** N-gram models, smoothing techniques, POS tagging, and HMM-based sequence labeling to real text data using Python (SpaCy, NLTK, PyTorch)	L3 – Apply	PO1, PO2, PO5
CO3	**Construct** and **evaluate** word embedding models (Word2Vec, GloVe) and use them for semantic similarity, text classification, and sentiment analysis tasks	L4 – Analyze	PO3, PO5
CO4	**Design** and **fine-tune** Transformer-based LLMs (BERT, GPT-style models) for classification, Named Entity Recognition, and generative NLP tasks using HuggingFace and PyTorch	L5 – Evaluate	PO3, PO4, PO5
CO5	**Implement** end-to-end NLP pipelines for applications including machine translation, dialogue systems, question answering, RAG, and address ethical and safety considerations in LLMs	L6 – Create	PO4, PO5, PO12

PO1: Engineering Knowledge; PO2: Problem Analysis; PO3: Design/Development of Solutions; PO4: Modern Tool Usage; PO5: Research; PO12: Life-long Learning (Ethics)

CO–PO Attainment Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	1	–	–	–	–	–	–	2
CO2	3	3	2	2	2	–	–	–	–	–	–	1
CO3	2	3	3	2	3	–	–	–	–	–	–	1
CO4	2	2	3	3	3	–	–	–	1	–	–	2
CO5	1	2	3	3	3	–	1	–	2	–	–	3

Scale: 3 = High, 2 = Medium, 1 = Low, – = No mapping

OEEC704B: Web Technology

Subject Name	Web Technology
Subject Code	OEEC704B
Credit	3
Lecture Hours	32
Pre-requisite	Basic Programming Concepts and Computer Fundamentals

Course Objective:

35. Understand the architecture and working principles of the World Wide Web.
36. Develop static web pages using HTML5 and CSS3.
37. Implement client-side interactivity using JavaScript.
38. Design responsive web interfaces suitable for multiple devices and apply basic server-side concepts and database connectivity.
39. Develop simple dynamic web applications following good web development practice.

Course Outcomes:

- CO1: Explain the fundamentals of web technologies and internet architecture.
- CO2: Create structured web pages using HTML5 and CSS3
- CO3: Develop interactive web pages using JavaScript.
- CO4: Design responsive and user-friendly web interfaces.
- CO5: Implement basic server-side scripting and database connectivity.
- CO6: Develop and deploy a simple web-based application integrating client-side and server-side components.

Relevant Links:

- Coursera: https://sl1nk.com/kw87w9o
- LinkedIn Learning: https://l1nk.dev/42p2q3t

Detailed Syllabus:

Module number	Topic	Sub Topics	Mapping with Industry and International Academia	Lecture Hours
1	Introduction to Web Technologies	Evolution of the Web, Internet Architecture, Client-Server Model, Web Browsers, HTTP & HTTPS, URL, DNS, HTML5 fundamentals, Page Structure, Lists, Tables, Forms, Multimedia, Introduction to CSS3, Selectors, Box Model, Layout Techniques	International Mapping: HTML5 and CSS3 standards recommended by the World Wide Web Consortium, GitHub platform for version control and collaborative development, HackerRank platform for web programming practice, Chrome Developer Tools for webpage inspection and debugging will be used.	8
2	Client-Side Scripting	JavaScript Basics, Variables, Data Types, Operators, Control Statements, Functions, Arrays, Objects, DOM Manipulation, Event Handling, Form Validation, Error Handling	International Mapping: ECMAScript (JavaScript) standards recommended by the Ecma International, GitHub platform for collaborative web development, HackerRank platform for JavaScript programming practice, Google Chrome Developer Tools and Visual Studio Code will be used for debugging, testing, and developing client-side web applications.	8

Module number	Topic	Sub Topics	Mapping with Industry and International Academia	Lecture Hours
3	Server-Side Web Technologies	Introduction to Server-Side Programming, PHP Basics, Forms Processing, Sessions & Cookies, Introduction to MySQL, Database Connectivity, CRUD Concepts, Dynamic Web Pages	International Mapping: PHP and MySQL based web application development following industry best practices, GitHub platform for collaborative development and version control, XAMPP/WAMP environment for server-side application development and testing, and phpMyAdmin for database management will be used.	8
4	Advanced Web Technologies	AJAX, JSON, XML, RESTful Web Services, Web Security Basics (Authentication, Authorization, XSS, SQL Injection), Responsive Web Design, Introduction to Web Hosting, Overview of Modern Web Frameworks	International Mapping: RESTful API development and JSON data exchange based on industry standards, responsive web design using HTML5 and CSS3 recommended by the World Wide Web Consortium, GitHub platform for collaborative web application development, Postman for API testing, and industry best practices for web security, authentication, and secure web application deployment will be followed.	8

Learning Resources:

Text Books:

40. "WEB Technology & Design" by C. Xavier.
41. "Web Technologies" by Achyut S Godbole and Atul Kahate.

Reference Books:

42. Learning Web Design, O'Reilly Media.
43. HTML and CSS: Design and Build Websites, Wiley.

PEEC791A: Computer Architecture Laboratory

Subject Name: Computer Architecture Laboratory **Credit: 1** **Subject Code: PEEC791A**

Introduction to VHDL: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures, Concurrent Signal Assignment, Event Scheduling, Statement Concurrency, Structural Designs, Sequential Behavior, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements

Dataflow Modeling: Basic Gates & Universal Gates using Dataflow, Combinational Dataflow Design, Arithmetic Logic Unit (ALU) Dataflow Design, Tri-State Buffers and Bus Implementations

Sequential Processing: Process Statement, Signal Assignment Versus Variable Assignment, Sequential Statements, ASSERT Statement, WAIT Statements,

Data Types: Object Types, Data Types, File Types

Configurations: Default Configurations, Component Configurations, Mapping Library Entities, Architecture Configurations

Text book

VHDL: Programming by Example, Douglas L. Perry, Fourth Edition.

PEEC791B: Microwave Theory and Technique Laboratory

Subject Code: PEEC791B	**Category:** Program Elective-3
Subject Name: Microwave Theory and Technique Lab	**Semester:** 7th
L-T-P: 0-0-3 (Total Contact Hrs. 21)	**Credit:** 1
Pre-Requisites: Mathematics, Electromagnetic Waves	

Course Objectives:

- To familiarize students with the operation and characteristics of microwave components and waveguide systems.
- To develop practical skills in measuring microwave parameters such as impedance, phase velocity, group velocity, coupling, directivity, insertion loss, and isolation.
- To provide hands-on experience with microwave sources, including Reflex Klystron and Gunn Oscillator, using X-band waveguide test benches.
- To enable students to analyze the performance of microwave devices such as directional couplers, magic tees, E-plane tees, H-plane tees, and phase shifters through experimental investigations.

Course Outcomes:

After successful completion of this laboratory course, students will be able to:

CO1: Determine the phase and group velocities of electromagnetic waves in a rectangular waveguide using dispersion characteristics.

CO2: Measure unknown microwave impedance and susceptance using the shift-in-minima technique on a waveguide test bench.

CO3: Analyze the operating characteristics of microwave sources such as Reflex Klystron and Gunn Oscillator.

CO4: Evaluate the performance of microwave passive components by measuring scattering parameters, coupling factor, directivity, insertion loss, isolation, and phase shift.

Course Content:

Module number	Description of Topic	Contact Hrs.
Module 1:	Experiment 1: Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω−β Plot].	3
Module 2:	Experiment 2: Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench.	3
Module 3:	Experiment 3: Study of the characteristics of a Reflex Klystron Oscillator.	3
Module 3:	Experiment 4: Study of Gunn-oscillator Characteristics using X-band waveguide test bench.	3
Module 4:	Experiment 5: Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up.	3
Module 4:	Experiment 6: Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band.	3
Module 4:	Experiment 7: Measurement of phase shift of a microwave phase shifter.	3

Text Books

1. Laboratory manual provided from the organization.
2. David M. Pozar, Microwave Engineering, 4th Edition, Wiley.
3. Samuel Y. Liao, Microwave Devices and Circuits, 3rd Edition, Pearson.
4. R. E. Collin, Foundations for Microwave Engineering, 2nd Edition, Wiley.

Reference Books

5. Annapurna Das and Sisir K. Das, Microwave Engineering, McGraw-Hill Education.
6. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, PHI.
7. M. L. Sisodia and G. S. Raghuvanshi, Microwave Circuits and Passive Devices, Wiley Eastern.

ESP702: ESP VII

Subject Name	ESP-VII
Subject Code	ESP702
Category	Sessional
Semester	7th
L-T-P	2-0-0 (Total Contact Hrs. 2)
Credit	2
Pre-Requisites	Basics Physics

Course Objective:

44. To learn about the basic of control systems and their applications for professional exams.
45. To learn about fundamentals of communication engineering for various exams.
46. To learn about various steady state and transient analysis of the systems for professional exams.
47. To learn about advance systems of communication for various exams.

Course Outcomes:

- To develop an understanding of basic of control systems.
- To learn basic communication process and their applications in devices.
- To understand steady state and transient states of devices and their effects.
- To use advance systems of communication and understand their operating principles.

Detailed Syllabus:

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
1	Communication Systems: Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; information theory: entropy, mutual information and channel capacity theorem; digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver,	18	L1 (Remember) L2 (Understand) L4 (Analyze)	PO1, PO2, PO3, PO12

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
	calculation of bandwidth, SNR and BER for digital modulation; fundamentals of error correction, Hamming codes; timing and frequency synchronization, inter-symbol interference and its mitigation; basics of TDMA, FDMA and CDMA.			
2	Control Systems: Basic control system components; feedback principle; transfer function; block diagram representation; signal flow graph; transient and steady-state analysis of LTI systems; frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; lag, lead and lag-lead compensation; state variable model and solution of state equation of LTI systems.	18	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1, PO2, PO3, PO12

Learning Resources:

Reference Books:

48. G. K. Publishers GATE Electronics & Communications.
49. McGraw Hill GATE 2020 Electronics & Communications.
50. Wiley GATE 2020 Electronics & Communications.

SDP782: SDP VII

Subject Name	Skill Development for Professionals - VII
Subject Code	SDP782
Category	Sessional
Semester	7th
L-T-P	0-0-1 (source screenshot shows 2-0-0; Total Contact Hrs. 2)
Credit	0.5 (source screenshot shows 1)
Pre-Requisites	Basic Mathematics, General English from primary to high school.

Course Objective:

51. To enhance the aptitude and analytical skill of students with multiple tricky approaches.
52. To prepare the students for various competitive examinations and professional exams.

Course Outcomes:

- Revision of entire syllabus along with specific type of mock tests for the competitive exams like UPSC, IBPS, SBI PO/SO, SSC, RAIL, INSURANCE etc.
- Learning advance quantitative aptitude techniques on algebra, geometry, mensuration, etc. which is very essential for appearing in different competitive exams along with SSC.
- Solving puzzle based problems and learning different analytical techniques.
- Miscellaneous practice sets on different competitive exams mains level papers.

Detailed Syllabus:

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
1	Quantitative Aptitude Miscellaneous problems on quantitative aptitude [CAT level-4].	12	L1 (Remember) L2 (Understand) L4 (Analyse)	PO1, PO2, PO3, PO4
2	Logical Reasoning Miscellaneous problems on logical reasoning [CAT level 4].	12	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1, PO2, PO3, PO4
3	Verbal English Miscellaneous problems on verbal English [CAT level-4].	12	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1, PO2, PO3, PO4

Learning Resources:

Reference Books:

53. Objective General English - S. P. Bakshi.
54. English Grammar and Competition - S. C. Gupta.
55. Fast Track Objective Arithmetic - Rajesh Verma.
56. Advance Maths - Rakesh Yadav.
57. Verbal and Non-Verbal Reasoning - R. S. Agarwal.
58. A New Approach to Reasoning - B. S. Sijwali.
59. Quantitative Aptitude - R. S. Agarwal.