Scheme of Studies & Syllabus

Master of Technology
Electronics and Communication Engineering
2022

Department of EECE

SCHOOL OF ENGINEERING & TECHNOLOGY

THE NORTHCAP UNIVERSITY
POWERED BY
Arizona State University

THE NORTHCAP UNIVERSITY, GURGAON

(Established under Haryana Govt. Notification No. Leg. 32/2006-HARYANA ACT No.25 of 2009)

Scheme of Studies & Syllabus
M.Tech in Electronics and Communication Engineering

Department of EECE offers the following programs during the academic year 2022-23:

Master of Technology (M.Tech.) in Electronics and Communication Engineering with specialization in

- Communication Engineering
- VLSI Design

Unique Selling Points of the Programme:

- **Industry ready curriculum** ensures learning of cutting-edge technologies which helps students to head start their career in core industries such as Telecommunication & IT industries, Mobile communication (3G, 4G and 5G), Internet technologies, Navigation systems etc.
- **ISRO assisted NavIC lab** for hands-on experience on Indian navigation system for good research work and placements in government research labs and may seamlessly continue for PhD.
- **Good research environment** with state-of-the-art laboratories in the field of Navigation System, Signal Processing, Communication Engineering etc. and **MATLAB** enabled campus.
- **Industry standard software** such as **Cadence** and **Xilinx** for hands-on experience to Front-end and Back-end processes of the VLSI industry and thus getting placements in VLSI giants.
- **Updated curriculum** aligned with the industry need with inputs from industry experts.
- **Highly qualified and experienced faculty** with a strong focus on Research.
- **Flexible teaching pedagogy** - Class room teaching, lab classes, webinars, MOOC and blended learning.
- **Holistic Pedagogy**-Emphasis on development of additional skills:
    - With strong emphasis on project-based experiential learning
    - Courses on emerging technologies like IoT, Cloud computing etc.
    - Open elective with interdisciplinary learning
    - Dissertation in two phases with more emphasis on industry oriented and socially relevant problems
- **Teaching assistantship to GATE qualified students** as per Government rules.
- **Excellent Placements with attractive packages** each year in reputed Indian and multi-national companies for last more than 12 years.
- **Strong Industry-Academia interaction** through Industry associated research projects, industrial visits, expert lectures, workshops and conferences.

Department of EECE
M. Tech in Electronics and Communication Engineering
(With specialization in Communication Engineering / VLSI Design)
2022

M.Tech full time (2 years)

Sem	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	L	T	P	Weekly Contact Hours	Credits
I	ECL505 Adv. Digital Communication 3-0-2(4)	ECL523 Digital VLSI Design 3-0-2(4)	Program Elective-1 3-0-2(4)	Program Elective-2 3-0-2 (4)	ECC509 Seminar 0-0-4(2)	ECS501 Community Service	12	0	12	24	18
II	ECL501 Digital Signal Processing 3-0-2(4)	ECL513 Machine Learning 2-0-2(3)	Program Elective-3 3-0-2(4)	Program Elective-4 3-0-2(4)	ECD512 Minor Project 0-0-10(5)	ECS502 Community Service (140 hours = 2 credit)*	11	0	18	19	22
III	MAL616 Research Methodology 2-1-0(3)	Open Elective 2-0-2(3)	ECD605 Dissertation-I 0-0-12(6)	Program Elective-5 3-0-2(4)		ECS601 Community Service	7	1	16	12	16
IV	ECD602 Dissertation-II 0-0-24(12)					ECS602 Community Service (140 hours = 2 credit)*	0	0	24	-	14
TOTAL CREDITS OF THE M.TECH DEGREE PROGRAMME = 70											70

*Students can utilize the summer/winter break period to complete the 140 Community Service hours every year

Department of EECE
M. Tech in Electronics and Communication Engineering
(With specialization in Communication Engineering / VLSI Design)
2022

PG Diploma with 1 year exit

Sem	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	L	T	P	Weekly Contact Hours	Credits
I	ECL505 Adv. Digital Communication 3-0-2(4)	ECL523 Digital VLSI Design 3-0-2(4)	Program Elective-1 3-0-2(4)	Program Elective-2 3-0-2 (4)	ECC509 Seminar 0-0-4(2)	ECS501 Community Service	12	0	12	24	18
II	ECL501 Digital Signal Processing 3-0-2(4)	ECL513 Machine Learning 2-0-2(3)	Program Elective-3 3-0-2(4)	Program Elective-4 3-0-2(4)	ECD512 Minor Project 0-0-10(5)	ECS502 Community Service (140 hours = 2 credit)*	11	0	18	19	22
Summer	ECV502 Skill based course (3)	ECT502 Industrial Internship (7)									10
EXIT OPTION: PG DIPLOMA; CREDITS = 50											50

*Students can utilize the summer/winter break period to complete the 140 Community Service hours in a year

Department of EECE
M.Tech in Electronics and Communication Engineering
(With specialization in Communication Engineering / VLSI Design)
2022
M.Tech Part time (3 years)

Sem	Subject 1	Subject 2	Subject 3	Subject 4	Subject 6	L	T	P	Weekly Contact Hours	Credits
I	ECL505 Adv. Digital Communication 3-0-2(4)	ECL523 Digital VLSI Design 3-0-2(4)	Program Elective-1 3-0-2(4)		ECS501 Community Service	9	0	6	15	12
II	ECL501 Digital Signal Processing 3-0-2(4)	ECL513 Machine Learning 2-0-2(3)	Program Elective-2 3-0-2 (4)	ECC509 Seminar 0-0-4(2)	ECS502 Community Service (140 hours = 2 credit)*	8	0	10	18	15
III	Program Elective-3 3-0-2(4)	Open Elective 2-0-2(3)	MAL616 Research Methodology 2-1-0(3)		ECS601 Community Service	7	1	4	12	10
IV	Program Elective-4 3-0-2(4)	ECD512 Minor Project 0-0-10(5)			ECS602 Community Service (140 hours = 2 credit)*	3	0	12	5	11
V	Program Elective-5 3-0-2(4)	ECD605 Dissertation-I 0-0-12(6)				3	0	14	5	10
VI	ECD602 Dissertation-II 0-0-24(12)					0	0	24	-	12
TOTAL CREDITS OF THE M.TECH DEGREE PROGRAMME = 70										70

*Students can utilize the summer/winter break period to complete the 140 Community Service hours every year

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Department of EECE
M. Tech in Electronics and Communication Engineering
(With specialization in Communication Engineering / VLSI Design)
2022

Program Core		
Adv. Digital Communication	Digital VLSI Design	Digital Signal Processing
Machine Learning	Research Methodology	Seminar
Minor Project	Dissertation- I	Dissertation- II

Program Electives

TRACK I: Communication Engineering			TRACK II: VLSI Design		
ECL506 Optical Communication	ECL502 Digital Image Processing	ECL621 Statistical Signal Processing	ECL525 Semiconductor device modeling and Technology	ECL530 Computer Aided VLSI Design	ECL631 Design of VLSI systems
ECL517 Information Theory and Coding	ECL504 Modern Telecom Switching	ECL623 Telecom Network Management	ECL527 Digital System Design with Verilog HDL	ECL538 Hardware Software CoDesign	ECL633 Mixed Signal Design
ECL535 Microwave Theory and Circuits	ECL508 Wireless Mobile communication	ECL611 Mobile Computing	ECL531 Design and Analysis of Computer Architecture	ECL540 Real Time Systems and Software	ECL635 Microwave and Optoelectronic Devices
ECL537 Detection and Estimation Theory	ECL562 Millimeter Wave Integrated Circuits	ECL653 Telecom Systems and Technologies	ECL536 VLSI Fabrication and Technology	ECL542 Designing with ASICs	ECL637 VLSI Test and Testability
ECL539 Speech Communication	ECL570 Internet of Things	ECL655 Access Networks	ECL532 Embedded System Design	ECL528 Analog VLSI Design	ECL524 Low Power VLSI Design
ECL532 Embedded System Design	ECL572 Modern Antennas and Arrays	ECL657 Wireless Sensor Networks	ECL542 Special Topics in VLSI Design	ECL570 Internet of Things	ECL625 ASIC Design and Verification with SV
ECL516 Special Topics in Electronics and Communication	ECL578 Broadband Communication	ECL659 Global Navigation Satellite Systems and Applications	ECL534 CMOS RF Circuit Design	ECL629 Cryptography and Crypto Chip Design	ECL627 MEMS
ECL564 Soft Computing	ECL576 Network Security	ECL601 Cloud Computing	ECL582 Data structures & algorithms using C++	ECL529 Linux & Scripting	ECL601 Cloud Computing

M.Tech in Electronics and Communication Engineering
Short Syllabus & Cos

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Digital Signal Processing**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL501	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☒Programme Elective ☐ Open Elective☐		
7. Frequency of offering (check one): ☐ Odd ☒ Even ☐ Either semester☐ Every semester			
8. Pre-requisite(s), if any: Basic knowledge of signals and systems			
9. Brief Syllabus: Basics of signal processing, Types of discrete type signals & Types of discrete time systems, Z transform, DFT, FFT, Digital filters-FIR,IIR, Multirate Signal Processing, Polyphasedecomosition, Digital Filter Banks, Advanced Digital Signal Processors, Code Composer Studio, Introduction to RTOS, Introduction to DSP/BIOS and its components, Case studies and analysis of Real time Situations			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Apply the basic concepts of digital signal processing on real time systems.		
CO 2	Transform discrete time signals from one domain to another.		
CO 3	Design FIR and IIR digital filters using different techniques.		
CO 4	Apply the concepts of multirate signal processing and digital signal processors.		
CO 5	Design polyphase structures and digital filter banks.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Advanced Digital Communication**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL505	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☒Programme Elective ☐ Open Elective☐		
7. Frequency of offering (check one): ☒Odd☐ Even ☐ Either semester☐ Every semester			

8. Brief Syllabus:

Random variables and Processes, Communication over additive Gaussian noise channels, Signal Space representation, Scalar and vector communication over Memory less channels, Additive white Gaussian noise, matched filter and error probabilities, AWGN Channels, M-Ary Orthogonal signals and matched filters, Carrier recovery and symbol synchronization in signal demodulation, Phase estimation , Communication over band limited channels, Nyquist criterion for zero ISI, Decision feedback.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Apply different random variables and processes
CO 2	Analyze communication over AWGN channels and use of different filters, synchronization and signal recovery.
CO 3	Analyze different digital modulation techniques will be learnt by the students and the distinction between them.
CO 4	Assess digital signals transmitted over bandlimited channels and the challenges faced for this transmission.
CO 5	Analyze the traffic and the switching techniques**.**

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Digital VLSI Design**	**3. Course Code** **ECL 523**	**4. L-T-P** **3 0 2**	**5. Credits** **4**
6. Type of Course (Check one):	Programme Core ☒Programme Elective ☐ Open Elective☐		
7. Frequency of offering (check one): ☒Odd☐ Even ☐ Either semester☐ Every semester			

8. Brief Syllabus:

MOS transistor, Enhancement and Depletion MOS transistors, Threshold Voltage, Fabrication and Modeling, MOSFET Scaling, CMOS Inverter, transfer characteristics, Power, Delay and Energy parameters, Combinational MOS Logic Design, Sequential MOS Logic Design, Static and Dynamic Latches and Registers, Low-Power Design Techniques, Design of Arithmetic Building Blocks, Memory Cells Design

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Demonstrate fundamental understanding on MOS device, its technology and operation.
CO 2	Understand the basic components of any design through detailed analysis on CMOS Inverter.
CO 3	Evaluate the performance of Static and Dynamic CMOS logic in designing combinational and sequential circuits.
CO 4	Design and implement Low-Power CMOS Logic Circuits.
CO 5	Implement and verify the working of arithmetic building blocks and memory cells.
CO 6	Apply the VLSI design flow to any lab experiment or a minor project.

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Electrical, Electronics and Communication Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name: Machine learning</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>Code: ECL513</td><td>2 -0- 2</td><td>3</td></tr>
<tr><td colspan="2">6. Type of Course (Check one):</td><td colspan="3">Programme Core [√] Programme Elective [ ] Open Elective [ ]</td></tr>
<tr><td colspan="5">7. Frequency of offering (check one): Odd [ ] Even [√] Either semester [ ] Every semester [ ]</td></tr>
<tr><td colspan="5">8. Brief Syllabus: Artificial Intelligence, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Models, Activation function, Self-organizing Maps, k-means clustering, dimensionality reduction, Statistical Learning, Support Vector Machines, Kernal regression, logistic regression, Decision Trees, Bayesian Learning. Applications</td></tr>
<tr><td colspan="5">9. Course Outcomes (COs)</td></tr>
<tr><td>CO 1</td><td colspan="4">Categorize various types of machine learning methods</td></tr>
<tr><td>CO 2</td><td colspan="4">Understand various neural network models</td></tr>
<tr><td>CO 3</td><td colspan="4">Plan and design various types of machine learning algorithms</td></tr>
<tr><td>CO 4</td><td colspan="4">Understand regression for single and multiple variables</td></tr>
<tr><td>CO 5</td><td colspan="4">Examine various applications of Machine Learning</td></tr>
</table>

L T P C 2 1 0 3	**Course: Research Methodology** **Code: MAL616**
Medium of Instruction : English Only	

Type of Course: Programme Core ☒ Programme Elective ☐ Open Elective ☐

Pre-requisite(s), if any: Nil

Frequency of offering ☒Odd ☐ Even ☐ Either semester ☐Every semester

Brief Syllabus: Foundations of Research, Scientific Research, Motivation, Research Objectives, Research Designs, Research Processes, Design of Experiments, Understanding Feasibility of Objectives and Processes, Qualitative and Quantitative Research Methods, Data Collection Processes, Biases in Data Collection, Data Pre-processing, Sampling Distribution and Confidence Intervals, Hypothesis Testing, Interpretation of Results, Literature Review, Technical Writing, Citations, IPR, Research Ethics, Reference management software, Plagiarism, Software for Detection of Plagiarism

Course Outcomes (COs)

CO1	Understand and define research problem
CO2	Understand concepts of data collection processes
CO3	Understand the basics of data analytics
CO4	Develop technical writing skills

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Optical Communication**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 506	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective☐		
7. Pre-requisite(s), if any: Analog and Digital Communication			
8. Frequency of offering (check one): ☐Odd ☐Even ☒ Either semester☐ Every semester			
9. Brief Syllabus: Introduction to optical sources and detectors, coherent systems - homodyne and heterodyne systems, coherent systems using PSK, FSK, ASK and DPSK modulations, related noise effects, synchronous, asynchronous and self - synchronous demodulation, sub carrier modulation , optical line coding schemes, optical receiver circuit, optical power budgeting line loading ,optical multiplexing and signaling schemes, optical amplifiers- Raman amplifier, Brillouin amplifier, optical components, free space optics, FTTH, optical CDMA, PON , EPON.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Understand the use of different types of optical fiber propagation characteristics and transmission properties and the significance of, dispersion and attenuation in optical fiber communications for a given communication link.		
CO 2	Capacity to demonstrate an understanding of light sources including the principles of laser action in semiconductors, the characteristics of optical transmitters based on semiconductor and external modulation techniques, and the characteristics of optical photodetectors.		
CO 3	Ability to demonstrate an understanding of fiber devices /components and multiple wavelength division multiplexing and OTDM techniques and familiarize with design considerations of fiber optic systems.		
CO 4	Understand the characteristics of optical transmitters, receivers and external modulation techniques, optical amplifiers and SONET .Understand the Optical Power Budgeting.		
CO 5	Perform characteristics of optical fiber, sources and detectors, design as well as conduct experiments in software and hardware, analyze the results to provide valid conclusions.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**			
2. Course Name: **Information Theory and Coding**		**3. Course Code**	**4. L-T-P**	**5. Credits**
		ECL 517	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐			
7. Pre-requisite(s), if any: Signals and Systems , Probability Theory, and Linear Algebra				
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester				
9. Brief Syllabus: Entropy and lossless sources, Shannon's source coding theorem, Kraft's inequality, Optimal codes, Shannon's source coding theorem and its converse, Capacity computation for some simple channels, Joint source channel coding theorem, Differential entropy, Gaussian Channels, Introduction to rate distortion function, rate distortion optimization, finite field arithmetic, Linear Block codes, Cyclic codes, LDPC codes, Wolf coding, Space time codes, Turbo coding.				
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed				
CO 1	Understand and apply fundamental concepts in information theory such as probability, entropy, information content and their inter-relationships			
CO 2	Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability.			
CO 3	Implement and analyze the basic coding and compression algorithms. Understand the finite field Arithmetic to solve the polynomials.			
CO 4	Determine error-correcting capability of linear codes and bounds for their performance			
CO 5	Compute the parameters of some well-known codes, e.g. Hamming, Reed-Solomon and BCH codes ,Space codes etc.			
CO 6	Implement the best system that has good efficiency and best security with the use of different codes			

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Microwave Theory and Circuits**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL535	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Microwave Engineering			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Basics and history of Microwaves, and Applications of Microwaves, Concept of Mode, impedance matching, Passive Components: Directional Coupler, Power Divider, Magic Tee. Active Components: Diodes, Oscillators, Transistors and Mixers, Microwave antenna for ground based systems, Microwave antenna for airborne based system and satellite borne system.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Distinguish and understand between high frequency and low frequency techniques.		
CO 2	Design and analyze the microwave transmission lines.		
CO 3	Design the various microwave passive components and devices.		
CO 4	Understand the various microwave active components and devices.		
CO 5	Analyze the microwave circuits and scattering parameters.		
CO 6	Understand the applications of the microwave communication.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Detection and Estimation Theory**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL537	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Information Theory Coding, Linear Algebra ,Signals and Systems			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, Detection of Deterministic Signals:Matched filter detector and its performance, detection of sinusoid with unknown amplitude, phase, frequency, Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, M-ary hypothesis testing, MAP and ML decision rules, MMS and MAP estimates, Estimation of nonrandom parameters :Cramer-Rao inequality, Signal Estimation in Discrete-Time: Weiner filtering, discrete Kalman filtering, Bounds on estimation errors			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Learn about basic Estimation Methods: Maximum Likelihood Estimation, Maximum A Posterior i Estimation, Minimum Variance Unbiased Estimation, Minimum Mean Square Error Estimation, Linear Minimum Mean Square Error Estimation and Kalman Filtering		
CO 2	Learn about basic estimator properties such as Bias, Efficiency, Linearity		
CO 3	Learn Classical and Bayesian Estimation Approaches		
CO 4	Learn Basic Estimation Performance Bounds such as Cramer-Rao Bound		
CO 5	Gain ability to apply estimation methods to real engineering problems.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Speech Communication**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL539	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Signal and speech Processing			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Speech production mechanism, Classification of speech, sounds, nature of speech signal, Time domain parameters of speech, methods for extracting the parameters, Short time Fourier analysis, filter bank analysis, spectrographic analysis, solution of normal equations, Interpretation of linear prediction in auto correlation, Applications of speech processing - Speech recognition			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Prepare model for human speech production		
CO 2	Analyze speech signal using various time and frequency domain techniques		
CO 3	Extract pitch and formants of speech using various techniques		
CO 4	Apply speech processing techniques in various speech applications		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Digital Image Processing**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL502	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Digital Signal Processing			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Introduction to image processing, processing and enhancement of images in spatial and frequency domain. Various transforms like DFT, DCT, Walsh and K-L transforms, Image segmentation, Image compression, Image restoration and noise models, Introduction to wavelets and Haar transforms. Advanced techniques for image processing.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Describe and explain basic principles of digital image processing		
CO 2	Use various transforms to analyse images and perform various image processing operations		
CO 3	Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement)		
CO 4	Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation & image representation)		
CO 5	Review advanced image processing techniques		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Modern Telecom Switching System**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL504	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Wireless communication			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Electronic switching systems: basics of a switching system - electronic space division switching - stored program control - time division switching,Network traffic load and parameters - grade of service and blocking probability - incoming traffic and service time characterization - blocking models and loss estimates – delay systems. Traffic analysis, The concept of ISDN, narrowband ISDN and broadband ISDN, ISDN interfaces and End-user applications, ISDN architecture, voice over IP and ATM Networks.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Able to Distinguish between wireless and Telecommunications		
CO 2	Explain call signaling between the networks.		
CO 3	Distinguish between different switching techniques		
CO 4	Design and analyze a network for given traffic considerations		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Wireless and Mobile Communication**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 508	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☒Programme Elective ☐ Open Elective☐		
7. Pre-requisite(s), if any: Wireless Communication			
8. Frequency of offering (check one): ☐Odd ☐Even ☒ Either semester☐ Every semester			
9. Brief Syllabus: Access schemes, MAC protocols, problems and limitations of different protocols, cellular concepts, Evolution of mobile communication, GSM standard, call flows, location tracking, mobility management, GPRS, UMTS, Fading and Diversity effects in wireless communication, combining techniques, Spread spectrum, types, CDMA, SCDMA, capacity analysis, bit error analysis, power control, OFDM, MCDMA, MIMO Systems, Capacity analysis. Case studies and analysis of Real time Situations			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Distinguish between wireless and mobile communications and multiple access schemes.
CO 2	Learn GSM and its evolution including GPRS and UMTS and spread spectrum techniques
CO 3	Understand different fading channels and diversity schemes.
CO 4	Analyze OFDM, MCDMA and MIMO systems and their applications

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Millimetre Wave Integrated Circuits**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL562	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Microwave Engineering, Field & Waves			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Introduction to millimeter wave systems and applications. Working principle and design of millimeter wave devices and circuits, Analysis of basic transmission lines for mm wave frequency, Integrated fin lines, H-guide, Groove-guide, Transitions, Comparison between SGP and VBIC models .Detectors, Attenuators, Power Divider/Combiners, Low power front-end receivers. SG-25 Series Technologies : On-chip transmission line design			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Understand the millimeter wave technology and systems.		
CO 2	Apply the concepts of millimeter wave transmission lines.		
CO 3	Design the millimeter wave passive components		
CO 4	Design the millimeter wave active components.		
CO 5	Analyze the working of millimeter wave systems		
CO 6	Relate the advanced technology for millimeter waves integrated circuits design and fabrication.		

COURSE TEMPLATE

1. Department:	**Department of EECE**			
2. Course Name: Internet of Things		**3. Course Code**	**4. L- T -P**	**5. Credits**
		Code: ECL570	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective √	Open Elective ☐	
7. Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ✓	Every semester ☐

8. Brief Syllabus: Introduction and definition of Internet of things, IoT growth, Application areas, characteristics, IoT Stack, basic programming fundamentals of Atmega328p and NodeMCU, sensors, their types & interfacing, messaging protocols: MQTT, CoAP, XMPP, AMQP, Communication protocols: IEEE 802.15.4, Zigbee, 6LoWPAN, wireless HART, Bluetooth and Li-Fi, Wireless sensor node, Internet protocol version 4 and internet protocol version 6, IoT with cloud – challenges, various cloud service providers, fog computing, security aspects, Application Building with IoT, IFTTT, various applications.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand the fundamental elements and underlying technologies of Internet of things
CO 2	Knowledge about basics of Microcontrollers, sensors and their interfacing
CO 3	Apply the advanced sensors and actuators for building IoT applications
CO 4	Understand and study the basic messaging & communication protocols and Addressing & identification protocols of IoT
CO 5	Study cloud basics and build IoT-Based Applications

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**			
2. Course Name: **Modern Antenna and Arrays**		**3. Course Code**	**4. L-T-P**	**5. Credits**
		ECL572	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐			
7. Pre-requisite(s), if any: Field & Waves, Antenna & Wave Propagation				
8. Frequency of offering (check one): ☐Odd ☐Even ☒ Either semester ☐ Every semester				
9. Brief Syllabus: Conformal antenna arrays-Characteristics, Radiation mechanism, Antenna impedance, Mutual coupling effects, Beam width, Beam steering, Mutual coupling and radiation patterns. Circular array antennas-working principle and design, comparison of linear and circular arrays, Printed Microstrip Rectangular and Circular patch Antenna arrays, Planar arrays, Phased arrays, Quasi-optical antenna, Smart antenna, Monolithic Integrated antennas.				
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed				
CO 1	Apply basic antenna theory			
CO 2	Differentiate types of modern antennas.			
CO 3	Design linear and planar arrays and circular arrays.			
CO 4	Synthesize special arrays			
CO 5	Relate to current technology in antenna synthesis and fabrication			

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Soft Computing**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 564	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☐ Open Elective ☒		
7. Pre-requisite(s), if any: Signals and Systems, Probability Theory, and Linear Algebra			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Introduction to artificial intelligence, expert system, soft computing techniques such as Artificial Neural Network- Activation Functions, Generalization, Back-Propagation algorithm, Self-organizing networks, Radial Basis Function Network Fuzzy logic- membership functions , fuzzy If – Then rules, fuzzy mapping rules and fuzzy implication functions and Genetic Algorithm. Hybrid systems such as fuzzy-neural, neuro-fuzzy, etc. Case studies, Applications and use of MATLAB.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Recognize the feasibility of applying a soft computing methodology for a particular problem.		
CO 2	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems		
CO 3	Apply genetic algorithms to combinatorial optimization problems		
CO 4	Apply neural networks to pattern classification and regression problems		
CO 5	Effectively use existing software tools to solve real problems using a soft computing approach and computational intelligence.		
CO 6	Evaluate and compare solutions by various soft computing approaches for a given problem.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: Network Security	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL576	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
8. Brief Syllabus: Common attacks and defense mechanisms, attacker profiles, basic security model, Data encryption design criterion, DES, multiple DES, AES, standard block cipher mode operations, stream ciphers, key generations, number theory, diffie-hellman key exchange, RSA, Elliptical cryptography, Key distribution and management, Cryptographic hash functions, cryptographic checksums, HMAC, offset codebook mode operations, birthday attacks, digital signature, dual signature and electronic transactions, blind signature and electronic cash, public key infrastructure, IPsec, SSL/TLS			
9. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Familiarization with the Mission of network security and its challenges		
CO 2	Apply various data encryption and decryption techniques.		
CO 3	Conceptualize the key generation, exchange and distribution management		
CO 4	Apply network security protocols		
CO 5	Aware of latest technologies like firewalls and application gateways		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Broadband Communication**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL578	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☐ Open Elective ☒		
7. Pre-requisite(s), if any: Digital Communication System, Wireless Mobile Communication			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Broadband networks and services, ISDN, broadband ISDN, B-ISDN standards and interface, B- ISDN protocol, ATM technology -VP,VC,ATM Packet, ATM Network Management, ATM digital exchange interface Management, Internet Telephony and voice over IP (VoIP)- RTP and RTCP, Next generation internet, multicasting in internet, real time communication over internet, Internet and web Traffic measurement and characterization			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Categorize various broadband networks technologies in present, past and future sets and factors involved in doing so.		
CO 2	Design parameters, standards and technologies and to achieve good quality service for reliable communication		
CO 3	Apply the technologies and engineering techniques underpinning broadband technologies in LANs both wired and wireless.		
CO 4	Design of Fixed Terrestrial, Mobile Terrestrial and Satellite broadband wide area networks and telecommunications systems.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Statistical Signal Processing**	**3. Course Code** **ECL 621**	**4. L-T-P** **3 0 2**	**5. Credits** **4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Digital signal processing			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Random variables, random processes, Auto-regressive (AR) , Moving Averages(MA) and ARMA processes. Statistical detection and estimation theory, Coherent detection, Detection and estimation in the presence of noise. Least mean square methods, Signal modelling using various methods, Parametric and non-parametric spectral estimation methods, principal component spectrum estimation, Adaptive and optimal filtering.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Categorize random variables and processes		
CO 2	Differentiate between auto-regressive and moving average random processes		
CO 3	Detect signals in the presence of noise		
CO 4	Model signals using various methods		
CO 5	Use various filters for processing random signals		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Telecom Network Management**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 623	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		

7. Pre-requisite(s), if any: Computer networks

8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester

9. Brief Syllabus: Data communications and Network Management Overview, Protocols and standards, SNMPv1 Network Management, SNMPv2 Network architecture and protocols, SNMP Management, Communication and functional models, Telecommunications Management Network, Network Management Tools and Systems and Web-Based Management, Enterprise Management Solutions, Case studies and real time problems

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Apply concepts of network protocols and challenges on network management
CO 2	Familiarization with the functions of network management and its relevance to communication
CO 3	Conceptualize various network management protocols w.r.t to telecommunication network architecture
CO 4	Analyze the challenges faced by network managers.

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **MOBILE COMPUTING**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL611	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Basics of wireless engineering			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Introduction to mobile computing, SS7 and GSM, wireless networking protocols: mobile IP, Mobile TCP and other OSI layer Ad-hoc networks, routing, routing algorithms and Protocols, wireless protocols: wireless TCP, data broadcasting, mobile data management, location awareness, adaptations, user interfacing issues, security issues, Technology surveys and case studies.			
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Differentiate between mobile, pervasive and ubiquitous computing		
CO 2	Know the details of various existing mobile networks		
CO 3	Differentiate between wired, wireless and mobile networks and their working		
CO 4	Know the working of mobile IP, mobile TCP and other OSI layers for mobile networks		
CO 5	Relate to advanced technologies of mobile computing		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Telecom systems and Technologies**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 653	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Pre-requisite(s), if any: Digital Communication system and Telecom switching			
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
9. Brief Syllabus: Classification of communication systems, wired and wireless communication system, multiplexing techniques, Access schemes, packet switching systems: X.25, frame and cell relay, ATM, signal impairments and the channel length, DSL techniques, different versions of DSL, TDM technique and digital transmission techniques, PDH, synchronous digital multiplexing, Introduction, measurement areas, measurement of power levels in telecommunication system, high frequency power measurement, spectrum measurement, Markov chain			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand various types of communication systems
CO 2	Apply basics of switching and signaling systems
CO 3	Classify DSL, its types, terminologies and working
CO 4	Apply different transmission techniques in detail
CO 5	Analyze Telecommunication system testing techniques employed
CO 6	Apply concepts of basics of Broadband services and Queuing theory

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Access Networks**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 655	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Frequency of offering (check one): ☒ Odd ☐ Even ☐ Either semester ☐ Every semester			
8. Brief Syllabus: Emerging access technologies, concept of all multiple access technologies, DSL, ADSL, XDSL access network: technology overview, Fiber access topologies: point to point, passive star, ring, passive optical network, Wi-Fi, Wi-Max, LTE, WPAN, Zig bee, WSN, WBAN, IP QoS Control Mechanisms, Resource Reservation Protocol (RSVP), Differentiated Services, Multi-Protocol Label Switching (MPLS), IP Multimedia Sub-system			
9. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Understand various types of Emerging access technologies		
CO 2	Apply basics DSL, ADSL, XDSL access networks		
CO 3	Differentiate fiber access topologies		
CO 4	Design Wireless Access Networks		
CO 5	Classify Broadband Network Technologies		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: **Wireless Sensor Networks**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL657	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐		
7. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester			
8. Brief Syllabus: WSN architecture and protocol Stack, mote platforms, WSN applications, Factors influencing WSN design, physical and MAC layer technologies, channel effects, challenges for routing and transport protocols, cross layered solutions, time synchronization, Network time protocol, Localization, ranging techniques, wireless sensor and actor networks			
9. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	**Form Wireless Sensor network for different Applications.**		
CO 2	Analyze the best suited MAC protocol for the given application of WSN		
CO 3	Analyze the best suited Routing protocol for the given application of WSN.		
CO 4	Develop the cross layer solution for given application.		

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**			
2. Course Name: **Global Navigation Satellite Systems and Applications**		**3. Course Code**	**4. L-T-P**	**5. Credits**
		ECL659	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐			
7. **Frequency of offering (check one):** ☐ Odd ☐ Even ☒ Either semester ☐ Every semester				
8. **Brief Syllabus**: Orbit, Space Segment, Ground Segment, Link Budget, Multiple Access, Introduction to Global Navigation Satellite System (GNSS), Global Navigation Satellite System (GNSS), How position is determined by the GNSS? NAVSTAR - Global Positioning System, GLONASS, BDS, NavIC (IRNSS), GALILEO, QZSS,DGNSS, RTK, SBAS, GNSS errors, GNSS correction methods, GNSS- applications, trends and opportunities.				
9. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him/her once it is completed				
CO 1	Able to apply concepts of satellite communication			
CO 2	Determine the user position using the GNSS signals			
CO 3	Apply the concepts of Differential GPS to develop various applications			
CO 4	Understand the various applications and new trends and opportunities of GNSS			

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Embedded System Design**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 532	3 0 2	4
6. Type of Course (Check one):	Programme Core ✓	Programme Elective ☐	Open Elective ☐
7. Frequency of offering (check one): ☐ Odd ☐ Even √ Either semester ☐ Every semester			
8. Brief Syllabus: Introduction to ESD, Emulator, RTOS, Task, Semaphores and Shared Data Operating system, Processor selection in Embedded System (Microprocessor V/s Micro-controller), Detailed Architecture of 8-bit Microcontroller 8051, Embedded System Development, Networks for Embedded Systems, Introduction to 32-bit controller (ARM7).			

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Compare embedded system design models, architecture using different processor technologies (single-purpose, general-purpose, application specific processors.
CO 2	Write assembly language program in 8051 for various embedded system applications.
CO 3	Analyze and design hardware and software for small digital systems involving 8051 microcontroller.
CO 4	Apply concepts in real world applications.

COURSE TEMPLATE

1. Department:	**Department of Computer Science and Engineering**		
2. Course Name: Cloud Computing	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL601	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✔	Open Elective ☐
7. Pre-requisite(s), if any: None			
8. Frequency of offering (check one): Odd ☐	Even ☐	Either semester ✔	Every semester ☐

9. Brief Syllabus:

Parallel and Distributed System Models, Cloud enabling technologies, Cloud Platform Architecture, Service Oriented Architecture, Cloud Programming and Software environments, Performance Scalability and Consistency on Cloud, Cloud Security. The course examines the most important APIs used in the Amazon and Microsoft Cloud, including the techniques for building, deploying, and maintaining machine images and applications. Students will learn how to use Cloud as the infrastructure for existing and new services.

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

CO 1	Identify the Parallel and Distributed computing technologies involved in Cloud.
CO 2	Explain the design principles involved in building a Cloud platform over virtualized clusters and data centers.
CO 3	Analyze different performance metrics for evaluating Cloud Applications.
CO 4	Prepare Cloud based applications that can scale out.
CO 5	Apply task and data parallel distributed algorithms for Cloud.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Semiconductor Device Modeling & Technology**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 525	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Pre-requisite(s), if any: Basic knowledge of Electronics Devices.			
8. Frequency of offering (check one): ☐ Odd ☐ Even ✓ Either semester ☐ Every semester			
9. Brief Syllabus: Working of FIN-FET, MOSFET scaling, Short channel effects on MOSFET, SOI MOSFET, Burried Channel MOSFET, Channel Length Modulation, CMOS process flow, Fabrication details of devices.			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	To understand the concepts of semiconductor materials and analyze its properties.
CO 2	Analyze the characteristics and concepts of P-N Junction Diode
CO 3	Analyze the characteristics and concepts of Metal-Semiconductor Junction
CO 4	Analyze the characteristics and concepts of MOSFET and BJT
CO 5	Awareness, Apply and Understanding of current trends in semiconductor device modeling in Design and Fabrication Unit.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Digital System Design with Verilog HDL**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 527	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester
8. Brief Syllabus: ASIC Design Flow, Language Constructs and Conventions in Verilog HDL, Combinational Logic Design, Sequential Logic Design, Architecture of FPGA, Behavioral Modeling, Modeling Techniques, State Machine, Moore and Mealay State Model, Usr Defined Primitives, Programming Language Interface, Current Trends.			

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand the basic concepts and programming of Verilog HDL.
CO 2	Understand and analyze the programming of combinational and sequential logic design in Verilog HDL.
CO 3	Apply conditional and looping in the programming of Verilog HDL.
CO 4	Apply different modeling techniques in the programming of Verilog HDL.
CO 5	Analyze the concepts of user defined primitives and PLIs.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Design & Analysis of Computer Architecture**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 531	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester
8. Brief Syllabus: Classification of parallel computing structures; Instruction level parallelism - static and dynamic pipelining, improving branch performance, superscalar and Very Long Instruction Word (VLIW) processors; High performance memory system; Shared memory multiprocessors and cache coherence; Multiprocessor interconnection networks; Performance modeling; Issues in programming multiprocessors; Data parallel architectures.			

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Design basic and intermediate RISC pipelines, including the instruction set, data paths, and ways of dealing with pipeline hazards.
CO 2	Able to understand various techniques of instruction-level parallelism, including superscalar execution, branch prediction, and speculation, in design of high-performance processors.
CO 3	Able to analyze State and understand memory hierarchy design, memory access time formula, performance improvement techniques, and trade-offs.
CO 4	State and compare properties of shared memory and distributed multiprocessor systems and cache coherency protocols.
CO 5	Learn from additional topics in computer architecture, such as multi-core processors, thread-level parallelism, and warehouse computing.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: VLSI Fabrication & Technology	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 536	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Pre-requisite(s), if any: Semiconductor Device Modelling Technology			
8. Frequency of offering (check one): Odd ☐ Even ☐ ✓ Either semester ☐ Every semester			
9. Brief Syllabus: Crystal growth, wafer preparation, Czochralski process, float zone process, Oxidation of silicon, dry oxidation, wet oxidation, epitaxial growth of thin films, diffusion of different dopants in silicon and GaAs, ion implantation, thermal evaporation, sputtering, wet etching, dry etching, photolithography, electron beam lithography, Advance lithography techniques, process integration and IC packaging.			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	To understand crystal growth techniques of silicon and GaAs.
CO 2	To Analyze concepts of dry and wet oxidation
CO 3	To understand the theory of diffusion and ion implantation
CO 4	To Analyze concepts of dry and wet etching
CO 5	To discriminate the principles of different lithography techniques
CO 6	To understand the concepts of process integration and IC packaging

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **CMOS RF Circuit Design**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL534	**3 0 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester

8. Brief Syllabus:

Basic Concepts in RF Design using CMOS, Modulation and Detection, Random Processes and Noise, Analog and Digital Modulation, Non Coherent Detection, Transceiver Architectures, Low-Noise Amplifiers, Mixers, Oscillators, Frequency Synthesizers, Phase Locked loop, Voltage Controlled oscillator, Frequency Divider, Power Amplifiers, Impedance Matching, Advanced Trends for wireless systems.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Analyze the various performance measures of RF circuits
CO 2	To understand RF filters high frequency amplifiers, mixers, Oscillators and power amplifiers.
CO 3	To acquire knowledge on the design of RF filters, amplifiers and Oscillators
CO 4	To offer students experience on designing and simulating RF circuits

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Computer Aided VLSI Design**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 530	**3 0 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester
8. Brief Syllabus: ASIC Design Flow. Different File Formats used in ASIC Flow. Static Timing Analysis. CTS.			

9. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand the VLSI Design flow – FE & BE
CO 2	The importance of CAD tools and technologies in current scenario of chip design.
CO 3	Understand the algorithm for synthesis and physical design, as Partitioning – Floor planning – Placement & Routing Algorithms and their limitations.
CO 4	Able to work on the Cadence SoC Encounter EDA Tools & Technologies to understand the project level aspects in a CAD flow.
CO 5	Able to understand the role of optimization of various aspects of a chip, floorplan, partition, routing, congestion, timing, etc. and FPGA implementation.
CO 6	Able to develop/write a simple algorithm as a project.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Hardware – Software Co-design**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL538	**3 0 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Pre-requisite(s), if any: Computer architecture, digital design, software design, and embedded systems..			
8. Frequency of offering (check one): ☐ Odd ☐ Even ✓ Either semester ☐ Every semester			
9. Brief Syllabus: Introduction to hardware & software co-design, Hardware Software back-ground and Hardware Software co-design research, Co-design concepts as functional decomposition and virtual machines, Methodology for co-design and Unified representation for Hardware & Software, Abstract Hardware & Software model, Performance Evaluation, Object oriented techniques in hardware design.			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	To understand the concepts of hardware software co design
CO 2	Analyze and study the architectural concepts with performance considerations
CO 3	Understanding of co design techniques
CO 4	Analyze issues involved in Co-Design process.
CO 5	Awareness, Apply and Understanding of current trends in hardware – software co-design.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Real Time System & Software	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL540	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ☑	Open Elective ☐
7. Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ☑ Every semester ☐
8. Brief Syllabus: Real-time Versus Conventional Software, Computer Hardware for Monitoring and Control, Data Flow Diagrams, State machine, Software Engineering Issues. Process and State-based Systems model, Requirements and Design Specifications, Declarative Specifications & Deterministic Scheduling, Execution Time Prediction & Timer Applications, Programming Languages & Operating Systems.			

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Study and explore the internals different types of operating system
CO 2	Understand Operating system form and function
CO 3	Analyze the differences between various types of operating systems & timmers .
CO 4	Understand classic operating systems literature,programming languages.
CO 5	Assess criteria to measure the appropriateness of a computer system for its current deployment and future evolution, and to interpret the results .

COURSE TEMPLATE

<table>
<tr><td colspan="2">1. Department:</td><td colspan="3">Department of Electrical, Electronics and Communication Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2. Course Name:
Designing with ASICs</td><td>3. Course Code</td><td>4. L-T-P</td><td>5. Credits</td></tr>
<tr><td>ECL542</td><td>3 0 2</td><td>4</td></tr>
<tr><td colspan="2">6. Type of Course (Check one):</td><td colspan="3">Programme Core ☐ Programme Elective ✓ Open Elective ☐</td></tr>
<tr><td colspan="5">7. Frequency of offering (check one): ☐ Odd ☐ Even ✓ Either semester ☐ Every semester</td></tr>
<tr><td colspan="5">8. Brief Syllabus:
ASIC Design Flow, Types of ASICs, ASIC Cell Libraries, CMOS logic cell, Data Path Logic Cells, I/O Cells, ASIC Library Design, Logical effort, PLA Tools, Logic synthesis, Low Level Design Entry, Overview of VHDL & VerilogHDL, PLA Tools, Floorplanning, Placement & Routing, EDIF. Logic Synthesis in Verilog and VHDL Simulation. ASIC Construction, Floor Planning, Placement, and Routing.</td></tr>
<tr><td colspan="5">9. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed</td></tr>
<tr><td>CO 1</td><td colspan="4">Understand VLSI Circuit & System and ASICs, FPGAs Flow</td></tr>
<tr><td>CO 2</td><td colspan="4">Exposure to Standard Cells, Cell Libraries, IPs, Semi-Custom and Full Custom Designs, etc.</td></tr>
<tr><td>CO 3</td><td colspan="4">Able to explore a Logic Synthesis EDA Tool and map an RTL Code onto a Standard Cell Library.</td></tr>
<tr><td>CO 4</td><td colspan="4">To understand and apply the Physical Design Flow, e.g., floorplanning, placement, Routing.</td></tr>
<tr><td>CO 5</td><td colspan="4">To understand the role of Computer-Aided Design (CAD) tools in Automating the ASIC Design Flow to Design a VLSI System from Sub-Systems.</td></tr>
</table>

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**		
2. Course Name: Analog VLSI Design	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL528	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Electiv☐		
7. Frequency of offering (check one): ☐Odd ☐Even ☒ Either semester☐ Every semester			
8. Brief Syllabus: Introduction to MOS Device Physics, Small Signal & Large Signal Models of MOS & BJT transistor. SingleStage Amplifiers:, Differential Amplifiers, Passive and Active Loaded Differential Amplifiers: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers, Current Mirror Circuits, Frequency Response of Amplifiers, CMOS Operational Amplifiers, Stability and Frequency Compensation, Design of two stage MOS Operational Amplifier, two stage MOS operational Amplifier with cascodes, MOS telescopic-cascode operational amplifiers, MOS Folded-cascode operational amplifiers.			
9. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Understanding the structure, operation , analysis of MOSFETs		
CO 2	Design and analysis of BJT and MOSFETs amplfier .		
CO 3	Design of current mirror, op amp and OTA		
CO 4	Design of non linear analog circuits.		

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Cryptography & Crypto-Chip Design**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 629	**3 0 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ✓ Every semester ☐

8. Brief Syllabus:

Information system reviewed, LAN, MAN, WAN. Threats to Security, Physical, Biometric security, data security, system security, etc. Encryption Techniques: Conventional and Modern techniques, Algorithms, and Key managements. Message Authentication and Hash Algorithm, Firewalls and Cyber laws: Design principles, trusted systems, IT act, and virtual private networks. Future Threats to Network and Recent attacks on networks. Applications: AES Algorithms, Development of digital signature chip design. Hardware and software design tradeoffs.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	To understand the importance of security of data in communication.
CO 2	To Analyze the threats to security system.
CO 3	To model various encryption techniques for data communication
CO 4	To design various algorithms for message authentication.
CO 5	To gain knowledge in firewall and cyber laws.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Design of VLSI Systems**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL631	**3-0-2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Pre-requisite(s), if any: Fundamentals of MOS transistor. Combinational and Sequential circuit Design. Verilog HDL fundamentals and Programming Skills			
8. Frequency of offering (check one): ☐ Odd ☐ Even ✓ Either semester ☐ Every semester			
9. Brief Syllabus: VLSI System Design Methodology: Hierarchy, Modularity, Locality. Chip Design Methods and Optimization. Design Capture EDA Tools: HDL Design, Schematic Design, Layout Design, Design Verification, Design for Test, System Level Testing. Data Path Sub System Design: Addition, Subtraction, etc. Array Subsystem Design and Control Unit Design: SRAM, FSM, PLA, etc. Special purpose Subsystems: Clocking strategies, PLL techniques, Clock distribution and I/O structures. VLSI Applications, Case Study: RISC Microcontroller, ATM Switch, etc.			

10. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Analyze VLSI Design flow and System
CO 2	Understand the design and synthesis process
CO 3	Solve the problems associated with testing of semiconductor circuits
CO 4	Implement and verify sub blocks of a design
CO 5	Apply various design styles from performance point of view in the analysis of an SoC
CO 6	Ability to apply different techniques to design the I/Os and Clocks of a system

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Mixed Signal Design	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 633	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Pre-requisite(s), if any: Analog VLSI Design(ECL528), DSD with VerilogHDL (ECL-527)			
8. Frequency of offering (check one): ☐ Odd ☐ Even ✓ Either semester ☐ Every semester			
9. Brief Syllabus: Signals, Sampling, Aliasing and Tools: Sampling Techniques and circuits for signal sampling. Mixed signal design challenges and issues.Analog Filters: implementation with Integrator, Analog filtering topology for LP, BP, etc., Analog filters, analog to Digital Converters Digital Filters: Digital to analog Converters, Digital Filtering topology. SNR of data converters: Quantization, SNR Improvement. Design Basics and Noise-Shaping of Data Converters: First and Second Order Noise Shaping. Bandpass Data Converters and A High-Speed Data Converter: Continuous time BP noise shaping. Mixed signal design Applications and latest trends			

10. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understanding of different kinds of signals and their properties.
CO 2	Identifying different aspects of Mixed Signal Designs and mixed signal design challenges.
CO 3	Analyze and design different data converters.
CO 4	Understanding of data transmission and its processing.
CO 5	Analyze mixed signal Integrated Circuits and their real life applications. various factors need to be taken care for their layout.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Microwaves & Optoelectronics Devices	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL 635	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	Odd ☐	Even ☐	✓ Either semester ☐ Every semester

8. Brief Syllabus: Microwave frequencies, microwave transistor, Avalanche Transit Time Devices -IMPATT Diode, Microwave Integrated Circuit, Microwave tubes-Klystron, Reflex Klystron and Magnetron, Optoelectronics-Photovoltaic devices, Optoelectronic & Display Devices. Characterization of displays, Plasma display, LCD, Electronchromic display and electrophoretic display.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Fundamental understanding of microwave frequencies and different microwave devices.
CO 2	Able to describe, analyze and design simple microwave circuits and Integrated Circuits
CO 3	Analyze mathematically the operation and working of the various microwave devices and Able to apply concepts in designing.
CO 4	Demonstrate fundamental understanding of different optoelectronics devices.
CO 5	Understanding the Significance, characteristics of optoelectonic devices and knowledge of latest trends.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: VLSI Test & Testability	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL637	**3- 0- 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester

8. Brief Syllabus: Testing need and problems related to digital and analog testing, Design for test, Software testing. Faults in Digital circuits. Fault models. Digital test pattern generation. Roth's algorithm. Pseudo random test pattern generation. Delay fault testing, Signatures and self test, Reed-Muller and spectral coefficients, Signature analysis and Online self test Testability Techniques, Boundary scan and IEEE standard 1149.1, Offline built in Self Test (BIST), Hardware description languages and test Testing of Analog and Digital circuits. Testing techniques for Filters, A/D Converters, RAM, Programmable logic devices and DSP.

9. Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Conceptualize the testing and verification requirements.
CO 2	To model and generate digital design testing patterns for combinational and sequential circuits.
CO 3	Ability to design signatures and self-test for various circuits
CO 4	To apply and verify testing techniques on analog and digital circuit.
CO 5	Ability to apply different techniques on practical circuits and debugging issues.

COURSE TEMPLATE

1. Department:	**Electrical, Electronics and Communication Engineering**			
2. Course Name: **Low-Power VLSI Design**		**3. Course Code**	**4. L-T-P**	**5. Credits**
		ECL524	**3 0 2**	**4**
6. Type of Course (Check one):	Programme Core ☐ Programme Elective ☒ Open Elective ☐			
7. Pre-requisite(s), if any: Knowledge on Clocked networks, Digital circuits and CMOS theory				
8. Frequency of offering (check one): ☐ Odd ☐ Even ☒ Either semester ☐ Every semester				
9. Brief Syllabus: Need for low-power VLSI Chips, Sources of Power dissipation-static and dynamic, transistor sizing and technology scaling, Device & Technology Impact on Low Power, Power estimation Simulation Power analysis: SPICE level circuit simulation, gate level logic simulation, Monte Carlo System, Probabilistic power analysis, Low Power Design Circuit level, Logic level, Low power Architecture & Systems, Low power Clock Distribution Methodology; Signal Drivers and buffers, skews, clock network. Architectural level power estimation and advanced developments in low-power VLSI design				
10. Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed				
CO 1	Will have knowledge of fundamentals of VLSI Design Principles.			
CO 2	Understand power estimation and probabilistic power analysis.			
CO 3	Ability to calculate power dissipation in CMOS circuits at circuit and logic level.			
CO 4	Design a complete low power architecture and system.			
CO 5	Implement low power clock distribution in CMOS Circuits.			

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **ASIC Design and Verification with SystemVerilog**	**3. Course Code** **ECL 625**	**4. L-T-P** **3 0 2**	**5. Credits** **4**
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ✓ Every semester ☐

8. Brief Syllabus:

Verification Guidelines: Verification Methodology, Data Types, Procedural Statements, Task and Functions, Routine Arguments, Local Data Storage, Basic OOP, Static and Global variables, Objects and Classes, Connecting the Testbench and Design, Stimulus Timing, SystemVerilog Assertation, Four-Port ATM Routers, Randomization, Constraints Details, Pre and Post Randomization, Threads and Interprocess Communication, Events, Semaphore, Mailbox, Testbench Building, Advanced OOPs and Guidelines.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Model a scenario for Verification of a DUT in SystemVerilog.
CO 2	Analyze the usefulness of a driver, monitor, checker, testcases in a verification environment.
CO 3	Understand different kindls of datatypes and can distinguish difference between an HDL and HVL.
CO 4	Design testbench to verify the functionality of a design.
CO 5	Understand the concept of randomization and its importance in verification coverage in a bigger design.
CO 6	Able to design a VIP for an IP as a project.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: MEMS	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL627	3-0-2	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one)	Odd ☐	Even ☐	Either semester ✓	Every semester ☐
8. Brief Syllabus: Overview of MEMS Technology, MEMS system-level design methodology, Equivalent Circuit representation of MEMS, signal-conditioning circuits, and sensor noise calculation. Pressure sensors with embedded electronics (Analog/Mixed signal): Accelerometer with transducer, Gyroscope, RF MEMS switch with electronics, Bolo meter design. RF MEMS, and Optical MEMS, actuators, accelerometers.			

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understanding MEMS Technology
CO 2	Learning various MEMS materials and their properties
CO 3	Understanding of the fabrication process of various MEMS-materials
CO 4	Understanding of various MEMS sensors and actuators
CO 5	Learning and Understanding the applications and future studies of MEMS technology

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: **Data Structures & Algorithm in C++**	**3. Course Code**	**4. L-T-P**	**5. Credits**
	ECL582	**3 0 2**	4
6. Type of Course (Check one):	Programme Core ☐	Programme Elective ✓	Open Elective ☐
7. Frequency of offering (check one):	☐ Odd	☐ Even	✓ Either semester ☐ Every semester

8. Brief Syllabus:

Mathematics for Algorithmic Algorithm Analysis, Asymptotic Notations. Computational Complexity of an algorithm. Divide and Conquer Algorithms: Master theorem, Recurrence relation. Sorting Bubble Sort, Insertion Sort, Selection Sort, Heap Sort, Merge Sort, Quick Sort. Shortest Path Algorithm, Greedy Algorithms. Knapsack Problem, NP Hard and NP complete Problems, Cooks Theorem, Back Tracking General Method, the 8 Queen Problem, Subset Problem, Graph Coloring Problem, Hamiltonian Cycle.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Apply the learning of the basic array and linked list operations.
CO 2	Able to understand the basics of C++.
CO 3	Understand and apply the sorting and searching algorithm.
CO 4	Apply the learning of the notations.
CO 5	Understanding the Elementary Data Structures and Analyze the NP Problem.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: LINUX and SCRIPTING	**3. Course Code**	**4. L –T- P**	**5. Credits**
	Code: ECL529	**3- 0-2**	**4**
6. **Type of Course (Check one):**	Programme Core ☐	Programme Elective ☑	Open Elective ☐
7. **Frequency of offering (check one):** Odd ☐	Even ☐	Either semester ☑	Every semester ☐

8. **Brief Syllabus:** Introduction to Unix and Linux, Command and Utility Syntax, Linux file and directories, Creating files, Creating directories, Disk utilization information, File and directory permission and privileges, Job and process management, Scheduling Jobs, Text editors- vi, vim editors, Editing files, Running C/C++ on Linux compiler, Tcl scripting, Commands, Data types, Variables, Operators, Arrays, Strings, Lists, Dictionary, Shell scripting, if-then scripts, loops, Aliases, User and Global Aliases

9. **Course Outcomes (COs)**

CO 1	Understand the importance and differences between Linux/UNIX systems.
CO 2	To learn to handle various files and directories in Linux.
CO 3	Able to manage various jobs and processes in Linux system.
CO 4	Understand various editors and execute C programs on Linux compiler.
CO 5	To learn how to write robust Tcl scripts by using various features of Tcl.
CO 6	Develop substantial Shell and Perl scripts, when appropriately reusing previously created scripts.