Vivekanand Education Society's Institute of Technology

Bachelor of Engineering (B.E.)

Department of Electronics and Telecommunication Engineering

(Semester – III & IV)

Program Structure for Second Year
Electronics and Telecommunications Engineering
Scheme for Autonomous Program
(With Effect from 2023-2024)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC301	Engineering Mathematics- III	3	--	1*	3	--	1	4
ECC302	Electronic Devices & Circuits	3	--	--	3	--	--	3
ECC303	Digital System Design	3	--	--	3	--	--	3
ECC304	Network Theory	3	--	1	3	--	1	4
ECC305	Electronic Instrumentation & Control Systems	3	--	--	3	--	--	3
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1
ECL302	Digital System Design Lab	--	2	--	--	1	--	1
ECL303	Electronic Instrumentation & Control Systems Lab	--	2	--	--	1	--	1
ECL304	Skill Lab: C++ and Java Programming	--	2+2*	--	--	2	--	2
ECM301	Mini Project – 1 A	--	4$	--	--	2	--	2
Total		**15**	**14**	**2**	**15**	**07**	**02**	**24**

*** Should be conducted batch wise.**
$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC301	Engineering Mathematics- III	20	20	60	**2**	25	--	125
ECC302	Electronic Devices & Circuits	20	20	60	**2**	--	--	100
ECC303	Digital System Design	20	20	60	**2**	--	--	100
ECC304	Network Theory	20	20	60	**2**	25	--	125
ECC305	Electronic Instrumentation & Control Systems	20	20	60	**2**	--	--	100
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	25	25	50
ECL302	Digital System Design Lab	--	--	--	--	25	--	25
ECL303	Electronic Instrumentation & Control Systems Lab	--	--	--	--	25	--	25
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	25	25	50
ECM301	Mini Project – 1 A	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	--	**175**	**75**	**750**

***CA- Continuous Assessment**

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4
ECC402	Microcontrollers	3	--	--	3	--	--	3
ECC403	Linear Integrated Circuits	3	--	--	3	--	--	3
ECC404	Signals & Systems	3	--	1	3	--	1	4
ECC405	Principles of Communication Engineering	3	--	--	3	--	--	3
ECL401	Microcontrollers Lab	--	2	--	--	1	--	1
ECL402	Linear Integrated Circuits Lab	--	2	--	--	1	--	1
ECL403	Principles of Communication Engineering Lab	--	2	--	--	1	--	1
ECL404	Skill Lab: Python Programming	--	2+2*	--	--	2	--	2
ECM401	Mini Project – 1B	--	4$	--	--	2	--	2
Total		**15**	**14**	**2**	**15**	**07**	**02**	**24**

*** Should be conducted batch wise.**
$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC402	Engineering Mathematics- IV	20	20	60	**2**	25	--	125
ECC403	Microcontrollers	20	20	60	**2**	--	--	100
ECC404	Linear Integrated Circuits	20	20	60	**2**	--	--	100
ECC405	Signals & Systems	20	20	60	**2**	25	--	125
ECL401	Principles of Communication Engineering	20	20	60	**2**	--	--	100
ECL402	Microcontrollers Lab	--	--	--	--	25	--	25
ECL403	Linear Integrated Circuits Lab	--	--	--	--	25	25	50
ECL404	Principles of Communication Engineering Lab	--	--	--	--	25	25	50
ECM401	Skill Lab: Python Programming	--	--	--	--	25	25	50
	Mini Project – 1B	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	--	**175**	**100**	**775**

***CA- Continuous Assessment**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC301	Engineering Mathematics- III	3	--	1*	3	--	1	4

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC301	Engineering Mathematics- III	20	20	60	**2**	25	--	125

Course Code:	Course Title	Credit
ECC301	**Engineering Mathematics-III**	4

Prerequisite: Engineering Mathematics-I, Engineering Mathematics-II	
Course Objectives:	
1	To build a strong foundation in mathematics, provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
2	To prepare student to apply reasoning informed by the contextual knowledge to engineering practice, to work as part of teams on multi-disciplinary projects.
Course Outcomes:	

1	Apply Laplace transform and its properties to find the transform of a given function and evaluate some integrals of real value function.
2	Solve problems on finding inverse Laplace transform of given functions and apply to solve initial and boundary value problems associated with ordinary differential equations.
3	Expand a periodic function as a Fourier series in terms of sine and cosine functions.
4	Construct an analytic function from a harmonic function, obtain a family of orthogonal trajectories. Plot the image of a curve under a complex transformation from z-plane to w-plane
5	Evaluate integration of complex variable functions using the knowledge of Cauchy integral formula, residue of singular points. Apply Cauchy residue theorem to evaluate some integrals of real value functions.
6	Evaluate directional derivative, gradient, divergence, curl. Solve problems on line, surface and volume integrals applying Green's, Stoke's and Gauss divergence theorem.

Module		**Content**	**Hrs**
1		**Laplace Transform**	**6**
	1.1	Definition and Condition of Existence of Laplace transform	
	1.2	Laplace transform of standard functions like polynomial, exponential, sine, cosine and hyperbolic.	
	1.3	Properties of Laplace transform: Linearity, First Shifting, Second Shifting, Change of Scale, Multiplication by t, Division by t, Laplace Transform of derivative, integral and convolution of two functions	
	1.4	Evaluation of real improper integrals by using Laplace transformation.	
2		**Inverse Laplace Transform**	**6**
	2.1	Definition and Inverse Laplace transform of standard functions.	
	2.2	Inverse Laplace transform using Partial fractions, derivatives property	
	2.3	Inverse Laplace transform using Convolution property.	

	2.4	Applications to solve initial and boundary value problems involving Ordinary differential equations.	
3		**Fourier Series**	**6**
	3.1	Drichlet's conditions, Definition of Fourier series and Parseval's Identity.	
	3.2	Fourier series of periodic function with period 2π and $2l$	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series	
4		**Function of Complex Variables**	**6**
	4.1	Function of complex variable f(z), Limit, Continuity and Differentiability of f(z), Analytic function. Necessary and sufficient conditions for f(z) to be Analytic. Cauchy-Riemann equations in Cartesian and Polar coordinates.	
	4.2	Milne-Thomson method: Determine analytic function f(z) when real part (u), imaginary part (v) or its combination is given.	
	4.3	Harmonic function, Harmonic conjugate and Orthogonal trajectories.	
	4.4	Conformal mapping, Linear and Bilinear mappings, cross ratio property, fixed points and standard transformations.	
5		**Complex Integration:**	**8**
	5.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions, Cauchy's Integral formula.	
	5.2	Taylor's and Laurent's series expansion.	
	5.3	Singularity, Zeroes, Poles of f(z), Residues, Cauchy's Residue Theorem.	
	5.4	Application of Residue Theorem to evaluate integration of some real value functions.	
6		**Vector Differential and Integral Calculus**	7
	6.1	Gradient, Directional derivative, Divergence and Curl. Solenoidal and irrotational (conservative) vector fields.	

	6.2	Line Integral (path dependent and independent), Work done, Conservative vector fields, Scalar potential.	
	6.3	Green's theorem in a plane, Surface integral, Stoke's theorem.	
	6.4	Volume integral, Gauss divergence Theorem.	
		Total	**39**

Textbooks:	
1	R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publication.
Reference Books:	
1	Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication.
2	Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited
3	Brown and Churchill, Complex Variables and Applications, McGraw-Hill Education.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC302	Electronic Devices & Circuits	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC302	Electronic Devices & Circuits	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credit
ECC302	Electronic Devices & Circuits	3
Prerequisite: Engineering Physics-I , Engineering Physics-II , Basic Electrical Engineering		
Course Objectives:		
1	Know functionality and applications of various electronic devices.	
2	Explain working of various electronics devices with the help of V-I characteristics.	
3	Derive expressions for performance parameters of BJT and MOSFET circuits.	
4	Evaluate performance of Electronic circuits (BJT and MOSFET based).	

5	Select the appropriate circuit for the given application.
6	Design electronic circuit (BJT, MOSFET based) circuits for given specifications**.**
Course Outcomes:	
1	To explain functionality of different electronic devices.
2	To perform DC and AC analysis of small signal amplifier circuits.
3	To analyze small signal amplifiers.
4	To analyze frequency response of small signal amplifiers.
5	To analyze large signal amplifiers.
6	To explain working of differential amplifiers and it's applications in Operational Amplifiers

Module		**Content**	**Hrs**
1		**Introduction of Electronic Devices**	**5**
	1.1	Study of pn junction diode characteristics & diode current equation. Application of zener diode as a voltage regulator.	
	1.2	Construction, working and characteristics of BJT, JFET, and E-MOSFET	
2		**Biasing Circuits of BJTs and MOSFETs**	**6**
	2.1	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias)	
	2.2	DC load line and region of operation for MOSFETs. Analysis and Design of biasing circuits for JFET (self bias and voltage divider bias), E-MOSFET (Drain to Gate bias & voltage divider bias).	
3		**Small Signal Amplifiers**	**6**
	3.1	Concept of AC load line and Amplification, Small signal analysis (Zi, Zo, Av and Ai) of CE amplifier using hybrid pi model.	

	3.2	Small signal analysis (Zi, Zo, Av) of CS (for EMOSFET) amplifiers.	
	3.3	Introduction to multistage amplifiers.(Concept, advantages & disadvantages)	
4		**Frequency response of Small signal Amplifiers:**	
	4.1	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance,	**8**
	4.2	High and low frequency analysis of CE amplifier.	
	4.3	High and low frequency analysis of CS (E-MOSFET) amplifier.	
5		**Large Signal Amplifiers:**	
	5.1	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier	
	5.2	Analysis of Class A power amplifier (Series fed and transformer coupled).	**6**
	5.3	Transformer less Amplifier: Class B power amplifier. Class AB output stage with diode biasing	
	5.4	Thermal considerations and heat sinks.	
6		**Introduction to Differential Amplifiers**	
	6.1	E-MOSFET Differential Amplifier, DC transfer characteristics, operation with common mode signal and differential mode signal	**8**
	6.2	Differential and common mode gain, CMRR, differential and common mode Input impedance	
		Total	**39**

Textbooks:	
1	D. A. Neamen, “Electronic Circuit Analysis and Design,” Tata McGraw Hill, 2ndEdition.
2	A. S. Sedra, K. C. Smith, and A. N. Chandorkar, “Microelectronic Circuits Theory and Applications,” International Version, OXFORD International Students, 6thEdition.
3	Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002
Reference Books:	
1	Boylestad and Nashelesky, “Electronic Devices and Circuits Theory,” Pearson Education, 11th Edition.
2	A. K. Maini, “Electronic Devices and Circuits,” Wiley.
3	T. L. Floyd, “Electronic Devices,”Prentice Hall, 9th Edition, 2012.
4	S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, Tata Mc-Graw Hill, 3rd Edition
5	Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for continuous assessment will be considered on approval by the subject teachers. The Assessment Tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC303	Digital System Design	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC303	Digital System Design	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credit
ECC303	Digital System Design	3

Prerequisite: Basic Electrical Engineering	
Course Objectives:	
1	To understand number system representations and their inter-conversions used in digital electronic circuits.
2	To analyze digital logic processes and to implement logical operations using various combinational logic circuits.
3	To analyze, design and implement logical operations using various sequential logic circuits.
4	To study the programmable logic devices and finite state machines

5	To learn basic concepts in /Verilog and implement combinational and sequential circuits using Verilog.
Course Outcomes:	
1	To understand types of number systems, digital logic, digital circuits and logic families.
2	To analyze, design and implement combinational logic circuits.
3	To analyze, design and implement sequential logic circuits.
4	To develop a digital logic and apply it to solve real life problems.
5	To study types of PLDs and Finite State Machines.
6	To simulate and implement basic combinational and sequential circuits using VHDL/Verilog.

Module		**Content**	**Hrs**
1		**Number Systems and Codes**	**4**
	1.1	Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code, Binary Arithmetic, Addition, Subtraction using 1's and 2's Complement	
2		**Logic Family and Logic Gates**	**5**
	2.1	Difference between Analog and Digital signals, Logic levels, TTL and CMOS Logic families and their characteristics	
	2.2	Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem	
3		**Combinational Logic Circuits**	**12**
	3.1	SOP and POS representation, K-Map up to four variables and Quine-McClusky method for minimization of logic expressions	
	3.2	Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Carry Look ahead adder and BCD adder, Magnitude Comparator	

	3.3	Multiplexer and Demultiplexer: Multiplexer operations, cascading of Multiplexer, Boolean function implementation using MUX, DEMUX and basic gates, Encoder and Decoder	
4		**Sequential Logic Circuits & Finite State Machines**	**14**
	4.1	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register	
	4.2	Counters: Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N, BCD Counter	
	4.3	Applications of Sequential Circuits: Frequency division, Ring counter, Johnson counter Introduction to design of Moore and Mealy circuits, Analysis of FSM, state diagram, State Table, Sequence designing using state diagram	
5		**Programmable Logic Devices**	**2**
	5.1	Introduction: Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic (PAL)	
6		**Introduction to Verilog**	**2**
	6.1	Basics of Verilog Programming, VERILOG programming : Dataflow, Behavioral, Structural, Blocking non-blocking statement, combinational and sequential programming	
		Total	**39**

Textbooks:	
1	John F. Warkerly, *"Digital Design Principles and Practices"*, Pearson Education, Fifth Edition (2018).
2	Morris Mano, Michael D. Ciletti, *"Digital Design"*, Pearson Education, Fifth Edition (2013).
3	R. P. Jain, *"Modern Digital Electronics''*, Tata McGraw Hill Education, Fourth Edition (2010).
4	A. Anand Kumar, *"Fundamentals of Digital Circuits"*, PHI, Fourth Edition (2016).
5	Volnei A. Pedroni, *"Digital Electronics and Design with VHDL",* Morgan Kaufmann Publisher, First Edition (2008).
6	Stephen Brown & Zvonko Vranesic, *"Fundamentals of Digital Logic with Verilog Design*", Third Edition, MGH (2014).
Reference Books:	
1	Thomas L. Floyd, *"Digital Fundamentals"*, Pearson Prentice Hall, Eleventh Global Edition (2015).
2	Mandal, *"Digital Electronics Principles and Applications"*, McGraw Hill Education, First Edition (2010).
3	Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, *"Digital Systems Principles and Applications"*, Ninth Edition, PHI (2009).
4	Donald P. Leach, Albert Paul Malvino, Gautam Saha, *"Digital Principles and Applications"*, The McGraw Hill, Eight Edition (2015).
5	Stephen Brown & Zvonko Vranesic, *"Fundamentals of Digital Logic Design with VHDL"*, Second Edition, TMH (2009).
6	J. Bhasker, *"A Verilog HDL Primer"*, Star Galaxy Press, Third Edition (1997).
7	Samir Palnitkar, *"Verilog HDL A guide to Digital Design and Synthesis"* , 2nd Edition, Pearson Education, (2009)

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
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8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC304	Network Theory	3	--	1	3	--	1	4

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC304	Network Theory	20	20	60	**2**	25	--	125

Course Code:	Course Title	Credits
ECC304	Network theory	4

Prerequisite: Basic Electrical Engineering, Engineering Mathematics II	
Course Objectives:	
1	To evaluate the Circuits using network theorems.
2	To analyze the Circuits in time and frequency domain.
3	To study network Topology, network Functions and two port networks.
4	To synthesize passive networks by various methods..

Course Outcomes:	
1	Apply their knowledge in analyzing Circuits by using network theorems.
2	Apply the time and frequency method of analysis.
3	Evaluate circuit using graph theory.
4	Find the various parameters of two port networks.
5	Apply network topology for analysing the circuit.
6	Synthesize the network using passive elements.

Module		**Content**	**Hrs**
1		**Electrical circuit analysis**	**7**
	1.1	Circuit Analysis: Analysis of Circuits with and without dependent sources using generalized loop and node analysis, super mesh and super node analysis techniques. Circuit Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems (Use only DC source)	
	1.2	Magnetic circuits: Concept of Self and mutual inductances, coefficient of coupling, Dot convention, equivalent circuit, solution using mesh analysis (for Two Loops only).	
2		**Graph Theory**	**6**
	2.1	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix.	
	2.2	Relationship between sub matrices A, B & Q. KVL & KCL using matrix.	
3		**Time and frequency domain analysis**	**8**

	3.1	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equations with step signals.	
	3.2	Frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor. Solution using second order equation for step signal.	
4		**Network Functions**	**6**
	4.1	Network functions for the one port and two port networks, driving point and transfer functions, Poles and Zeros of Network functions, necessary conditions for driving point functions, necessary conditions for transfer functions.	
	4.2	Analysis of ladder & symmetrical lattice network (Up to two nodes or loops)	
5		**Two Port Networks**	**5**
	5.1	Parameters: Open Circuits, short Circuit, Transmission and Hybrid parameters, relationship among parameters, conditions for reciprocity and symmetry.	
	5.2	Interconnections of Two-Port networks T & π representation.	
6		**Synthesis of RLC circuits**	**7**
	6.1	Hurwitz Polynomial, Positive Real Functions: Concept of positive real function, necessary and sufficient conditions for Positive real Functions.	
	6.2	Synthesis of LC, RC & RL Circuits: properties of LC, RC & RL driving point functions, LC, RC & RL network Synthesis in Cauer-I & Cauer-II , Foster-I & Foster-II forms (Up to Two Loops only).	
		Total	**39**

Textbooks:	
1	Franklin F Kuo, “Network Analysis and Synthesis”, Wiley Toppan, 2nd ed. ,1966.
2	M E Van Valkenburg, “Network Analysis”, Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.
Reference Books:	
1	A. Chakrabarti, “Circuit Theory”, Dhanpat Rai & Co., Delhi, 6th Edition.
2	A. Sudhakar, Shyammohan S. Palli “Circuits and Networks”, Tata McGraw-Hill education.
3	Smarajit Ghosh “Network Theory Analysis & Synthesis”, PHI learning.
4	K.S. Suresh Kumar, “Electric Circuit Analysis” Pearson, 2013.
5	D. Roy Choudhury, “Networks and Systems” , New Age International, 1998.

Internal Assessment:
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Continuous Assessment:-
Continuous Assessment is **of 20 marks.** The assessment tools for continuous assessment will be considered on approval by the subject teachers. The Assessment Tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
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End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC305	Electronic Instrumentation & Control Systems	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC305	Electronic Instrumentation & Control Systems	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credit
ECC305	**Electronic Instrumentation & Control System**	3

Prerequisite: Basics of Electronics and Electrical Engineering	
Course Objectives:	
1	To provide basic knowledge about the various sensors and transducers
2	To provide fundamental concepts of control system such as mathematical modeling, time response and frequency response.
3	To develop concepts of stability and its assessment criteria.

Course Outcomes: After successful completion of the course student will be able to:	
1	Identify various sensors, Transducers and their brief performance specification.
2	Understand principle of working of various transducer used to measure Temperature, Displacement, level and their application in industry
3	Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
4	Evaluate the transfer functions for a given Control system.
5	Understand the analysis of system in time domain and frequency domain.
6	Predict stability of given system using appropriate criteria.

Module		**Content**	**Hrs**
1		**Principle of Measurement, Testing and Measuring instruments**	**04**
	1.1	Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	1.2	Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Mega ohm bridge Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge	
2		**Sensors and Transducers**	**07**
	2.1	Basics of sensors and Transducers-Active and passive transducers, characteristics and selection criteria of transducers	

	2.2	Displacement and pressure- Potentiometers, pressure gauges, linear Variable differential transformers (LVDT) for measurement of pressure and displacement strain gauges	
	2.3	Temperature Transducers- Resistance temperature detectors (RTD). Thermistors and thermocouples, their ranges and applications	
3		**Introduction to control system Analysis**	**08**
	3.1	Introduction: Open and closed loop systems, example of control systems	
	3.2	Modelling: Modelling, Transfer function model	
	3.3	Block diagram reduction techniques and Signal flow graph	
4		**Response of control system**	**5**
	4.1	Dynamic Response: Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types	
	4.2	Concept of lag and lead compensator.	
5		**Stability Analysis in Time Domain**	**9**
	5.1	Concept of stability: Routh and Hurwitz stability criterion	
	5.2	Root locus Analysis: Root locus concept, general rules for constructing root-locus, root locus analysis of control system.	
6		**Stability Analysis in frequency domain**	**6**
	6.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	
	6.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, computation of stability margins in frequency domain. Frequency response analysis of RC, RL, RLC circuits.	
		Total	**39**

Textbooks:	
1	A.K. Sawhney, "*Electrical & Electronic Measurement & Instrumentation"* – DRS . India
2	B.C Nakra, K.K. Cahudhary, Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
3	W.D. Cooper, "*Electronic Instrumentation And Measuring Techniques*" – PHI
4	Nagrath, M.Gopal, "*Control System Engineering*", Tata McGraw Hill.
5	Rangan C. S., Sarma G. R. and Mani V. S. V., "*Instrumentation Devices And Systems*", Tata McGraw-Hill, 2nd Ed., 2004
6	K.Ogata, "*Modern Control Engineering*, Pearson Education", IIIrd edition.
Reference Books:	
1	Helfrick&Copper, "*Modern Electronic Instrumentation & Measuring Techniques"* – PHI
2	M.M.S. Anand, "*Electronic Instruments and instrumentation Technology"*.
3	Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998.
4	Benjamin C.Kuo, "*Automatic Control Systems*, Eearson education", VIIth edition
5	Doeblin E.D., Measurement system, Tata Mc Graw Hill., 4th ed, 2003.Madan Gopal, "Control Systems *Principles and Design"*, Tata McGraw hill, 7th Edition,1997.
6	Normon, "*Control System Engineering"*, John Wiley & sons, 3rd edition.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL301	Electronic Devices & Circuits Lab	1

Prerequisite: Engineering Physics-I , Engineering Physics-II , Basic Electrical Engineering	
Lab Objectives:	
1	To make students familiar with equipments and measuring instruments used to perform Electronics Devices and Circuits laboratory work.
2	To provide hands on experience to develop laboratory setup for performing given experimental using various equipments, electronic devices and measuring instruments.
3	To develop ability among students to gather appropriate data and analyse the same to relate theory with practical.

4	To develop trouble shooting abilities among students.
Lab Outcomes:	
1	Know various equipments, electronics devices and components, and measuring instruments used to perform laboratory work.
2	Students will be able to explain functionality of various equipments, electronics devices and components and neasu6 instruments used to perform laboratory work.
3	Students will be able connect various equipments, devices, components and measuring devices using bread board as per the circuit diagram for experiment to be performed.
4	Students will able to perform experiment to gather appropriate data.
5	Students will able to analyze data obtained from experiment to relate theory with experiment results.
6	Students will able to prepare laboratory report (Journal) to summarise the outcome each experiment.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	To study of PN junction diode characteristics.
2*	To study Zener as a voltage regulator.
3*	To study characteristics of CE configuration..
4*	To study BJT biasing circuits
5	To study FET biasing circuits
6*	To study BJT as a CE amplifier.
7*	To study frequency response of CE amplifier.
8	To study EMOSFET biasing circuits.
9	Simulation experiment on study of CS amplifier.
10	Simulation experiment on study frequency response of CS amplifier.

11	Simulation experiment on study of differential amplifier.
12	Simulation experiment on multistage amplifier.

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related labs.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL302	Digital System Design Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL302	Digital System Design Lab	--	--	--	--	25	--	25

Lab Code	Lab Name	Credit
ECL302	Digital System Design Lab	**1**

Prerequisite: Basic Electrical Engineering	
Lab Objectives:	
1	To get familiarize with basic building blocks of Digital System Design and verify the operation of various digital ICs.
2	To train students to design and implementation of combinational circuits.
3	To instruct students on how to design and implement sequential circuits.
4	To introduce simulation software like Verilog to design basic digital circuits.
Lab Outcomes:	
1	Students will be able to identify various Digital ICs and basic building blocks of digital system design.

2	Students will be able to design and implement combinational circuits like adder, subtractor, multiplexer, code converters etc.
3	Students will be able to identify and understand the working of various types of flip flops and their interconversions.
4	Students will be able to design and implement basic sequential circuits such as counters, registers etc.
5	Students will be able to acquire basic knowledge of Verilog basic programming.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Simplification of Boolean functions
2*	Design AND, OR, NOT, EXOR, EX-NOR gates using Universal gates: NAND and NOR
3*	Implement digital circuits to perform Binary to Gray and Gray to Binary operations
4*	Implement Half adder, Full adder, Half subtractor and Full subtractor circuits
5	Design and implement BCD adder using 4-bit Binary Adder IC-7483
6*	Implement logic equations using Multiplexer
7	Verify encoder and decoder operations
8*	Design and implement Magnitude Comparator
9*	Verify truth table of different types of flip flops
10*	Flip flop conversions JK to D, JK to T and D to T Flip Flop
11*	Design asynchronous/synchronous MOD N counter
12	Verify different counter operations
13*	Write VHDL/Verilog simulation code for different logic gates
14	Write VHDL/Verilog simulation code for combinational and sequential circuits
15.	Write VHDL/Verilog simulation code for 4:1 Multiplexer, 2 to 4 line binary decoder

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL303	Electronic Instrumentation & Control System Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL303	Electronic Instrumentation & Control System Lab	--	--	--	--	25	--	25

Course Code:	Course Title	Credit
ECL303	Electronic Instrumentation & Control System Lab	1

Prerequisite: Basics of Electronics and Electrical Engineering, Signals and Systems	
Course Objectives:	
1	Introduction to Electronics instruments for measurement of different physical and electrical parameter.
2	To simulate and analyze different parameters of control system.
3	To discuss stability of control system using various criteria.

Course Outcomes: After successful completion of the course student will be able to:	
1	Explain the principle of working of various transducers and their application in industry.
2	Measure the physical and electrical parameters of various transducers and sensors.
3	Understand the concept of first order and second order systems with their frequency response.
4	Solve problems and calculate the time response specification of control system.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Sr. No.	**Name of the Experiment**
1	Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2	Designing AC bridge Circuit for capacitance measurement.
3	Study and characteristics of Resistive Temperature Detector (RTD).
4	Study and plot characteristics of various Thermocouples.
5	Study and plot characteristics of various Thermocouples.
6	Study of Linear Variable Differential Transformer (LVDT).
7	To study and understand the principle of Strain gauge.
8	To plot the frequency response of First order System
9	To plot the frequency response of Second order System
10	To Examine Steady State Error for Type 0, 1, 2 System
11	To study time response of Second order under damped systems. Calculate time response specifications.
12	To plot root locus and inspect the stability of the system.
13	To design Lead and Lag Compensator using Root locus.
14	To inspect the stability of system by Bode plot using Simulation software.

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related labs.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL304	Skill Lab: C++ and Java Programming	--	2+2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECL304	Skill Lab: C++ and Java Programming	2

Prerequisite: C-Programming	
Course Objectives:	
1	Describe the principles of Object Oriented Programming (OOP)
2	To understand object-oriented concepts such as data abstraction, encapsulation, inheritance and polymorphism
3	Utilize the object-oriented paradigm in program design.
4	To lay a foundation for advanced programming.
5	Develop programming insight using OOP constructs.

Course Outcomes:	
1	Describe the basic principles of OOP.
2	Design and apply OOP principles for effective programming.
3	Develop programming applications using OOP language.
4	Implement different programming applications using packaging
5	Analyze the strength of OOP.
6	Percept the Utility and applicability of OOP.

Module		**Content**	**Hrs**
1		**C++ Overview**	**8**
	1.1	Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP and C++ as object oriented programming language.	
	1.2	C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.	
2		**C++ Control Structures**	**8**
	2.1	**Branching -** If statement, If-else Statement, Decision. **Looping –** while, do-while, for loop **Nested control structure-** Switch statement, Continue statement, Break statement	
	2.2	**Array-** Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array.	

3		**Object-Oriented Programming using C++**	**12**
	3.1	**Operator Overloading-** concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. **Function-** Function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function. **Constructor-** Definition, Types of Constructor, Constructor Overloading, Destructor	
	3.2	**Inheritance-** Introduction, Types of Inheritance, Inheritance, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Visibility Modes Public, Private, Protected and Friend, Aggregation, Classes Within Classes. Deriving a class from Base Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, **Polymorphism-** concept, relationship among objects in inheritance, hierarchy, Runtime & Compile Time Polymorphism, abstract classes, Virtual Base Class.	
4		**Introduction to Java**	**7**
	4.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	4.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
5		**Inheritance, Polymorphism, Encapsulation using Java**	**11**
	5.1	Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String: String Class and Methods in Java.	

	5.2	Inheritances: Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator	
6		**Exception Handling and Threading in Java**	**6**
	6.1	**Exception Handling**: fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception subclasses). Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Printwriter class.	
	6.2	**Threading**: Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread	
		Total	**52**

Textbooks:	
1	Bjarne Stroustrup, “The C++ Programming language”, Third edition, Pearson Education.
2	Yashwant Kanitkar, “Let Us Java”, 2nd Edition, BPB Publications.
3	D.T. Editorial Services, “Java 8 Programming Black Book”, Dreamtech Press, Edition: 2015
4	Deitel, “C++ How to Program”, 4th Edition, Pearson Education.
Reference Books:	
1	Herbert Schidt, “The Complete Reference”, Tata McGraw-Hill Publishing Company Limited, Ninth Edition.
2	Java: How to Program, 8/e, Dietal, PHI.
3	Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Languageser Guide”, Pearson Education.
4	Sachin Malhotra, Saurabh Chaudhary, “Programming in Java”, Oxford

Lab Work

Useful Links and Software Tools:	
1	Raptor-Flowchart Simulation:http://raptor.martincarlisle.com/
2	Eclipse: https://eclipse.org/
3	Netbeans:https://netbeans.org/downloads/
4	CodeBlock:http://www.codeblocks.org/
5	J-Edit/J-Editor/Blue J
Online Repository:	
1	Google Drive
2	GitHub
3	Code Guru

Suggested Experiments: Students are required to complete at least 10 experiments (**07 experiments** on **C++** and **03 experiments on JAVA**).	
Note: *Before performing practical necessary Theory will be taught by concern faculty*	
Sr. No.	**Name of the Experiment (C++)**
1	Add Two Numbers
2	Print Number Entered by User
3	Swap Two Numbers
4	Check Whether Number is Even or Odd

5	Find Largest Number Among Three Numbers
6	Create a simple class and object.
7	Create an object of a class and access class attributes
8	Create class methods
9	Create a class to read and add two distance
10	Create a class for student to get and print details of a student.
11	Demonstrate example of friend function with class
12	Implement inheritance.
Sr. No.	**Name of the Experiment (JAVA)**
1	Display addition of number
2	Accept marks from user, if Marks greater than 40,declare the student as "Pass" else "Fail""
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Create thread by implementing 'runnable' interface or creating 'Thread Class.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECM301	Mini Project – 1 A	--	4$	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECM301	Mini Project – 1 A	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECM301	**Mini Project-1a : PCB Design + Arduino**	2

Prerequisite: BEE	
Course Objectives:	
1	To make students familiar with the basics of electronic devices and circuits, electrical circuits and digital systems
2	To familiarize the students with the designing and making of Printed circuit boards(PCB)
3	To increase students critical thinking ability and provide solutions to some real time problems.
4	To make students familiar with the basics of Electronics, Arduino board, Arduino IDE (Integrated Development Environment) .

5	To familiarize the students with the programming and interfacing of different devices with Arduino .
Course Outcomes:	
1	Able to identify electronics circuit for particular application/experiment.
2	Design and simulate the circuits by putting together the analog and digital components
3	Learn the Soldering, PCB design process and gain up-to-date knowledge of PCB design software.
4	Write basic codes for the Arduino board using the IDE for utilizing the onboard resources.
5	Apply the knowledge of interfacing PCB, different devices to the Arduino board using basic electronic tools and equipment's (like millimeter, CRO, DSO etc.)
6	Analysis of hardware fault detection and correction for building application using PCB and Arduino IDE.

Module		Content	Hrs
1		**Identification and Designing of Circuit**	8
	1.1	Identification of particular application with understanding of its detail operation. Study of necessary components and devices required to implement the application.	
	1.2	Designing the circuit for particular application either analog , digital, electrical , analog and digital, Linear integrated circuits etc which is implemented on PCB and software on Arduino.	
2		**Software simulation and Implementation on GPP**	8
	2.1	Simulation of circuit for particular application using software's to verify the expected results	
	2.2	Implementation of verified circuit on general purpose printed circuit board (GPP). Now Verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
	2.3	**Introduction to Arduino Board :** Introduction to Arduino Uno board and integrated development environment(IDE)	
	2.4	Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.	
3		**PCB design and optimization**	8
	3.1	Design the circuit by placing components using PCB design software's. Reduce the size of PCB by varying the position of components or devices for optimize use of copper clad material.	
	3.2	**Implementation of PCB** : Transfer the designed PCB on Copper clad either by using dark room or taking printout on glossy paper, etc (available suitable method). Perform Etching and then Soldering.	
	3.3	**GPIO (along with Analog pin) Programming :** Introduction to programming GPIO, Analog and PWM PINS. Interface any Digital Sensors to the Arduino board and display sensor values on serial Monitor.	
	3.4	Interface any Analog sensor to the Arduino board and display sensor Synchronization.	
4		**Interfacing output devices/Displaying and communication devices**	8

	4.1	Interface an Analog Sensors to the Arduino board and display sensor values on LCD/TFT/Seven segment Display.	
	4.2	Interface a temperature sensor to Arduino and switch on a relay to operate a fan if temperature exceeds given threshold. Also display the temperature on any of the display device.	
	4.3	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods. Interface Wi-fi / Bluetooth/ GSM/ Zigbee / RF module to Arduino and program it to transfer sensor data wirelessly between two devices.	
5		**PCB and Arduino Interfacing**	**8**
	5.1	Interface implemented PCB with Arduni for final application.	
	5.2	Verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
6		**Understanding the Troubleshooting**	**8**
	6.1	Identify the hardware faults in designed circuit and subsequently rectify it . Understand the trouble shooting by removing some wired connection.	
	6.2	Now again verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
		Total	**48**

Textbooks:	
1.	Schultz Mitchel E., *"Grob's Basic Electronics",* McGraw-Hill Education; 10th edition, 25 October , 2006.
2.	Charles Platt, *"Make Electronics: Learning by discovery",* O'Reilly; 2nd edition, 18 September , 2015.
3.	Forrest M Mims III, *"Getting started in Electronics",* Book Renter, Inc.; 3rd edition , 1 January 2000.
4.	R S Khandpur, "*Printed circuit board*", McGraw-Hill Education; 1st edition, 24 February , 2005.
5.	Kraig Mitzner, "*Complete PCB Design Using OrCAD Capture and PCB Editor",* Academic Press; 2nd edition , 20 June 2019.
6.	Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017)

Useful Softwares:	
1.	LTspice:https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#
2.	Eagle : https://www.autodesk.in/products/eagle/overview
3.	OrCAD: https://www.orcad.com/
4.	Multisim : https://www.multisim.com/
5.	Webbench: http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html
6.	Tinkercad : https://www.tinkercad.com/
7.	Arduino IDE: https://www.arduino.cc/en/main/software
Useful Links:	
1	https://www.electronicsforu.com
2	https://circuitdigest.com
3	https://www.electronicshub.org

Term Work:	
1	**Guideline to maintain quality of mini project are as follows :** This they can achieve by making proper selection of Mini Projects. Encourage the use of free software for simulation, design and analysis of mini projects. **Project Topic selection and approval :-** 1. The group may be of maximum **FOUR (04)** students. 2. Topic selection and approval by **2 Expert** faculty from department at the start of semester 3. **Log Book** to be prepared for each group to record the work progress in terms of milestones per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signature in it per week. The log book can be managed **online** with proper authentication method using google sheets/forms or open source project management software. 4. **Suggested steps for mini project selection and implementation** a. It is mandatory to design (analog+digital) sensor/IC based circuit on PCB in this project. Without PCB project will be rejected. b. Application is made using PCB + Arduino (IDE).(Hardware + software co-design). c. Mini project should be completely hardware based.(minimal software use) d. Identification and testing of different components, instruments, simulation software for projects. e. Topic selected should be application based. It must not be picked from experiment list or very simple. f. Designing and analysing circuits by students using standard material and software. g. Initial project demonstration and testing is expected to be done by soldering on general purpose PCB. Discourage use of breadboards. h. Study of PCB, Simulation on software and making of final PCB layout for given circuit. i. Implementing the final circuits on PCB by mounting required components with application using Arduino. 5. Suggested list of components : Transistors, diodes, regulators, gates, counters, FF, Latches, Decoder, Mux, comparator, Adder, Subtractor, ALU, CPLDs, DC motors, resistor, capacitor, inductor, Op-amp etc.(Students may add more components as per the requirement of project)
2	**Project Report Format:** 1. Mini Project **report** should include circuit diagram, operation, application, waveforms (if applicable), simulation results and final prepared PCB image, conclusion, etc. 2. Report should not exceed **08 pages**. Simply staple it to discourage use of plastic.

3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	**Term Work evaluation and marking scheme:** 1. At end of semester the above 2 expert faculty who have approved the topic will internally **evaluate the performance**. 2. Students have to give presentation and demonstration on the Mini Project- 1-A 3. In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. Based upon it the marks will be awarded to student. 4. Distribution of 50 Marks scheme is as follows: 1. **Initial Stage** : Circuit simulation + Zero PCB (GPP) implementation + Arduino Interfacing = **05** Marks 2. **Project report** : Circuit Design + Explanation + Analysis+ Results + Conclusion = **10** Marks 3. **Implementation**: PCB (simulation + Layout) + Final result with Arduino interfacing + Working Demo = **25** Marks 4. **Final Presentation** : PPT (upto **08** slides) + Answers given to Questions = **10** Marks
	In continuous assessment focus shall be on 1. Each individual student, assessment based on individual's contribution in group activity. 2. Their understanding and response to questions.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC401	Engineering Mathematics- IV	3	--	1*	3	--	1	4

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC401	Engineering Mathematics- IV	20	20	60	**2**	25	--	125

Course Code:	Course Title	Credit
ECC401	Engineering Mathematics-IV	4

Prerequisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics- III	
Course Objectives:	
1	To build a strong foundation in mathematics, provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
2	To prepare student to apply reasoning informed by the contextual knowledge to engineering practice, to work as part of teams on multi-disciplinary projects.

Course Outcomes:	
1	Find Eigen values, Eigen vectors of matrix, apply Caley Hamilton theorem to find a function of a matrix, distinguish derogatory matrix, and diagonalizable matrix
2	Reduce a quadratic for to canonical forms using congruent and orthogonal transformations and characterize it on the basis of rank, index and class value.
3	Identify a vector spaces and its basis. Calculate norm, inner products, establish related properties. Find an orthogonal and orthonormal basis using Gram Schmidt process.
4	Compute probability using probability distribution of discrete and continuous Random variable, Poisson and Normal distribution.
5	Apply Testing of Hypothesis associated with Sampling distribution of large sample, small sample and chi square distribution.
6	Apply the concept of Correlation and Regression, fitting of curve to the given data sets.

Module		**Content**	**Hrs**
1		**Linear Algebra (Theory of Matrices)**	**6**
	1.1	Eigen values and Eigen vectors, and properties.	
	1.2	Cayley-Hamilton Theorem (without proof), Functions of Square Matrix.	
	1.3	Derogatory and non-derogatory matrices.	
	1.4	Similarity of matrices, diagonalizable and non-diagonalizable matrices.	
2		**Linear Algebra (Quadratic Forms)**	**5**
	2.1	Quadratic forms over real field, Linear transformation of Quadratic form, Reduction of Quadratic form to canonical forms (diagonal and normal) using a congruent transformation.	
	2.2	Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semi-definite and Indefinite.	

	2.3	Reduction of Quadratic form to a canonical forms (diagonal and normal) using an orthogonal transformation.	
3		**Linear Algebra (Vector Space, Basis and Orthonormal Basis)**	**7**
	3.1	Vector spaces over real field, subspaces.	
	3.2	Vectors in n-dimensional vector space, Linear combinations, Linear dependence and independence set of vectors, Basis of a vector space.	
	3.3	Norm, Inner product, distance between two vectors, angle between two vectors, orthogonal vectors, Triangular and Cauchy-Schwarz inequality.	
	3.4	Orthogonal and orthonormal Basis, Gram-Schmidt process to construct an orthonormal Basis.	
4		**Probability**	**8**
	4.1	Discrete and continuous random variable with probability distribution and probability density function.	
	4.2	Expectation, Variance, Moment generating function, Raw and central Moments, Covariance, Correlation coefficient and their properties	
	4.3	Probability Distribution: Binomial, Poisson and Normal distribution	
5		**Probability Distribution and Sampling Theory**	**8**
	5.1	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Test of significance of mean and difference between the means of two samples for Large samples.	
	5.2	Degree of freedom, Student's t-distribution, Test of significance of mean and difference between the means of two samples for Small samples.	
	5.3	Chi-Square Test: Test of goodness of fit. Contingency table and Test of independence of attributes, Yate's Correction.	
6		**Statistical Techniques**	5
	6.1	Karl Pearson's coefficient of correlation (r).	
	6.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks).	
	6.3	Fitting of first and second degree curves.	

	6.4	Lines of regression.	
		Total	**39**

Textbooks:	
1	D. C. Lay, “Linear Algebra and its Applications”, Pearson.
2	Gupta and Kapoor, “Fundamental of Mathematical Statistics”, S Chand.
Reference Books:	
1	T. Veerarajan, “Probability, Statistics and Random Processes”, McGraw-Hill.
2	Howard Anton and Chris Rorres, “Elementary Linear Algebra with Supplemental Applications”, Wiley.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	6 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC402	Microcontrollers	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC402	Microcontrollers	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credit
ECC402	Microcontrollers	3

Prerequisite: ECC303 – Digital System Design	
Course Objectives:	
1	To understand the architecture of 8051.
2	To understand the architecture of the ARM7 core.
3	To write programs for 8051 microcontrollers.
4	To understand the design of Microcontroller Applications.

Course Outcomes:	
1	Understand the detailed architecture of 8051.
2	Understand the detailed architecture of ARM7 Core.
3	Write programs for 8051 microcontrollers.
4	Design an application using a microcontroller.

Module		Detailed Contents	Hrs
1.0		**Overview of Microprocessor based System**	**5**
	1.1	Overview of microcomputer systems and their building blocks, Memory Interfacing, Steps taken by the microprocessor to fetch and execute an instruction from the memory.	
	1.2	Concepts of Program counter register, Reset, Stack and stack pointer, Subroutine, Interrupts and Direct Memory Access.	
	1.3	Concept of RISC & CISC Architecture, Harvard & Von Neumann Architecture	
2		**8051 Microcontroller**	**10**
	2.1	Comparison between Microprocessor and Microcontroller	
	2.2	Features, architecture and pin configuration	
	2.3	CPU timing and machine cycle	
	2.4	Input / Output ports	
	2.5	Memory organization	

	2.6	Counters and timers	
	2.7	Interrupts	
	2.8	Serial data input and output	
3		**8051 Assembly Language Programming and Interfacing**	**11**
	3.1	Addressing modes, Need of Assembler & Cross Assemble, Assembler Directives	
	3.2	Instruction Set	
	3.3	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts	
	3.4	Interfacing with LEDs, Relay and Keys	
4		**ARM7**	**4**
	4.1	Introduction & Features of ARM 7	
	4.2	Concept of Cortex-A, Cortex-R and Cortex-M	
	4.3	Architectural inheritance, Pipelining	
5		**ARM7 Instruction Set**	**6**
	5.1	Programmer's model	
	5.2	Brief introduction to exceptions and interrupts handling	
	5.3	Instruction set: Data processing, Data Transfer, Control flow	
6		**ARM 7 based microcontroller**	**3**
	6.1	Understanding features, architecture & addressing modes of STM32.	
Total			**39**

Textbooks:	
1	M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
2	C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010.
3	Steve Furber, "ARM System on chip Architecture", Pearson,2nd edition, 2001
Reference Books:	
1	"MCS@51 Microcontroller, Family User's Manual" Intel
2	James A. Langbridge, "Professional Embedded Arm Development", Wrox, John Wiley Brand & Sons Inc., Edition 2014
3	Warren Gay, "Beginning STM32, 2018 edition.
4	https://www.st.com/resource/en/datasheet/stm32f205rf.pdf

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC403	Linear Integrated Circuits	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC403	Linear Integrated Circuits	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credit
ECC403	Linear Integrated Circuits	3

Prerequisite: Basic Electrical Engineering, Electronic Devices & Circuits	
Course Objectives:	
1	To understand the concepts, working principles and key applications of linear integrated circuits.
2	To perform analysis of circuits based on linear integrated circuits.
3	To design circuits and systems for particular applications using linear integrated circuits.
Course Outcomes:	
1	Outline and classify all types of integrated circuits.

2	Understand the fundamentals and areas of applications for the integrated circuits.
3	Develop the ability to design practical circuits that perform the desired operations.
4	Understand the IC 555 timer and its applications.
5	Design voltage regulators for different applications.
6	Identify the appropriate integrated circuit modules for designing engineering applications.

Module		**Content**	**Hrs**
1		**Introduction to Operational Amplifier**	**7**
	1.1	Block diagram of Op-Amp. Ideal and practical characteristics of op-amp.	
	1.2	Configurations of Op-Amp: Open loop and closed loop Configurations of Op-amp, Inverting and Non-inverting configuration of Op-amp and buffer.	
	1.3	Summing amplifier, difference amplifiers and Instrumentation amplifier using Op-amp.	
2		**Linear Applications of Operational Amplifier**	**8**
	2.1	Voltage to current and current to voltage converter.	
	2.2	Integrator & differentiator (ideal & practical), Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters.	
	2.3	Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.	
3		**Non-Linear Applications of Operational Amplifier**	

	3.1	Comparators: Inverting comparator, Non Inverting comparator zero crossing detectors,Inverting Schmitt trigger	**7**
	3.2	Waveform Generators: Square wave generator and triangular wave generator. Basics of Precision Rectifiers: Half wave and full wave precision rectifiers.	
4		**Timer IC 555 and it's applications**	**7**
	4.1	Functional block diagram and working of IC 555	
	4.2	Design of Astable and Monostable multivibrator using IC 555	
	4.3	Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator.	
5		**Voltage Regulators.**	**6**
	5.1	Functional block diagram, working and design of three terminal fixed voltage regulators (78XX, 79XX series).	
	5.2	Functional block diagram, working and design of general purpose IC 723 (HVLC and HVHC).	
	5.3	Introduction and block diagram of switching regulator, Introduction of LM 317	
6		**Special Purpose Integrated Circuits**	**4**
	6.1	Functional block diagram and working of VCO IC 566 and application as frequency modulator.	
	6.2	Functional block diagram and working of PLL IC 565 and application as FSK Demodulator.	
		Total	**39**

Textbooks:	
1	Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson Prentice Hall, 4th Edition.
2	D. Roy Choudhury and S. B. Jain, “Linear Integrated Circuits”, New Age International Publishers, 4th Edition.
Reference Books:	
1	K. R. Botkar, “Integrated Circuits”, Khanna Publishers (2004) Tata McGraw Hill, 3rd Edition.University Press, Indian Edition.
2	Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 4th Edition.
3	David A. Bell, “Operational Amplifiers and Linear Integrated Circuits”, Oxford University Press,3rd Edition
4	R. F. Coughlin and F. F. Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Prentice Hall, 6th Edition.
5	J. Millman, Christos CHalkias, and Satyabratatajit, Millman’s,“Electronic Devices and Circuits,” McGrawHill, 3rdEdition.

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8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC404	Signals & Systems	3	--	1	3	--	1	4

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC404	Signals & Systems	20	20	60	**2**	25	--	125

Course Code:	Course Title	Credit
ECC404	Signals & Systems	4

Prerequisite: ECC301 – Engineering Mathematics III	
Course Objectives:	
1	To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.
2	To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course Outcomes:	
1	Classify and Analyze different types of signals and systems.
2	Analyze continuous time LTI signals and systems in the transform domain.
3	Analyze and realize discrete time LTI signals and systems in the transform domain.
4	Represent signals using Fourier Series and Analyze the systems using the Fourier Transform.
5	Demonstrate the concepts learnt in signals and systems Course using the modern engineering tools.
6	Apply the knowledge of signals and systems in various fields of engineering.

Module		Detailed Contents	Hrs
1.0		**Introduction to signals and systems**	**7**
	1.1	**Introduction to Signals:** Definition, Basic Elementary signals - exponential, sine, step, impulse, ramp, rectangular, triangular. Operations on signals. **Classification of Signals:** analog and discrete time signals, even and odd signals, periodic and non-periodic signals , deterministic and non-deterministic signals, energy and power signals	
	1.2	**Systems and Classification of systems:** System Representation, continuous time and discrete systems, system with and without memory, causal and non-causal system, linear and nonlinear system, time invariant and time variant system, stable system.	
2		**Time domain analysis of Continuous Time and Discrete Time systems**	**7**

2	**2.1**	**Linear Time Invariant (LTI) systems:** Representation of systems using differential /difference equation, Impulse, step and exponential response, System Stability and Causality	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems	
	2.3	**Correlation and spectral Density:** auto-correlation, cross correlation, analogy between correlation and convolution, energy spectral density, power spectral density, relation of ESD and PSD with auto-correlation	
3		**Fourier Analysis of Continuous and Discrete Time Signals and Systems**	**7**
	3.1	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform, Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, Limitations of Fourier Transform.	
	3.2	Systems characterized by difference/differential equation, transfer function of system, total response of a system.	
4		**Laplace Transform and Continuous time LTI systems**	**6**
	4.1	Need of Laplace Transform, Concept of Region of Convergence, Properties of Laplace Transform, Relation between continuous time Fourier Transform and Laplace Transform, unilateral Laplace Transform, inverse Laplace Transform.	
	4.2	**Analysis of continuous time LTI systems using Laplace Transform:** Causality and stability of systems in s-domain, Total response of a system.	
5		**z-Transform and Discrete time LTI systems**	8
	5.1	Need of z-Transform, z-Transform of finite and infinite duration sequences, Concept of Region of Convergence, z-Transform properties, Standard z-transform pairs, relation between z transform and discrete time Fourier Transform, one sided zTransform. Inverse z-Transform: Partial Fraction method only.	

	5.2	**Analysis of discrete time LTI systems using z-Transform:** Systems characterized by Linear constant coefficient difference equation, Transfer Function, plotting Poles and Zeros of a transfer function , causality and stability of systems, Total response of a system.	
6		**Applications of Signals and Systems**	**4**
	6.1	Signal Processing Applications: Speech and Audio Processing, Multimedia (image & video) processing	
	6.2	Underwater acoustic signal processing, filtering of signals.	
Total			**39**

Textbooks:

1	Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
2	Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition 2009.
3	Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, Second Edition, 2002.
4	Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.

Reference Books:	
1	Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third edition, 2010
2	Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.
3	V. Krishnaveni and A. Rajeshwari, Signals and Systems, Wiley-India, First Edition 2012.
4	Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, special Indian Economy edition, 2009.
5	Luis F. Chaparro, Signals and Systems Using MATLAB, Academic Press
6	Rabiner, Lawrence R., and Bernard Gold. "Theory and application of digital signal processing." Englewood Cliffs.
7	Signals and Systems Laboratory: Virtual Laboratory http://ssl-iitg.vlabs.ac.in/

Internal Assessment:

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5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks

7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC405	Principles of Communication Engineering	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECC405	Principles of Communication Engineering	20	20	60	**2**	--	--	100

Course Code:	Course Title	Credits
ECC405	Principles of Communication Engineering	3
Prerequisite: 1. Engineering Mathematics- III 2. Electronic Devices and Circuits		
Course Objectives:		
1	To illustrate the fundamentals of basic communication system.	
2	To understand various analog modulation and demodulation techniques.	
3	To focus on applications of analog modulation and demodulation techniques.	
4	To explain the key concepts of analog and digital pulse modulation and demodulation techniques.	

Course Outcomes:	
1	Understand the basic components and types of noises in communication system.
2	Analyze the concepts of amplitude modulation and demodulation.
3	Analyze the concepts of angle modulation and demodulation.
4	Compare the performance of AM and FM receivers.
5	Describe analog and digital pulse modulation techniques.
6	Illustrate the principles of multiplexing and demultiplexing techniques.

Module		Content	Hrs
1		**Basics of Communication System**	**5**
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain. Basic concepts of wave propagation	
	1.2	Types of noise, signal to noise ratio, noise figure, noise temperature and Friss formula.	
2		**Amplitude Modulation and Demodulation**	**12**
	2.1	Basic concepts, need for modulation, waveforms (time domain and frequency domain), modulation index, bandwidth, voltage distribution and power calculations.	
	2.2	DSBFC: Principles, low-level and high-level transmitters, DSB suppressed carrier, Balanced modulators with diode (Ring modulator and FET) and SSB systems.	
	2.3	Amplitude demodulation: Diode detector, practical diode detector, Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television.	

3		**Angle Modulation and Demodulation**	**10**
	3.1	Frequency and Phase modulation (FM and PM): Basic concepts, mathematical analysis, FM wave (time and frequency domain), sensitivity, phase and frequency deviation, modulation index, deviation ratio, bandwidth requirement of angle modulated waves, narrowband FM and wideband FM.	
	3.2	Varactor diode modulator, Direct FM transmitter, indirect FM Transmitter , Noise Triangle, pre- emphasis and de-emphasis.	
	3.3	FM demodulation: Balanced slope detector, Foster-Seely discriminator, Ratio detector amplitude limiting and thresholding, Applications of FM and PM.	
4		**Radio Receivers**	**4**
	4.1	Characteristics of radio receivers, TRF, Super - heterodyne receiver block diagram, tracking and choice of IF, AGC and its types and Communication receiver.	
	4.2	FM receiver block diagram, comparison with AM receiver.	
5		**Analog and Digital Pulse Modulation & Demodulation**	**6**
	5.1	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria, Sampling techniques, aliasing error and aperture effect.	
	5.2	PAM, PWM, PPM generation, detection and applications. Basics of PCM system and differential PCM system. Concepts of Delta modulation (DM) and Adaptive Delta Modulation (ADM).	
6		**Multiplexing & De-multiplexing**	**2**
	6.1	Frequency Division Multiplexing transmitter & receiver block diagram and applications. Time Division Multiplexing transmitter & receiver block diagram and applications.	
		Total	**39**

Textbooks:	
1	Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth edition.
2	B.P. Lathi, Zhi Ding "Modern Digital and Analog Communication system", Oxford University Press, Fourth edition.
3	Wayne Tomasi, "Electronics Communication Systems", Pearson education, Fifth edition.
Reference Books:	
1	Taub, Schilling and Saha, "Taub's Principles of Communication systems", Tata McGraw Hill, Third edition.
2	P. Sing and S.D. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hill, Third edition.
3	Simon Haykin, Michel Moher, "Introduction to Analog and Digital Communication", Wiley, Second edition.
4	Dennis Roddy and John Coolen, Electronic Communication, Pearson, 4/e, 2011.
5	Louis Frenzel, "Communication Electronics", Tata McGraw Hill, Third Edition.

Internal Assessment:
Assessment consists of one Mid Term Test of **20 marks** and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for continuous assessment will be considered on approval by the subject teachers. The Assessment Tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	**60 Marks**
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL401	Microcontrollers Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL401	Microcontrollers Lab	--	--	--	--	25	--	25

Lab Code	Lab Name	Credit
ECL401	Microcontrollers Lab	1

Lab Objectives:

1	To understand development tools of microcontroller based systems.
2	To learn programming for different microcontroller operation & interface to I/O devices.
3	To develop microcontroller based applications.

Lab Outcomes:	
1	Understand different development tools required to develop microcontroller based systems.
2	Write assembly language programs for arithmetic and logical operations, code conversion & data transfer operations.
3	Write assembly language programs for general purpose I/O, Timers & Interrupts.
4	Interface & write programs for Input and Output devices
5	Develop microcontroller based Applications.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr. No.	**Name of the Experiment**
1	Perform Arithmetic and Logical Operations (Using Immediate, Direct and Indirect addressing)
2	Code Conversion
3	Transfer of data bytes between Internal and External Memory
4	Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc.
5	Interfacing of Matrix Keyboard, LED, 7 Segment display, LCD, Stepper Motor, UART
6	Interfacing of STM32 with LED, Seven segment display, LCD, Keypad & Motors
7	Interfacing of STM32 with sensors like gas sensors, proximity sensors & temperature senator.

Useful Links:	
1	www.leetcode.com
2	www.hackerrank.com
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html
4	www.codechef.com

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Continuous assessment exam	
1	Based on the subject and related lab of

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL402	Linear Integrated Circuits Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL402	Linear Integrated Circuits Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL402	Linear Integrated Circuits Lab.	1

Prerequisite: Basic Electrical Engineering, Electronic Devices & Circuits	
Lab Objectives:	
1	To understand the concepts, working principles and key applications of linear integrated circuits.
2	To perform analysis of circuits based on linear integrated circuits.
3	To design circuits and systems for particular applications using linear integrated circuits.
Lab Outcomes:	
1	Understand the differences between theoretical, practical and simulated results in integrated circuits.

2	Apply the knowledge to do simple mathematical operations.
3	Apply knowledge of op-amp, timer and voltage regulator ICs to design simple applications.

Suggested Experiments: Students are required to complete at least 08 experiments.	
Minimum 6 hardware practical (compulsorily based on IC 741, IC 555, IC 723 and remaining on VCO 566 or PLL 565) and 2 simulations should be conducted. At least one experiment from each Module of syllabus	
Sr. No.	**Name of the Experiment**
1	Design inverting, non-inverting amplifier and buffer using IC 741.
2	Design summing and difference amplifier using op-amp.
3	Design voltage to current converter with grounded load.
4	Design and analyze Integrator
5	Design and analyze Differentiator
6	Design Schmitt trigger using Op-amp.
7	Design Wein bridge and RC phase shift Oscillator.
8	Design and analyze second order High pass and Low pass filter
9	Design and analyze Band pass and Band reject filter.
10	Design Astable multivibrator using IC 555 for fixed frequency and variable duty cycle.
11	Design Monostable Multivibrator using IC 555.
12	Design Low voltage Low current voltage regulator using IC 723.
13	Design High voltage High current voltage regulator using IC 723.
14	Design Frequency Modulator using IC 566
15.	Design FSK Demodulator using IC 565
16.	Design Precision rectifier
17.	Design Square & Triangular wave generator.

Term Work:	
1	Term work should consist of 08 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of and ECC403 and ECL402

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL403	Principles of Communication Engineering Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL403	Principles of Communication Engineering Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL403	Principles of Communication Engineering Lab.	**1**

Prerequisite:	1. Usage of basic Electronic instruments and components. 2. Fundamentals of Electronic Devices and circuits
Lab Objectives:	
1	To give an understanding of Time and Frequency domain representation of signals.
2	To demonstrate continuous wave modulation and demodulation.
3	To demonstrate analog and digital pulse communication.
4	Able to use simulation software to build communication circuits.

Lab Outcomes:	
1	Analyze analog modulation techniques.
2	Analyze the waveforms of Radio receivers.
3	Implement analog pulse modulation and demodulation circuits.
4	Demonstrate digital pulse modulation and demodulation techniques.
5	Verify the concepts of TDM and FDM.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Generation of AM modulation and demodulation.
2*	Analyze waveforms at various stages of SSB system.
3*	Generation of FM modulation and demodulation
4*	Analyze the output waveforms of each block of AM transmitter /receiver
5*	Analyze the output waveforms of each block of FM transmitter /receiver
6	Design and implement Pre-emphasis and De-emphasis circuit.
7*	Verification of sampling theorem
8*	Generation of PAM modulation and demodulation.
9*	Generation of PWM and PPM modulation and demodulation.
10*	Demonstrate Digital pulse transmission technique (PCM)
11	Demonstrate Digital pulse transmission technique (DM,ADM)
12	Observation of FDM multiplexing and de-multiplexing signals.

13*	Observation of TDM multiplexing and de-multiplexing signals.

Useful Links:	
1	https://swayam.gov.in/nd1_noc20_ee69/preview

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL404	Skill Lab: Python Programming	--	2+2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECL404	Skill Lab: Python Programming	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECL404	Skill Lab: Python Programming	2

Prerequisite: Skill Lab: C++ and Java Programming	
Course Objectives:	
1	To describe the core syntax and semantics of Python programming language
2	To explore functions and decision flow control statements in Python
3	To infer the Object-oriented Programming concepts in Python
4	To formulate GUI Programming and Databases operations in Python
5	To develop applications using variety of libraries and functions

6	**To automate the procedures with python programming**
Course Outcomes: After successful completion of the course student will be able to:	
1	Describe syntax and semantics in Python
2	Construct single valued and multi-valued functions along with control statements.
3	Interpret object oriented programming in Python.
4	Design GUI Applications in Python
5	Express proficiency in the handling Python libraries for data science
6	Implement automation to create, delete, rename, organize and manage various types of files using python.

Module		**Content**	**Hrs**
1		**Introduction to Python**	**6**
	1.1	Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input Statements in python	
	1.2	Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures	
2		**Functions and Decision flow control statement**	**8**
	2.1	Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code.	
	2.2	Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and	

		while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements	
3		**Object Oriented Programming**	**9**
	3.1	Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes	
	3.2	Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Exception Handling	
4		**Graphical User Interface and Image processing**	**9**
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.	
	4.2	Basic Image Processing using OpenCV library, simple image manipulation and enhancement	
5		**Numpy, Pandas, Matplotlib, Seaborn, Scipy**	**10**
	5.1	Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy.	
	5.2	Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation	
	5.3	Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn.	
	5.3	Introduction to Scipy, Scipy Sub packages – Integration and Optimization, Eigen values and Eigen Vectors, Statistic, Weave and IO.	
6		**Automation with Python**	**10**
	6.1	File handling: Reading and writing files, Organizing files, working with excel, word, pdf, text, sending email, OS and SYS modules	
	6.2	Case study in Python (On topics like Automation project, data structure algorithms, Network establishment, web scraping etc.)	
		Total	**52**

Textbooks:	
1	Yashavant Kanetkar, “Let us Python: Python is Future, Embrace it fast”, 1st edition, BPB Publications (8 July 2019)
2	Dusty Phillips, “Python 3 object-oriented Programming”, Second Edition PACKT Publisher August 2015.
3	John Grayson, “Python and Tkinter Programming”, Manning Publications (1 March 1999).
4	Dr. R. Nageswara Rao, Dreamtech Press, “Core Python Programming”, 1st edition
5	James Payne, “Beginning Python: Using Python 2.6 and Python 3.1”, Wrox publication
6	E Balagurusamy, “Introduction to computing and problem solving using python” , McGraw Hill Education.
7	Zed A. Shaw, “Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code”, Addison Wesley; 3rd edition (1 October 2013).
8	AL Sweigart, “Automate The Boring Stuff with Python”-Practical Programming for beginners
9	Bassem Aly, “Hands-on Enterprise Automation with Python”, Packt publisher
10	Jamie Buelta, “Python Automation Cookbook”, Packt publisher
Reference Books:	
1	M. L. Liu, “Distributed Computing Principles and Applications”, Pearson Addison Wesley, 2004
2	George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005

3	Andreas C. Mueller, “Introduction to Machine Learning with Python”, O’Reilly; 1 edition (7 October 2016)
4	David Beazley, Brian K. Jones, “Python Cookbook: Recipes for Mastering Python 3”, O'Reilly Media; 3rd edition (10 May 2013).
5	Bhaskar Chaudhary, “Tkinter GUI Application Development Blueprints: Master GUI programming in Tkinter as you design, implement, and deliver 10 real world application”, Packt Publishing (November 30, 2015)

Software Tools:

1. Python IDE: https://www.python.org/downloads/
2. Anaconda Environment: https://www.anaconda.com/distribution/

Online Repository:

1. Github
2. Python 3 Documentation: https://docs.python.org/3/
3. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
4. http://spoken-tutorial.org
5. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
6. Numpy Documentation: https://numpy.org/doc/
7. Pandas Documentation: https://pandas.pydata.org/docs/
8. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
9. Scipy Documentation : https://www.scipy.org/docs.html
10. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
11. https://nptel.ac.in/courses/106/106/106106182/
12. NPTEL course: “The Joy of Computing using Python”

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc
2	Write a Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc).
3	Write a Python program to implement control structures.
4	Assume a suitable value for distance between two cities (in km).

	Write a program to convert and print this distance in meters, feet, inches and centimetre.
5	Write a program to carry out the following operations on the given set s = {10, 2, -3, 4, 5, 88} a. Number of items in sets s b. Maximum element in sets s c. Minimum element in sets s d. Sum of all elements in sets s e. Obtain a new sorted set from s, set s remaining unchanged f. Report whether 100 is an element of sets s g. Report whether -3 is not an element of sets s.
6	Write python program to understand different File handling operations
7	Create 3 lists – a list of names, a list of ages and a list of salaries. Generate and print a list of tuples containing name, age and salary from the 3 lists. From this list generate 3 tuples – one containing all names, another containing all ages and third containing all salaries.
8	Write Python program to implement classes, object, Static method and inner class
9	If any integer is given as in input through the keyboard, write a program to find whether it is odd or even number.
10	If ages of Ram, Shyam, and Ajay are given as an input through the keyboard, write a program to determine the youngest of the three.
11	Write a program that prints square root and cube root of numbers from 1 to 10, up to 4 decimal places. Ensure that the output is displayed in separate lines, with number center-justified and square and cube roots right-justified.
12	Write a program that defines a function count_lower_upper( ) that accepts a string and calculates the number of uppercase and lowercase alphabets in it. It should return these values as a dictionary. Call this function for some sample strings.
13	A 5-digit positive integer is entered through the keyboard, write a recursive function to calculate sum of digits of 5-digit number.
14	Write Python program to create, append, update, delete records from database using GUI.
15	Write Python program to obtain histogram of any image

16	Write a Python Program to split color image in R,G,B and obtain individual histograms.
17	Write Python program for histogram equalization
18	Write Python Program for edge detection
19	Write Python Program for image segmentation
20	Write Python program to implement GUI Canvas application using Tkinter
21	Write Python program to implement GUI Frame application using Tkinter
22	Write Python program to study define, edit arrays and perform arithmetic operations.
23	Write python program to study selection, indexing, merging, joining, concatenation in data frames
24	Evaluate the dataset containing the GDPs of different countries
25	Analyze the Federal Aviation Authority (FAA) dataset using Pandas to do the following: a. a. View: aircraft make name, state name, aircraft model name, text information, flight phase, event description type, b. fatal flag c. Clean the dataset and replace the fatal flag NaN with “No”. d. Find the aircraft types and their occurrences in the dataset e. Remove all the observations where aircraft names are not available f. Display the observations where fatal flag is “Yes”
26	Analyze the “auto mpg data” and draw a pair plot using seaborn library for mpg, weight, and origin.
27	Write a python program to use SciPy to solve a linear algebra problem.
28	Implement automation with python by reading, writing and managing excel file
29	Implement automation with python by reading, writing and managing csv file
30	Implement automation with python by reading, writing and managing word file
31	Creating a simple report using python

Term Work:	
1	Term work should consist of 10 experiments.

2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECM401	Mini-Project-1b: Raspberry Pi based Projects	--	4$	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA*					
ECM401	Mini-Project-1b: Raspberry Pi based Projects	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECM401	Mini-Project-1b: Raspberry Pi based Projects	2

Prerequisite: Mini-Project -1a, C++ and Java Programming, Electronic Devices and Circuit.	
Course Objectives:	
1.	To make students familiar with the basics of Electronics, Microcontroller, Raspberry Pi, and Python programming.
2.	To familiarize the students with the programming and interfacing of different devices with Raspberry Pi Board.
3.	To increase students critical thinking ability and provide solutions to some real time problems.

Course Outcomes:	
1	Write code using python language using IDE for utilizing the onboard resources.
2	Apply the knowledge of interfacing different devices to raspberry Pi board to accomplish a given task
3	Design Raspberry Pi based projects for a given problem.

Module		Content	Hrs
1		**Introduction to Raspberry PI**	**4**
	1.1	What is Raspberry PI? Downloading and Installation of NOOBS,	
	1.2	First Power-Up & Having a Look around, Introduction to the Shell and Staying updated.	
2		**Interfacing with Input / Output Devices using Python**	**6**
	2.1	Familiarization with Raspberry PI and perform necessary software installation. Apparatus Requirement: Hardware: Raspberry PI Board, Memory of 16GB, Power adapter, Memory Writer. Software: NOOBS, Raspbian OS, Win32 disk Imager, SD-Formatter software	
	2.2	To Interface LED/Buzzer with Raspberry PI and write a program to turn ON LED for 1 sec after every 2 sec. Apparatus Requirement: Raspberry PI with inbuilt Python Package, LED, Buzzer.	
	2.3	To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI and write a program to turn ON LED when Push button is pressed or at sensor detection. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Push Button Switch, Digital Sensor (IR/LDR).	
	2.4	To interface analog sensor using MCP 3008 analog to digital converter chip. Apparatus Requirement: Raspberry PI with inbuilt Python Package, analog sensor, MCP 3008 chip.	

3		**Interfacing Temperature Sensor, Motors, Display Devices**	**10**
	3.1	To interface DHT11 sensor with Raspberry PI and write a program to print temperature and humidity readings and to turn ON motor when push button is pressed. Apparatus Requirement: Raspberry PI with inbuilt Python Package, DTH11 Sensor, Relays, Motor Driver, Motors	
	3.2	**To interface motor using relay with Raspberry PI and write a program to turn ON motor when push button is pressed.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, Relays, Motor Driver, Motors.	
	3.3	**To interface OLED with Raspberry PI and write a program to print temperature and humidity readings on it.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, OLED display device.	
4		**Interfacing Communication Devices and Cloud Networking**	**6**
	4.1	To interface Bluetooth/Zigbee/RFID/WiFI with Raspberry PI and write a program to send sensor data to smartphone using Bluetooth/Zigbee/RFID/WIFI. (Any one can be used for performing) Apparatus Requirement: Raspberry PI with inbuilt Python Package, Bluetooth/Zigbee/RFID/WIFI.	
	4.2	Write a program on Raspberry PI to upload temperature and humidity data from thingspeak cloud. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Cloud networks such as thingspeak (open source), AWS, Azure, etc. anyone can be used for understanding purpose and building projects.	
5		**Understanding of Communication Protocols**	**10**
	5.1	Write a program on Raspberry PI to publish temperature data to MQTT broker 3	
	5.2	Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it.	
	5.3	Configuration of Webserver using Raspberry PI.	
6		**ESP 32 Socs**	**12**
	6.1	ESP 32 Architecture, Specification,GPIO	

	6.2	Programming ESP32 with Arduino IDE, Interfacing sensors with ESP	
	6.3	ESP32 Vs ESP8266	
		Total	**48**

Textbooks:	
1.	"DK Workbooks: Raspberry Pi Project Workbook", DK Children; Workbook edition (March 7, 2017)
2.	Simon Monk, "Raspberry PI Cookbook Software and Hardware Problems and Solutions" O'Reilly 2nd Edition
3.	Donald Norris, "Raspberry Pi Electronic Projects for Evil Genius", McGraw-Hill Education TAB; 1 edition (May 20, 2016)
4.	Simon Monk, Programming the Raspberry Pi, 2nd Edition: Getting Started with Python" The McGraw Hill

Software Tools:	
1.	Raspbian OS: https://www.raspberrypi.org/downloads/
2.	Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
3.	SD Card Formatter: https://www.sdcard.org/downloads/formatter/
Online Repository:	
1.	GitHub
2.	NPTEL Videos on Raspberry Pi Programming
3.	https://www.electronicsforu.com/raspberry-pi-projects
4.	https://circuitdigest.com/simple-raspberry-pi-projects-for-beginners
5.	https://www.electronicshub.org/raspberry-pi-projects/
6.	https://www.udemy.com/course/internet-of-things-iot-demystified/

Term Work:	
1	**Guidelines for Mini Project** 1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity. 2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties. 3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project. 4. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments. 5. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning. 6. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor. 7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate. 8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. 9. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI. 10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. 11. This policy can be adopted on case by case basis.
2	**Term Work** 1. The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester. 2. Distribution of Term work marks for both semesters shall be as below; a. Marks awarded by guide/supervisor based on log book : 10 b. Marks awarded by review committee : 10 c. Quality of Project report : 05
3	**Mini Project shall be assessed based on following points;** 1. Quality of problem and Clarity 2. Innovativeness in solutions 3. Cost effectiveness and Societal impact 4. Full functioning of working model as per stated requirements 5. Effective use of skill sets

	6. Effective use of standard engineering norms 7. Contribution of an individual's as member or leader 8. Clarity in written and oral communication
	In continuous assessment focus shall be on 1. Each individual student, assessment based on individual's contribution in group activity. 2. Their understanding and response to questions.

Vivekanand Education Society's
Institute of Technology

Bachelor of Engineering (B.E.)

Department of
Electronics and Telecommunication Engineering

(Semester – V & VI)

Program Structure for Third Year

Electronics and Telecommunication Engineering

Scheme for Autonomous ProgramSemester V & VI

(With Effect from 2023-2024)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC501	Digital Communication	3	--	--	3	--	--	3
ECC502	Discrete Time Signal Processing	3	--	--	3	--	--	3
ECC503	Digital VLSI	3	--	--	3	--	--	3
ECC504	Random Signal Analysis	3	--	1	3	--	1	4
ECCDLO 501X	Department Optional Course-1	3	--		3	--	--	3
ECL501	Digital Communication Lab	--	2	--	--	1	--	1
ECL502	Discrete Time Signal Processing Lab	--	2	--	--	1	--	1
ECL503	Digital VLSI Lab	--	2	--	--	1	--	1
ECL504	Professional Communication & Ethics- II	--	2*+2~	--	--	2	--	2
ECM501	Mini Project 2A Embedded System Project	--	4$	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**07**	**1**	**23**

*** Theory should be conducted for the full class.**

~ Batch-wise practical's to be conducted

$ Indicates work load of a learner (Not Faculty) for Mini Project 2A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	CA*					
ECC501	Digital Communication	20	20	60	2	--	--	100
ECC502	Discrete Time Signal Processing	20	20	60	2	--	--	100
ECC503	Digital VLSI	20	20	60	2	--	--	100
ECC504	Random Signal Analysis	20	20	60	2	25	--	125
ECCDLO 501X	Department Optional Course-1	20	20	60	2	--	--	100
ECL501	Digital Communication Lab	--	--	--	--	25	25	50
ECL502	Discrete Time Signal Processing Lab	--	--	--	--	25	25	50
ECL503	Digital VLSI Lab	--	--	--	--	25	25	50
ECL504	Professional Communication & Ethics – II	--	--	--	--	25	25	50
ECM501	Mini Project 2A Embedded System Project	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	--	**150**	**125**	**775**

***Continuous Assessment**

Department Level Optional Course-1

Course Code	Course Name
ECCDLO5011	Digital and IPTV Engineering
ECCDLO5012	Data Compression and Cryptography
ECCDLO5013	IT Infra and Security
ECCDLO5014	Data Structures and Algorithm
ECCDLO5015	Sensor Technology

Program Structure for Third Year

Electronics and Telecommunication Engineering

Scheme for Autonomous ProgramSemester V & VI

(With Effect from 2023-2024)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC601	Electromagnetics and Antenna	3	--	--	3	--	--	3
ECC602	Computer Communication Networks	3	--	--	3	--	--	3
ECC603	Image Processing and Machine Vision	3	--	--	3	--	--	3
ECC604	Artificial Neural Network and Fuzzy Logic	3	--	--	3	--	--	3
ECCDLO 601X	Department Level Optional Course-2	3	--	--	3	--	--	3
ECL601	Electromagnetics and Antenna Lab	--	2	--	--	1	--	1
ECL602	Computer Communication Networks Lab	--	2	--	--	1	--	1
ECL603	Image Processing and Machine Vision Lab	--	2	--	--	1	--	1
ECL604	Skill Lab: Linux and Networking and Server Configuration	--	4	--	--	2	--	2
ECM601	Mini Project 2B FPGA based Project	--	4$	--	--	2	--	2
Total		**15**	**14**	**--**	**15**	**07**	**--**	**22**

$ Indicates work load of a learner (Not Faculty) for Mini Project 2B. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	CA*					
ECC601	Electromagnetics and Antenna	20	20	60	2	--	--	100
ECC602	Computer Communication Networks	20	20	60	2	--	--	100
ECC603	Image Processing and Machine Vision	20	20	60	2	--	--	100
ECC604	Artificial Neural Network and Fuzzy Logic	20	20	60	2	--	--	100
ECCDLO 601X	Department Level Optional Course-2	20	20	60	2	--	--	100
ECL601	Electromagnetics and Antenna Lab	--	--	--	--	25	25	50
ECL602	Computer Communication Networks Lab	--	--	--	--	25	25	50
ECL603	Image Processing and Machine Vision Lab	--	--	--	--	25	25	50
ECL604	Skill Lab: Linux and Networking and Server Configuration	--	--	--	--	25	25	50
ECM601	Mini Project 2B FPGA based Project	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	--	**125**	**125**	**750**

***Continuous Assessment**

Department Level Optional Course-2

Course Code	Course Name
ECCDLO6011	Mixed Signal VLSI
ECCDLO6012	Computer Organization and Architecture
ECCDLO6013	Digital Forensic
ECCDLO6014	Database Management System
ECCDLO6015	IoT and Industry 4.0
ECCDLO6016	Radar Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC501	Digital Communication	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC501	Digital Communication	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC501	Digital Communication	3

Prerequisite:
Engineering Mathematics-IV
Signals and Systems
Principles of Communication Engineering

Course Objectives:

1	To describe the basics of information theory and source coding.
2	To illustrate various error control codes.
3	To describe the baseband system.
4	To learn different digital modulation and demodulation techniques

Course Outcomes:

1	Apply the concepts of information theory in source coding.
2	Compare different error control systems and apply various error detection codes.
3	Analyze different error correction codes.
4	Compare various baseband transmission methods for digital signals.
5	Evaluate the performance of optimum baseband detection in the presence of white noise.
6	Compare the performances of different digital modulation techniques

Module		Content	Hrs.
1	**Information Theory and Source Codes**		**05**
	1.1	Block diagram of digital communication system, the Information content of a source symbol, Source entropy, Average information rate, AWGN channel, and Shannon-Hartley channel capacity theorem.	
	1.2	Introduction of source code, Huffman code, Shannon-Fano code.	
2	**Error Control System and Error Detection Codes**		**03**
	2.1	Introduction of error control system, Automatic Retransmission Query (ARQ) system, Types of ARQ systems and comparison, Forward error correction (FEC) system. Comparison between FEC and ARQ.	
	2.2	Error detection codes: Vertical Redundancy Check (VRC) code, Longitudinal Redundancy Check (VRC) code, Cyclic Redundancy Check (CRC) code and Checksum code	
3	**Error Correction Codes**		**10**
	3.1	Linear block code: Code generation, calculation of minimum Hamming distance, error detection capability, error correction capability, implementation of encoder, error detection, syndrome table, error correction and implementation of decoder.	
	3.2	Cyclic code: Code generation, calculation of minimum Hamming distance, error detection capability, error correction capability, implementation of encoder, error detection, syndrome table, error correction and implementation of decoder.	
	3.3	Convolutional code: Generation, path responses, encoder, state transition table, state diagram, tree diagram, trellis diagram, decoding using Viterbi's algorithm.	
4	**Baseband Transmission**		**05**
	4.1	Block diagram of baseband transmitter-receiver system, Line codes (RZ and NRZ Uni Polar formats, RZ and NRZ Polar formats, NRZ Bipolar format (AMI format), NRZ Manchester format, and Quaternary Polar format). Comparison of line codes with respect to bandwidth, power requirement, synchronization capability, DC level, polarity inversion error and complexity. Power spectral density and spectrum of NRZ Unipolar and Polar formats.	
	4.2	Inter Symbol Interference (ISI), Inter Channel Interference (ICI).	

		Nyquist criterion for distortionless baseband binary transmission, Nyquist bandwidth and practical bandwidth.	
5	**Optimum Detection of Baseband Signal**		**04**
	5.1	Matched filter, Output SNR, Transfer function, Impulse response and Error probability. Integrate and dump receiver, Correlator receiver.	
6	**Digital Modulations**		**12**
	6.1	Classification of Digital Modulation techniques, concept of coherent and non-coherent detection. Power spectra and bandwidth efficiency	
	6.2	Generation, Detection, Error probability (using signal space representation and Euclidean distance), Bandwidth (using PSD and spectrum except for MSK) and applications of the following modulations: Binary ASK, Binary PSK, Quadrature PSK, Off-Set QPSK, M-ary PSK, Binary FSK, M-ary FSK, 16-ary QASK and MSK.	
		TOTAL	**39**

Textbooks:	
1	H. Taub, D. Schlling, and G. Saha- "Principles of Communication Systems", Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
2	Lathi B P, and Ding Z- "Modern Digital and Analog Communication Systems", Oxford University Press, Fourth Edition, 2017.
3	Haykin Simon- "Digital Communications", John Wiley and Sons, New Delhi, Fourth Edition, 2014.
4	John G. Proakis- "Digital Communications", McGraw-Hill, Fourth Edition
Reference Books:	
1	Sklar B, and Ray P. K.-"Digital Communication: Fundamentals and applications", Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2	T L Singal-"Analog and Digital Communication", Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3	P Ramakrishna Rao "Digital Communication", Tata Mc-Graw Hill, New Delhi, First Edition,2011.

4	K. Sam Shanmugam- “Digital and analog communication Systems”, John Wiley and sons,1979
5	Upamanyu Madhow- “Fundamentals of Digital Communication”- Cambridge University Press,2008
6	W.C. Huffman, Vera Pless “Fundamentals of Error Correcting Codes”, Cambridge University Press,2003
7	Graham Wade- “Coding Techniques ”, Palgrave, New York, January 2004

NPTEL / Swayam Course:

1. https://nptel.ac.in/courses/108/101/108101113/
2. https://nptel.ac.in/courses/108/102/108102096/
3. https://nptel.ac.in/courses/108/102/108102120/

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc.	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification , the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC502	Discrete Time Signal Processing	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC502	Discrete Time Signal Processing	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC502	Discrete Time Signal Processing	3

Prerequisite: Signals & Systems

Course Objectives:

1	To develop a thorough understanding of discrete Fourier transform and its use in spectral analysis and frequency domain filter designing.
2	To design and realize IIR filters and FIR filters, gain an appreciation for the trade-offs necessary in the filter design and to evaluate the effects of finite word lengths on the filters.
3	To introduce applications of digital signal processing in the field of biomedical and audio signal processing.

Course Outcomes:

1	Recall the system representations and understand the relation between different transforms.
2	Understand the concepts of discrete-time Fourier transform, fast Fourier transform and apply in system analysis.
3	Design digital IIR and FIR filters to satisfy the given specifications and evaluate the frequency response and pole-zero representations to choose a particular filter for

	the given application.
4	Interpret the different realization structures of Digital IIR and FIR filters.
5	Analyze the impact of hardware limitations on the performance of digital filters.
6	Apply signal processing concepts, algorithms in applications related to the field of biomedical signal processing.

Module		Content	Hrs
1		**Discrete Fourier Transform & Fast Fourier Transform**	**8**
	1.1	Discrete Fourier transform (DFT), DFT as a linear transformation, Properties of the DFT, Relationship of the DFT to other transforms	
	1.2	Fast Fourier Transform: Radix-2 Fast Fourier Transforms (FFT), Radix-2 decimation in time , Inverse FFT , Introduction to decimation in frequency FFT algorithms, Difference between DFT and FFT	
2		**IIR Digital Filters**	**8**
	2.1	LTI systems as frequency-selective filters like low pass, high pass, band pass, notch, comb, all-pass filters, and digital resonators, Analog filter approximations: Butterworth, Chebyshev I	
	2.2	Mapping from s-plane to the z-plane - impulse invariant and bilinear transformation, Design of IIR digital filters -Butterworth and Chebyshev-I from analog filters using impulse invariant and bilinear transformation techniques, Analog and digital frequency transformations	
3		**FIR Digital Filters**	**9**
	3.1	Characteristics of linear phase FIR digital filters, Symmetric and antisymmetric FIR filter, Location of the zeros of linear phase FIR filters, Minimum, maximum and mixed phase systems	
	3.2	Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackman, Bartlett), Comparison of IIR and FIR filters.	
4		**Digital Filter Structures**	**5**
	4.1	Realization structures for FIR systems: Cascade form, Frequency sampling structure, Lattice structure, Computational complexities for N length filter	
	4.2	Realization structures for IIR systems: Cascade form and parallel form structures, Lattice Ladder structure, Computational complexities for N order filter	

5		**Finite Word Length Effects in Digital Filters**	**5**
	5.1	Rounding and truncation errors, Quantization error, Output noise power from a digital system	
	5.2	Product quantization, Noise model for direct form and cascaded IIR structure (first order), Coefficient quantization error and zero input limit cycle	
6		**Applications of Digital Signal Processing**	**4**
	6.1	Introduction to Boi-medical signals: ECG, EEG, EMG, and EOG	
	6.2	Removal of Artifacts and Interferences in ECG and EEG	
		Total	**39**

Textbooks:	
1	Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education
2	Emmanuel C. Ifeachor, Barrie W. Jervis," Digital Signal Processing", A Practical Approach", Pearson Education
3	A Nagoor Kani "Digital Signal Processing", 2nd Edition, Tata Mc Graw Hill Education Private Limited
Reference Books:	
1	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach ", 4th Edition McGraw Hill Education (India) Private Limited, 2013
2	Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education, 3rd Edition, 2010
3	L. R. Rabiner and B. Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India, 2006
4	S Salivahan, C Gnanapriya, "Digital Signal Processing", McGraw Hill Education (India) limited, 4 th Edition, 2015
5	Monson H Hayes, "Digital Signal Processing", Schaum's Outline Series, 2 nd Edition, 2011
6	Rangaraj M. Rangayyan, "Biomedical Signal Analysis- A Case Study Approach", Wiley 2002

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 Marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC503	Digital VLSI	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC503	Digital VLSI	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC503	Digital VLSI	3

Prerequisite: Electronic Devices and Circuits , Digital System Design , Linear Integrated Circuits

Course Objectives:

1	To introduce process flow of VLSI Design.
2	To understand MOSFET operation from VLSI design perspective.
3	To learn VLSI design performance metric and various trade-offs.
4	To design, implement and verify combinational and sequential logic circuits using various MOS design styles.
5	To provides an exposure to RTL design and programming.

Course Outcomes:

1	Know various tools and processes used in VLSI Design.
2	Explain working of various CMOS combinational and sequential circuits used in VLSI Design.
3	Derive expressions for performance parameters of basic building blocks like CMOS inverter.
4	Relate performance parameters with design parameters of VLSI circuits.
5	Select suitable circuit and design style for given application.
6	Design and realize various combinational and sequential circuits for given specifications.

Module		Content	Hrs
1		**Review of MOSFET operation and Fabrication**	4
	1.1	Overview of VLSI Design Flow, Review of MOSFET operation, MOSFET Capacitances, MOSFET scaling, Short channel effects	
	1.2	Fabrication process flow of NMOS and CMOS, Lambda based design rules ,stick diagrams	
2		**Combinational CMOS Logic Circuits**	4
	2.1	CMOS inverter operation, Voltage Transfer characteristics (VTC), Noise Margins, Propagation Delay, Power Dissipation, Design of CMOS Inverter, Layout of CMOS Inverter	
	2.2	Realization of CMOS NAND gate, NOR gate, Complex CMOS Logic Circuits, Layout of CMOS NAND, NOR and complex CMOS circuits	
3		**MOS Design Logic Styles**	10
	3.1	Static CMOS, Pass Transistor Logic, Transmission Gate, Pseudo NMOS, Dynamic Logic, Domino Logic, NORA, Zipper, C2MOS	
	3.2	Setup time, Hold time, clocked CMOS SR Latch, CMOS JK Latch, MS –JK Flip Flop, Edge triggered D-Flip Flop and realization using design styles	
	3.3	Realization of Shift Register, MUX, 1-bit full adder	
4		**Semiconductor Memories**	7
	4.1	ROM array, 6T-SRAM (operation, design strategy, leakage currents, sense amplifier), layout of SRAM	
	4.2	Operation of 1T and 3T DRAM Cell, NAND and NOR flash memory	
5		**Data path and system design issues**	8
	5.1	Ripple carry adder, CLA adder, carry save adder, carry select adder, carry skip adder, Array Multiplier , barrel shifter	
	5.2	On chip clock generation and distribution, static timing analysis	
6		**RTL Design**	6
	6.1	High Level state machines, RTL design process	
	6.2	RTL design of Soda dispenser machine, FIR Filter, Sum of absolute differences, Laser Distance measure.	
		Total	39

Textbooks:	
1	Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.
2	Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.
3	Frank Vahid, "Digital Design with RTL design, VHDL and VERILOG", John Wiley and Sons Publisher 2011.
Reference Books:	
1	Neil H. E. Weste, David Harris and Ayan Banerjee, —*CMOS VLSI Design: A Circuits and Systems Perspective*, Pearson Education, 3rd Edition.
2	John P. Uyemura, "*Introduction to VLSI Circuits and Systems*", Wiley, Student Edition, 2013.
3	R. Jacob Baker, "*CMOS Circuit Design, Layout and Simulation*", Wiley, 2nd Edition, 2013
NPTEL/Swayam Courses:	
	https://nptel.ac.in/courses/117/101/117101058/ https://nptel.ac.in/courses/108/107/108107129/

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC504	Random Signal Analysis	3	--	1	3	--	1	4

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC504	Random Signal Analysis	20	20	60	2	25	--	125

Course Code:	Course Title	Credit
ECC504	Random Signal Analysis	#4

Prerequisite: Engineering Mathematics IV, Signals and Systems	
Course Objectives:	
1	To strengthen the foundations of probability.
2	To teach continuous and discrete random variables.
3	To explain statistical behaviour of one dimensional and two-dimensional random variables.
4	To describe the concept of random process which is essential for random signals and systems encountered inCommunications and statistical learning.
5	To develop problem solving skills and explain how to make the transition from a real- w o r l d problem to aprobabilistic model.
Course Outcomes:	
1	Apply theory of probability in identifying and solving relevant problems.
2	Differentiate continuous and discrete random variables and their distributions.
3	Analyse mean, variance, and distribution function of random variables and functions of random variables.

4	Define a random process, determine the type of the process, and find the response of LTI system for WSS process.
5	Explain linear regression algorithms and apply for predictive applications.

(#Theory credits: 3 & Tutorial credits: 1, Total credits: 4)

Module		Content	Hrs
1		**Basic Concepts in Probability**	**4**
	1.1	Definitions of probability, joint, conditional, and total probability, Bayes' theorem, independence of events, binary symmetric communication channel analysis using Bayes' theorem.	
2		**Introduction to Random Variables**	**8**
	2.1	Continuous, discrete, and mixed random variables, probability density function, probability distribution function, and probability mass function, properties of PDF and CDF	
	2.2	Special distributions- Binomial, Poisson, Uniform, Gaussian and Rayleigh Distributions Mean, variance and moments of random variables	
3		**Operations on One Random Variable**	**8**
	3.1	Function of a random variable and their distribution and density functions.	
	3.2	Expectation, variance, moments, and characteristic function of random variable.	
	3.3	Transformation of a random variable, characteristic functions, moment theorem.	
4		**Multiple Random Variables and Convergence**	**8**
	4.1	Pairs of random variables, joint CDF, and joint PDF.	
	4.2	One function of two random variables; joint moments, covariance, and correlation-independent, uncorrelated and orthogonal random variables.	
	4.3	Central limit theorem and its significance	
5		**Random Processes**	**6**
	5.1	Definitions, statistics of stochastic processes, n^{th} order distribution, second-order properties: mean and autocorrelation, SSS, WSS.	
	5.2	Mean and correlation Ergodic processes, transmission of WSS through LTI system	

6		**Introduction to Statistical Learning and Applications**	
	6.1	Regression and model building, simple linear regression, least square estimation of the coefficients.	**5**
	6.2	Applications of simple linear regression in prediction of new observations.	
		Total	**39**

Textbooks:	
1.	T. Veera Rajan, "Probability, Statistics and Random Process," Tata McGraw Hill Education, Third Edition (2018).
2.	Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables, and Stochastic Processes," Tata McGraw Hill Education.
3.	Henry Stark & John Woods, "Probability, Statistics, and Random Processes for Engineers, 4th Edition, Pearson Education, 2012.
4.	Douglas C. Montgomery, Elizabeth A. Peck and G. Geoffrey Vining, "Introduction to linear regression Analysis," student edition, Wiley publications.
Reference Books:	
1.	Scott Miller and Donald Childers, "Probability and Random Processes with Applications to Signal Processing and Communications," Elsevier Publication.
2.	Hwei Hsu, "Theory and Problems of Probability, Random Variables, and Random Processes", Schaum's Outline Series, McGraw Hill, 1997.
3.	P. Ramesh Babu, "Probability Theory and Random Process", Tata McGraw HillEducation.
4.	Alberto Leon Garcia, "Probability and Random Processes for Electrical Engineering", second edition, Pearson education.
5.	Daniela Witten, Trevor Hastie , Robert Tibshirani, "An Introduction to StatisticalLearning by Gareth James", 7th Edition, Springer 2017.
6.	Ronald Walpole, et. al., "Probability and Statistics for Engineers and Scientists", 8th edition, Pearson Education.
7.	P. Kousalya, "Probability, Statistics, and Random Processes", Pearson Education.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment is of 20 marks. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	**Assessment Tools**	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
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5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

Term Work: It is of 25 marks.
At least 08 Tutorials covering the entire syllabus must be given during the "Class Wise Tutorial". Term work assessment must be based on the overall performance of the student with every tutorial assessed from time to time.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

NPTEL / Swayam Course:	
1.	Introduction to probability and Statistics, Prof. G. Srinivasan (IIT Madras);
2.	https://onlinecourses.nptel.ac.in/noc21_ma01/preview

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 5011	Digital and IPTV Engineering	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 5011	Digital and IPTV Engineering	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5011	Digital and IPTV Engineering	3

Prerequisite:
Basics of various Television standards and operation
TCP/IP Protocol
Basics of conventional video camera and standards

Course Objectives:	
1	To provide in depth knowledge about Digital Television system
2	To familiarize students' various types of advanced types of Video cameras and Displays
3	To introduce the students to different television standards and applications
4	Acquaintance with HDTV and 3D TV system
5	To familiarize the students to IPTV, Its architecture, Protocols and hardware
6	To Introduce students to IP delivery networks, threats and mitigation

Course Outcomes:	
1	To understand the fundamentals and working principles of advanced digital television systems
2	To enable to choose or develop an appropriate camcorder and displays devices based on applications

3	To become familiar with current digital advanced TV standards
4	To understand fundamentals of IPTV
5	To acquire knowledge of IPTV and develop hardware and protocols
6	To provide customized IPTV services to end user with knowledge of IP delivery networks, threats and mitigation

Module		Content	Hrs
1		**Fundamentals of Digital Television**	**7**
	1.1	Fundamentals of colour television, Compatibility, and reverse compatibility, colour perception, Three colour theory, luminance, hue and saturation. Interlaced scanning, Composite video signal	
	1.1	Introduction to Digital TV, Digital TV signals and parameters	
	1.2	Digital TV transmitter and receiver its merits and demerits	
	1.3	MAC Signals and advanced MAC Signal Transmission	
	1.4	Digitization, Chroma subsampling, Digital audio compression techniques and video compression techniques MPEG1, MPEG2, H.264, MPEG- 4, AVC, H.265, SMPTE 421M	
	1.5	Set Top Box with recording	
2		**Digital Video Cameras, Displays and Streaming media device**	**5**
	2.1	Colour TV Digital cameras, Camcorders, Handycams, and Digicams	
	2.2	LED, LCD, OLED, PLASMA, Quantum Dot LED Displays	
	2.3	Chromecast	
	2.4	Consumer applications: DVD, Blue ray DVD	
3		**Digital TV standards and advanced TV**	**8**
	3.1	DVB-T, and its successors	
	3.2	ISDB –T	
	3.3	ATSC	
	3.4	ISD TV	
	3.5	DTMB	
	3.6	Ultra HDTV	
	3.7	CCTV	
	3.8	Direct to Home TV(DTH)	
	3.9	Smart TV and its functions	
	3.10	3D TV	
4		**IPTV**	**6**
	4.1	Introduction to IPTV	
	4.2	IP TV hardware	
	4.3	Features of IPTV	
	4.4	Architecture of IPTV	
	4.5	Bandwidth requirement	

	4.6	IPTV Set top Box, Smart TV comparison	
5		**IP TV Protocols and Applications**	**9**
	5.1	Internet Group Management Protocol (IGMP)	
	5.2	Real-Time Streaming Protocol (RTSP)	
	5.3	Real-Time Messaging Protocol (RTMP)	
	5.4	Hypertext Transfer Protocol (HTTP)	
	5.5	Applications of IPTV	
	5.6	IPTV Delivery: Broad cast, Unicast, Multicast	
	5.7	IPTV Streaming: Time Shifted Stream-On -the- fly streaming	
6		**IPTV Network Security: Threats and Countermeasures**	**4**
	6.1	Threats on IPTV Delivery Networks, Theft or Abuse of Network Assets, Theft of Service, Theft of IPTV-Related Data, Disruption of Service, Privacy Breach, Compromise of Platform Integrity	
	6.2	Security Issues of IPTV Delivery Networks: Protocols, Vulnerabilities, Countering the threats	
	6.3	Advantages and disadvantages of IPTV	
	6.4	Future of IPTV	
		Total	**39**

Textbooks:	
1	A. M. Dhake, *"Television and video Engineering,"* Tata McGraw Hill Publication, Second Edition, 2017.
2	Kelth jack, *"Video Demystified"*, Hand book for Digital Engineers, Newness, Elsevier, 4th Edition, 2005.
3	Marcelo S. Alencar, *"Digital Television Systems"*, Cambridge University Press, March 2009
4	Gilbert Held, *"Understanding IPTV"*, CRC Press, Auerbach Publication, First Edition, 2007.
Reference Books:	
1	D. Gerbarg, *" The digital evolution of Television",* Springer, (Author: Darcy Gerbarg Publication: Springer eBook, Publisher: Springer Nature, Date: Jan 1, 2009)
2	Maris Jos Abisolo, "Applications and Usability of interactive TV", Springer (Publisher: Springer International Publishing AG, ISBN: 9783319389066, Number of pages: 161, 1st edition 2016.)
3	Suliman Mohamed Fati, Saiful Azad, Al-Sakib Khan Pathan, *"IPTV Delivery Network"*, Wiley Publications, 2018
4	R. G. Gupta, *"Television Engineering & Video Systems"*, McGraw Hill Publication, Second Edition, 2017.
5	Morteza Sasani Ghamsari, *"Quantum dot based light emitting diodes"*, Google book, 2020

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 5012	Data Compression and Cryptography	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 5012	Data Compression and Cryptography	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5012	Data Compression and Cryptography	3

Prerequisite: Digital Signal Design, Digital Communication	
Course Objectives:	
1	Gain a fundamental understanding of data compression methods for text, images, video and audio.
2	Understand the concepts of cryptography and different algorithms to provide system security.
3	To recall number theory concepts for asymmetric cryptography and different algorithms related to type.
4	To learn system security methodologies.
Course Outcomes:	
1	Apply various compression techniques for text and understand image compression and its standards.
2	Select suitable compression techniques for specified lossless and lossy audio and video applications.
3	Compare between symmetric and asymmetric cryptography and also describe different symmetric cryptographic techniques and standards.
4	Apply number theory concepts to solve the cryptographic problems.

5	Analyze different public key cryptography algorithms and also describe methods that provide the goals for integrity, confidentiality and authentication.
6	Describe system security facilities designed to protect a computer system from security threats and also appreciate ethical issues related to system security

Module		Content	Hrs
1		**Introduction to Data Compression**	**7**
	1.1	Data compression, modelling and coding, Lossless and Lossy Compression, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window Compression: LZ-77, LZ-78, LZW	
	1.2	Image Compression DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards	
2		**Video and Audio Compression**	**6**
	2.1	Video compression: Motion compensation, temporal and spatial prediction, MPEG-4, H.264 encoder and decoder, High efficiency video coding- H.265	
	2.2	Sound, Digital Audio, μ-Law and A-Law Companding, MPEG – 4 Audio Layer, Advanced Audio Coding (AAC) standard	
3		**Cryptography**	**7**
	3.1	Security Goals, Cryptographic Attacks, Introduction to Cryptography and Steganography – difference	
	3.2	Symmetric Key Cryptography vs Asymmetric Key Cryptography	
	3.3	Symmetric key cryptography: Block cipher, Stream cipher, Feistal cipher, Substitution-permutation cipher	
4		**Number Theory**	**6**
	4.1	Prime Numbers, Fermat's and Euler's Theorem.	
	4.2	Chinese Remainder Theorem	
5		**Asymmetric Key Cryptography**	**9**
	5.1	Principles of Public Key Crypto System, RSA, Key Management, Diffie-Hellman Key Exchange	
	5.2	Message Integrity, Message Authentication and Hash Functions, SHA, HMAC, Digital Signature Standards.	
6		**System Security**	**4**
	6.1	Intrusion Detection System, Secure Electronic Transactions	

	6.2	Firewall Design, Digital Immune systems, Biometric Authentication, Ethical Hacking	
		Total	**39**

Textbooks:	
1	Khalid Sayood , "Introduction to Data Compression",3rd Edition, Morgan Kauffman
2	Mark Nelson, Jean-Loup Gailly, "The Data Compression Book", 2nd edition, BPB Publications
3	William Stallings, "Cryptography and Network Security Principles and Practices", 5th Edition, Pearson Education.
4	Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill.
Reference Books:	
1	David Salomon, "Data Compression: The Complete Reference", Springer.
2	Matt Bishop, "Computer Security Art and Science", Addison-Wesley.
3	Bernard Menesez, "Network Security and Cryptography", 7th Edition, Delmar Cengage Learning.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 5013	IT Infra & Security	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 5013	IT Infra & Security	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5013	IT Infra & Security	3
Prerequisite: Principles of Communication Engineering		
Course Objectives:		
1	To introduce basic fundamentals of IT Infrastructure and its Management.	
2	To develop underlying principles of infrastructure security.	
3	To explore software vulnerabilities and attacks.	
4	To introduce the protection mechanisms for operating systems and database security.	
5	To explore the security aspects of wireless network infrastructure and protocols.	
6	To investigate the different attacks on Web Applications and Web services.	
Course Outcomes:		
1	Understand IT Infrastructure and its Management.	
2	Understand the concept of Information securities.	
3	Summarize the concepts of vulnerabilities, attacks and protection mechanisms.	
4	Analyze software vulnerabilities and attacks on databases and operating systems.	

5	Explain the need for security protocols in the context of wireless communication.
6	Analyze the different attacks on Open Web Applications and Web services.

Module	Content		Hrs
1	**Overview of Networks and IT Infrastructure**		**09**
	1.1	Overview of OSI and TCP/ IP Networks, introduction to IP Addressing scheme, introduction to Networking Components	
	1.2	Information Technology, Design Issues of IT Organizations and IT Infrastructure, Information System Design Process, IT Infrastructure Management, Challenges in IT Infrastructure Management, Determining Customers, Requirements, Security controls and safeguards, IT security Plans.	
2	**Introduction to Information Security**		**06**
	2.1	Cyber-attacks, Vulnerabilities, Défense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC, MAC, RBAC, BIBA, Bell La Padula), Authentication and Access Control Services- RADIUS, TACACS, and TACACS+	
3	**Software Vulnerabilities**		**04**
	3.1	Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	
4	**Operating System and Database Security**		**08**
	4.1	Introduction operating system security, system security planning, Application security, Linux/ Unix security, Windows, security, Security Maintenance,	
	4.2	Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security	
5	**Wireless Security**		**05**
	5.1	The need for Wireless Network Security, Attacks on Wireless Networks, Security services, WEP & WPA protocols, Mobile IP, Virtual Private Network (VPN): PPTP, L2TP, IPSec	
6	**Web Security**		**07**
	6.1	Introduction: Transport Protocol and Data Formats, Web Browser, Threat Model Authenticated Sessions: Cookie Poisoning, Cookies and Privacy, Making Ends Meet Code Origin Policies, Cross-Site Scripting: Cookie Stealing, Defending against XSS, Cross-Site Request Forgery, JavaScript Hijacking	
		TOTAL	**39**

Textbooks:	
1	Gupta, “IT Infrastructure & Its Management”, First Edition, Tata McGraw-Hill Education.
2	William Stallings, “Computer Security Principles and Practice”, Sixth Edition, Pearson Education.
3	Dieter Gollmann, “Computer Security”, Third Edition, Wiley Publications.
4.	Forouzan, “Data Communications and Networking”, Fourth Edition, Mc Graw Hill Publication.
5	P. Nicopolitidis, M. S. Obaidat, G.I Papadimitriou, A.S Pomportsis, “Wireless Networks”, Wiley Publications, 2009.
Reference Books:	
1	Charles P. Pfleeger, “Security in Computing”, Fifth Edition, Pearson Education, 2012.
2	Tim Boyle, “CCNA Security Study Guide”, Wiley Publications, 2010.
3	Matt Bishop, “Introduction to Computer Security”, Pearson, 1st Edition, 2004.

Internal Assessment:
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Continuous Assessment:-
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4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
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8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 5014	Data Structure & Algorithm	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 5014	Data Structure & Algorithm	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5014	Data Structure & Algorithm	3

Prerequisite: Skill Lab: Python ProgrammingCourse	
Course Objectives: The course aims:	
1	To introduce the fundamental knowledge & need of Data Structures.
2	To abstract the concept of Algorithm and these concepts are useful in problem solving.
3	To implement fundamental knowledge and applications of Stack, Queue, Linked List, Trees, Graphs etc.
4	To understand the working of different Sorting, Searching & Hashing techniques.
5	To understanding about writing algorithms and step by step approach in solving problems with the help of fundamentaldata structures
Course Outcomes: After successful completion of the course the student will: -	
1	Compare functions using asymptotic analysis and describe the relative merits of worst-, average-, and best-caseanalysis
2	Apply various operations on Stack and Queue

3	Ability to demonstrate the operation of Linked list
4	Ability to demonstrate and apply Trees & Graph data structures
5	Become familiar with various Sorting and Searching Algorithms and their performance characteristics
6	Describe the hash function and concepts of collision and its resolution methods

Module		Content	Hrs.
		Prerequisite: Control Structures, Arrays, Recursion, Pointers, Structures,Memory Allocation Techniques, Self-referential structures.	
1		**Introduction to Data Structure & Algorithm**	**5**
	1.1	Introduction to Data Structures, Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures	
	1.2	Algorithm: Performance characteristics of algorithm, Importance of Algorithm Analysis, Complexity of an Algorithm, Introduction to Asymptotic Analysis and Notations	
2		**Stack & Queue**	**8**
	2.1	Introduction to Stack, ADTImplementation of Stack of Stack, operations on Stack, Array Implementation of Stack	
	2.2	Applications of Stack- Infix to Postfix Expression Conversion, Infix Expression to Prefix Expression Conversion, Postfix Expression Evaluation	
	2.3	Introduction to Queue, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction to Double Ended Queue	
	2.4	Applications of various types of Queue	
3		**Linked List**	**7**
	3.1	Introduction, Linked List v/s Array, Representation of Linked List, Types of Linked List - Singly Linked List, Doubly Linked List	
	3.2	Operations on Singly Linked List and Doubly Linked List	
	3.3	Singly Linked List Application-Polynomial Representation and Addition, Doubly Linked List Application	
4		**Trees & Graph**	**9**
	4.1	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree	
	4.2	Applications of Binary Tree- Expression Tree, Huffman Encoding	
	4.3	**Graph:** Introduction, Graph Terminology, Memory Representation of Graph, Operations Performed on Graph	

	4.4	Graph Traversal, Breadth First Search, Depth First Search, Applications of the Graph, Shortest Path, Minimum Spanning Tree	
5		**Searching & Sorting**	**6**
	5.1	**Searching:** Sequential Search, Index Sequential Search, Binary Search	
	5.2	**Sorting:** Bubble Sort, Quick Sort, Merge Sort	
6		**Hashing**	**4**
	6.1	Hashing-Concept, Hash Functions, Common hashing functions	
	6.2	Collision resolution Techniques	
		Total	**39**

Textbooks:	
1	Jean Paul Tremblay, Paul G. Sorenson, *"An introduction to data structures with applications"*, Tata McGrawHill, 1984.
2	Ellis Horowitz, Sartaj Sahani and Sanguthevar Rajasekaran, *"Fundamentals of Computer Algorithms"*, Second Edition, Universities Press (India) Pvt. Ltd.2008.
3	Allen Downey, Jeffrey Elkner, Chris Meyers, "Learning with Python", Dreamtech Press, Third Edition, 2020
Reference Books:	
1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, *"Algorithms"*, Tata McGrawHill, 2006.
2	Reema Thareja, "Data Structures using C", Oxford University Press, Second Edition, 2014.

Internal Assessment:
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*For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.		

End Semester Theory Examination:	
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3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 5015	Sensor Technology	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 5015	Sensor Technology	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5015	Sensor Technology	3

Prerequisite:

1. Engineering Physics-II
2. Electronic Devices & Circuits
3. Linear Integrated Circuits
4. Engineering Mathematics

Course Objectives:	
1	To understand various physical parameters and its sensing techniques.
2	To discuss working of different types of transducers and sensors.
3	To familiarize about MEMS sensors and Actuators.
4	To introduce wireless sensing technologies.
5	To develop understanding about signal conditioning using ADC and DAC.
6	To provide insight into various sensor applications.
Course Outcomes:	
1	Understand the transduction principal of various sensors.
2	Select sensors suitable for required application.

3	Analyse wireless sensing techniques.
4	Design the data acquisition system.
5	Identify signal conditioning method for particular application.
6	Create an application using various sensor technologies.

Module		Content	Hrs
1		**Introduction**	**3**
	1.1	**Classification of Sensors:** The sensors are classified with criteria like primary physical quantity to be sensed, transduction principle, material and technology used and application.	
	1.2	**Criteria to choose a Sensor:** Accuracy, Environmental condition, Range, Calibration, Resolution, Cost and Repeatability.	
	1.3	**Digital sensors:** Principle and its advantage over analog sensors.	
	1.4	**Smart Sensors:** Low-power, Self –diagnostic and Self- calibration.	
2		**Types of Sensors**	**9**
	2.1	**Temperature Sensors:** RTD, Thermocouple and Thermistors sensor.	
	2.2	**Proximity Sensors:** Inductive (LVDT), Capacitive, Photoelectric and Ultrasonic sensors.	
	2.3	**Chemical Sensors:** Gas, Smoke, Conductivity and pH sensor.	
	2.4	**Other Sensors:** Optical, Infrared (IR), Sound, Motion, Pressure, Level, Moisture, Humidity, Laser, Image and GPS sensor.	
3		**MEMS Sensors and Actuators**	**6**
	3.1	**MEMS SENSORS:** General design methodology, techniques for sensing, Pressure sensor, Mass Flow sensor, Acceleration sensor, Angular Rate sensor and Gyroscopes, Micro machined microphones, Chemical sensors, Taguchi Gas sensor, and Combustible Gas sensors.	
	3.2	**MEMS ACTUATORS:** Techniques for actuation, Digital Micro mirror Device, Micro Machined Valves.	

4		**Wireless Sensing Technologies**	**5**
	4.1	**Bluetooth:** Concepts of Pico net, Scatter net, Link types, Network connection establishments.	
	4.2	**ZigBee:** components, architecture, network topologies.	
	4.3	**Ultra Wide Band (UWB),** Near Field Communication (NFC) and RFID: technical requirements, components and characteristics.	
	4.4	**WLAN (WiFi):** WLAN Equipment, WLAN topologies, IEEE 802.11 Architecture.	
5		**Data Acquisition and Signal Conditioning**	**8**
	5.1	**Fundamentals of Data Acquisition:** Analog and Digital data acquisition system with different configurations, Data loggers, Noise and interference.	
	5.2	**Signal Conditioning:** Wheatstone Bridge, Flash ADC, R2R DAC.	
	5.3	Utilization of Signal conditioning circuits for Temperature, Pressure, Optical, Strain gauges, Displacement and piezoelectric Transducers.	
6		**Sensor Applications**	**8**
	6.1	Onboard Automobile sensing system, Home appliances sensors, Aerospace Sensors, Sensors for Environmental Monitoring, Biomedical Sensing Applications.	
	6.2	Radio sensors for industrial applications, Radio Astronomy, Remote Sensing, Ground Penetrating Radars, Underwater sensing, LIDAR.	
		Total	**39**

Textbooks:

1	D.V. S. Murthy, “Transducers and Instrumentation”, PHI Learning, 2nd Edition, 2013.
2	D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003.
3	Antti V. Raisanen, Arto Lehto, “Radio Engineering for Wireless Communication and Sensor Applications”, Artech House mobile communications series, USA, 2003.
4	Ramon Pallas Areny, John G. Webster, “Sensors and Signal Conditioning”, 2nd edition, John Wiley and Sons, 2000.
5	Vijay K. Garg, “Wireless Communication and Networking”, Morgan -Kaufmann Series in Networking, Elsevier, 2010.

Reference Books:	
1	Nadim Maluf, Kirt Williams, "An Introduction to Microelectromechanical Systems Engineering1", Artech House, 2004.
2	James J. Allen, "Micro Electro Mechanical System Design", Taylor and Francis, 2005
3	A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpatrai & Co.", 19th Edition, 2011.
4	Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020
5	C.S. Rangan, G.R. Sarma, V.S. Mani, "Instrumentation Devices and System", TMH, 1997.
6	Jacob Fraden, "Handbook of Modern Sensors Physics, Designs, and Applications", Fourth Edition, Springer, 2010

NPTEL Course:

1. Sensors and Actuators, Prof. Hardik J. Pandya, IISc Bangalore, : https://nptel.ac.in/courses/108/108/108108147/
2. Aditya K. Jagnnatham, IIT Kanpur, LTE, WLAN, Bluetooth and Future, : https://www.youtube.com/watch?v=vjhp0zTXEsc

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL501	Digital Communication Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL501	Digital Communication Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL501	Digital Communication Lab	1

Prerequisite: Engineering Mathematics-IV, Signals and Systems, Principles of Communication Engineering	
Lab Objectives:	
1	To learn source coding and error control coding techniques
2	To compare different line coding methods
3	To distinguish various digital modulations
4	To use different simulation tools for digital communication applications
Lab Outcomes:	
1	Compare various source coding schemes
2	Design and implement different error detection codes
3	Design and implement different error correction codes
4	Compare various line coding techniques
5	Illustrate the impulse response of a matched filter for optimum detection
6	Demonstrate various digital modulation techniques

Suggested Experiments: Students are required to complete at least 8 to 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Huffman code generation
2	Shannon-Fano code generation
3	Vertical redundancy Check (VRC) code generation and error detection
4	Horizontal Redundancy Check (HRC) code generation and error detection
5	Cyclic redundancy Check (CRC) code generation and error detection
6	Checksum code generation and error detection
7	Compare the performances of HRC and Checksum
8	Linear block code generation and error detection
9	Error detection and correction using Hamming code virtual lab http://vlabs.iitb.ac.in/vlabsdev/labs/mit_bootcamp/comp_networks_sm/labs/exp1/index.php
10	Cyclic code generation and error detection
11	Convolutional code generation
12	Line Codes generation and performance comparison
13	Spectrum of line codes (NRZ unipolar and polar)
14	Impulse responses of ideal (Nyquist filter) and practical (Raised cosine filter) solution for zero ISI
15	Matched filter impulse response for a given input
16	Generation (and detection) of Binary ASK
17	Generation (and detection) of Binary PSK
18	Generation (and detection) of Binary FSK
19	Generation (and detection) of QPSK & MSK
20	Generation (and detection) of 16-ary QASK

Term Work:	
1	Term work should consist of 8 to 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL502	Discrete Time Signal Processing Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL502	Discrete Time Signal Processing Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL502	Discrete Time Signal Processing Lab	1

Prerequisite: C Programming Language.	
Lab Objectives:	
1	To carry out basic discrete time signal processing operations
2	To implement and design FIR filters and IIR filters.
3	To implement applications related to the field of biomedical signal processing and audio signal processing. To develop troubleshooting abilities among students
Lab Outcomes:	
1	Perform basic discrete time signal processing operations such as Linear Convolution, Circular Convolution, Autocorrelation, Cross Correlation, etc. and interpret the results.
2	Demonstrate their ability towards interpreting and performing frequency analysis of different discrete time sequences and systems.
3	Design and implement the FIR and IIR Filters for given specifications.
4	Implement and analyze applications related to the field of biomedical signal processing and audio signal processing.

Suggested Experiments: Students are required to complete 8 to 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1 *	To perform linear convolution of two signals, auto correlation of non-periodic signals, periodic signals and random noise and interpret the results obtained.
2 *	To obtain cross correlation of a signal with its delayed and attenuated version (Concept of radar signal processing).
3 *	To determine impulse, magnitude, phase response and pole-zero plot of given transfer functions.
4 *	To perform circular convolution and linear convolution of two sequences using DFT.
5 *	To perform the DFT of DT sequence and sketch its magnitude and phase spectrum or To Generate a discrete time signal having minimum three frequencies and analyse its frequency spectrum.
6*	Implementation of fast Fourier transform algorithm to find DFT of a discrete time sequence.
7 *	Design of IIR digital filters and use the designed filter to filter an input signal which has both low and high frequency components or real-world signals like ECG/EEG, speech signal etc).
8	Design a notch filter to suppress the power supply hum in audio signals.
9 *	Design FIR filter using windowing method and use the designed filter to filter an input signal which has both low and high frequency components or real-world signal like ECG/EEG, speech signal etc.
10	Design of minimum phase, maximum phase and mixed phase systems.
11	To verify the location of zeros in symmetric and antisymmetric FIR filters.
12 *	To generate the ECG signal and detect the characteristic points
13	Classification of ECG signals
14	To extract delta, theta, alpha, sigma, and beta waveforms from EEG signals.
15*	Musical tone generation.
16	DTMF tone generation and detection.

Useful Links:	
1	Virtual Laboratory-http://vlabs.iitkgp.ernet.in/dsp/ for demonstration of concepts like DFT and its inverse, FIR filter using windowing method etc

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL503	Digital VLSI Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL503	Digital VLSI Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL503	Digital VLSI Lab	1

Prerequisite: Digital Design, Electronic devices and circuits	
Lab Objectives:	
1	To become familiar with open source circuit simulation tools like Ngspice, Magic etc.
2	To perform various type of analysis of combinational and sequential CMOS circuits
3	To evaluate performance of given combinational and sequential CMOS circuits
4	To design, implement and verify combinational and sequential CMOS circuits using open source VLSI design tools.
Lab Outcomes:	
1	Write spice/verilog code for given combinational and sequential CMOS circuits.
2	Perform various analysis like operating point, dc, transient etc of given CMSO circuits.
3	Evaluate performance of given CMOS circuits.
4	Draw layout of given CMOS circuit and also able extract various parasitic using open source layout tools like Magic.
5	Design, simulate, and verify CMOS circuit for given specifications using RTL design techniques

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1.	Constant Voltage and Constant field MOSFET scaling
2.	Layout of MOSFET and extraction of parasitic capacitances
3.	Voltage transfer characteristics of CMOS inverter and calculation of Noise Margin and static power
4.	Transient Analysis of CMOS inverter and calculation of tpHL, tpLH, tr, tf, average power
5.	Design of CMOS inverter for given specifications
6.	Layout of CMOS inverter and comparison of pre layout and post layout performance.
7.	Voltage transfer characteristics of 2 input NAND/NOR gate and calculation of noise margins and validation using equivalent inverter approach.
8.	Transient Analysis of 2 input NAND/NOR CMOS gate and calculation of tpHL tpLH, tr, tf, average power and validation using equivalent inverter approach.
9.	Layout of 2 input CMOS NAND/NOR gate and comparison of pre layout and post layout performance.
10.	Static and transient analysis of Complex CMOS gate.
11.	Layout of complex CMOS gate using Euler path.
12.	Implementation of various combinational and sequential circuits using different design styles.
13.	Design and implementation of NAND based and NOR based ROM array.
14.	Performance analysis of 6T-SRAM Cell
15.	Design of 6T SRAM cell robust read and write operation.
16.	Performance analysis of 1T and 3T DRAM Cell
17.	RTL design of Soda dispenser machine
18.	RTL design of FIR Filter
19.	RTL design of sum of absolute differences
20.	RTL design of Laser based distance measure

<table>
<tr><td colspan="2">Term Work:</td></tr>
<tr><td>1</td><td>Term work should consist of 10 experiments.</td></tr>
<tr><td>2</td><td>Layout and VERILOG coding experiments are compulsory to be covered in labs.</td></tr>
<tr><td>3</td><td>The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.</td></tr>
<tr><td>4</td><td>Total 25 Marks
(Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Digital design techniques : 5 Marks)</td></tr>
<tr><td colspan="2">The practical and oral examination</td></tr>
<tr><td></td><td>1. The practical and oral examination will be based on the entire syllabus.
2. Students are encouraged to share their experiment codes on online repositories.
3. Practical exam slip should cover all the 8 experiments for examination.</td></tr>
<tr><td colspan="2">Continuous assessment exam</td></tr>
<tr><td></td><td>Continuous Assessment is of 20 marks. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

<table>
<tr><th>Sr.no</th><th>Assessment Tools</th><th>Marks</th></tr>
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<tr><td>3.</td><td>Content beyond syllabus presentation</td><td>10 marks</td></tr>
<tr><td>4.</td><td>Creating Proof of concept</td><td>10 marks</td></tr>
<tr><td>5.</td><td>Mini Project / Extra Experiments/ Virtual Lab</td><td>10 marks</td></tr>
<tr><td>6.</td><td>GATE Based Assignment test/Tutorials etc</td><td>10 marks</td></tr>
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<tr><td>8.</td><td>Multiple Choice Questions (Quiz)</td><td>5 marks</td></tr>
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</table>
</td></tr>
</table>

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL504	Professional Communication & Ethics- II	--	2*+2~	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL504	Professional Communication & Ethics – II	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECL504	Professional Communication and Ethics-II	2

Prerequisite: Professional Communication and Ethics-I	
Course Objectives:	
1	To discern and develop an effective style of writing important technical/business documents.
2	To investigate possible resources and plan a successful job campaign.
3	To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4	To develop creative and impactful presentation skills.
5	To analyze personal traits, interests, values, aptitudes and skills.
6	To understand the importance of integrity and develop a personal code of ethics.
Course Outcomes:	
1	Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2	Strategize their personal and professional skills to build a professional image and meet the demands of the industry.

3	Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4	Deliver persuasive and professional presentations.
5	Develop creative thinking and interpersonal skills required for effective professional communication.
6	Apply codes of ethical conduct, personal integrity and norms of organizational behavior.

Module		Content	Hours
1		**ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)**	**6**
	1.1	**Purpose and Classification of Reports:** **Classification on the basis of:** • Subject Matter (Technology, Accounting, Finance, Marketing, etc.) • Time Interval (Periodic, One-time, Special) • Function (Informational, Analytical, etc.) • Physical Factors (Memorandum, Letter, Short & Long	
	1.2	**Parts of a Long Formal Report:** • Prefatory Parts (Front Matter) • Report Proper (Main Body) • Appended Parts (Back Matter)	
	1.3	**Language and Style of Reports** • Tense, Person & Voice of Reports • Numbering Style of Chapters, Sections, Figures, Tables and • Equations • Referencing Styles in APA & MLA Format • Proofreading through Plagiarism Checkers	
	1.4	**Definition, Purpose & Types of Proposals** • Solicited (in conformance with RFP) & Unsolicited Proposals • Types (Short and Long proposals)	
	1.5	**Parts of a Proposal** • Elements • Scope and Limitations • Conclusion	
2		**EMPLOYMENT SKILLS**	**6**
	2.1	**Cover Letter & Resume** • Parts and Content of a Cover Letter • Difference between Bio-data, Resume & CV • Essential Parts of a Resume • Types of Resume (Chronological, Functional & Combination)	

	2.2	**Statement of Purpose** • Importance of SOP • Tips for Writing an Effective SOP	
	2.3	**Group Discussions** • Purpose of a GD • Parameters of Evaluating a GD • Types of GDs (Normal, Case-based & Role Plays) • GD Etiquettes	
	2.4	**Personal Interviews** • Planning and Preparation • Types of Questions • Types of Interviews (Structured, Stress, Behavioural, Problem • Solving & Case-based) • Modes of Interviews: Face-to-face (One-to one and Panel) • Telephonic, Virtual	
3		**BUSINESS MEETINGS**	**2**
	3.1	**Conducting Business Meetings** • Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette	
	3.2	**Documentation** • Notice • Agenda • Minutes	
4		**TECHNICAL/ BUSINESS PRESENTATIONS**	**2**
	4.1	**Effective Presentation Strategies** • Defining Purpose • Analyzing Audience, Location and Event • Gathering, Selecting &Arranging Material • Structuring a Presentation • Making Effective Slides • Types of Presentations Aids • Closing a Presentation • Platform skills	
	4.2	**Group Presentations** • Sharing Responsibility in a Team • Building the contents and visuals together • Transition Phases	
5		**INTERPERSONAL SKILLS**	**8**
	5.1	**Interpersonal Skills** • Emotional Intelligence • Leadership & Motivation • Conflict Management & Negotiation • Time Management • Assertiveness	

		• Decision Making	
6		**CORPORATE ETHICS**	**2**
	6.1	**Intellectual Property Rights** • Copyrights • Trademarks • Patents • Industrial Designs • Geographical Indications • Integrated Circuits Trade Secrets (Undisclosed Information)	
		Case Studies Cases related to Business/ Corporate Ethics	
		Total	**26**

Textbooks:	
1	Fred Luthans, "Organisational Behavior" , McGraw Hill, edition
2	Robbins Stephen judge timothy "Organisational Behavior" Pearson
3	R.C Sharma and Krishna Mohan, "Business Correspondence and Report Writing"
4	Foundation course in Human values and Professional Ethics L R R Gaur, R. Asthana, G.P. Bagaria
Reference Books:	
1	Lesiker and Petit, "Report Writing for Business" , McGraw Hill, edition
2	Wallace and Masters, "Personal Development for Life and Work" , Thomson Learning, 12th edition
3	B N Ghosh, "Managing Soft Skills for Personality Development", Tata McGraw Hill.Lehman,

Internal Assessment:

Internal assessment will be for 50 Marks as given below

Sr No	Headings	Marks
A	Assignments	10 Marks
B	Continuous Assessment	20 Marks
C	Report On Presentation	10 Marks
D	Group Discussion	10 Marks
	Total	50 Marks

A) Assignments : List of assignments are as given below. The assignments have to be discussed in the group and approach approved by faculty. Each student in the group will have to write the assignments individually (10 Marks)

Sr No	List of Assignments
1.	Case Study on Conflict resolution and frustration
2.	Report Writing
3.	Proposal writing
4	Minutes of Meeting
5	Case study on Ethics

B)**Continuous Assessment:-**

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

C) Report on presentation: A detail typed report has to be prepared of minimum 25 pages and maximum 30 pages. The format of the report has to be discussed and approved by faculty

D) A final Group Discussion Round will be conducted and every student must participate in the group discussion

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECM501	Mini Project 2A Embedded System Project	--	4[$]	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECM501	Mini Project 2A Embedded System Project	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECM501	Mini Project-2a : Embedded systems project	2

Prerequisite: Microcontrollers, Linear Integrated Circuits. Mini Project 1b: Arduino & Raspberry Pi based Projects	
Course Objectives:	
1.	To develop background knowledge Embedded Systems.
2.	To understand designing of embedded systems.
3.	To choose proper microcontroller for Embedded systems
4.	To understand use of wireless sensors/communications with Embedded systems
5.	To understand communication techniques.
Course Outcomes:	
1.	Understand the embedded systems with design metrics.
2.	Understand microcontrollers and programming in Embedded C.
3.	Implementation of Embedded systems with different sensors and peripherals as IoT.
4.	Implementation of Embedded systems with different communication protocols as IoT.
5.	Analyze concepts of Real time operating systems.

Module		Content	Hrs
1		**Introduction**	8
	1.1	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Classification, Major Application Areas. Characteristics and quality attributes (Design Metric) of embedded system.	
	1.2	Identification of Project Title	
2		**Controller boards and Programming – Embedded C**	8
	2.1	ARM LPC 21XX (2148), STM32 boards and Texas MSP 430 lunchbox/ Tiva C board and **PIC/PSoc***	
	2.2	Comparison of C and embedded C, Data Types, Variable, Storage Classes, Bit operation , Arrays, Strings, Structure and unions, Classifier	
	2.3	**Exercise:** Identify the suitable board required for the particular application with respect to design metrics. (**Hint:** check clock frequency (speed) , memory (program and data), no. of ports for peripherals, timers/counters and serial communication requirement for project)	
	2.4	**Suggested Way to Identify :** https://predictabledesigns.com/how-to-selectthe-microcontroller-for-your-new-product/	
3		**Interfacing Sensors and peripherals using Embedded C**	8
	3.1	Sensors and Signal Conditioning Circuits amplifiers /attenuators /filters /comparators/ADC and DAC) , Interfacing with GLCD/TFT display, Relays and Drivers for interfacing Motors (DC and stepper)	
	3.2	Interfacing with BLDC motors and drivers, USB/HDMI camera interfacing	
	3.3	**Exercise :** Understand the Interfacing requirement like drivers, signal condition circuits for sensors, etc. for the selected application	
	3.4	**Study Material : For LCD interfacing with MSP430 LaunchPad** https://microcontrollerslab.com/lcd-interfacing-msp430-launchpad/#:~:text=LCD%20interfacing%20with%20MSP430%20microcontroller,Now%20I%20will&text=It%20requires%205%20volts%20dc,and%20seco nd%20pin%20is%20vcc.	
4		**Communication with programming in Embedded C**	8
	4.1	Serial communication, CAN bus, I2C, MOD bus, SPI	
	4.2	Interfacing with Wi-Fi, Bluetooth ,ZigBee, LoRa, RFID and putting data on IoT	

	4.3	Interfacing with GSM module , GPS module, SD card	
	4.4	**Exercise:** Understand Communication requirement for selected application and test it	
	4.5	**Study Material :** Serial Communication Interface: **STM32:**https://controllerstech.com/serial-transmission-in-stm32/#:~:text=Serial%20Transmission%20in%20Stm32&text=UART%20is%20widely%20used%20for,amongst%20which%20communication%20is%20 done. **LPC2148:** https://www.electronicwings.com/arm7/lpc2148-uart0 **MSP430:** https://www.ti.com/lit/ml/slap117/slap117.pdf	
5		**Real Time Operating Systems[RTOS]**	**8**
	5.1	Operating system basics , Types of OS , Tasks, process, Threads	
	5.2	Multiprocessing and ,Multitasking , Task scheduling	
		RTLinux/ Free RTOS and Mbed OS , Implementation with RTOS	
6		**Cloud/Web server**	**8**
	6.1	Implementation on web server ,	
	6.2	Thingspeak, AWS cloud platform for IoT based programming and modelling	
	6.3	**Exercise : perform ESP8266 interface with microcontroller**	
	6.4	**Study Material :** **STM32:** https://circuitdigest.com/microcontroller-projects/interfacingesp8266-with-stm32f103c8-stm32-to-create-a-webserver **LPC2148:** https://circuitdigest.com/microcontroller-projects/iot-based-ARM7-LPC2148-webserver-to-control-an-led **MSP430:** https://circuitdigest.com/microcontroller-projects/sending-emailusing-msp430-and-esp8266	
		Total	**48**

Textbooks:	
1.	Shibu K.V," Introduction to Embedded Systems", Mc Graw Hill, 2nd edition.
2.	Frank Vahid, and Tony Givargis, "Embedded System Design: A unified Hardware/Software Introduction", Wiley Publication.

3.	Raj Kamal," Embedded Systems Architecture, Programming and design", Tata MCgraw-Hill Publication.
4.	Dr. Iyer, Gupta," Embedded real systems Programming", TMH
5.	David Simon, "Embedded systems software primer', Pearson
6.	Andrew Sloss, Dominic Symes and Chris Wright, "ARM_System_Developers_Guide Designing_and_Optimizing_System_Software" Elsevier and Morgan Kaufmann Publishers.
7.	Michel J Pont "Embedded C" Pearson
8.	Shibu K.V," Introduction to Embedded Systems", Mc Graw Hill, 2nd edition.

Useful Softwares:	
	Tinkercad : https://www.tinkercad.com/
	Proteus software
	KEIL for ARM LPC 2148
	STM32Cube software
	MSP Flasher - Command Line Programmer
	msp430 code composer studio
Online repositories:	
1	https://circuitdigest.com
2	www. Github.com
3	https://www.electronicshub.org
NPTEL courses	
	1. Introduction to Embedded System Design (using MSP430) https://onlinecourses.nptel.ac.in/noc20_ee98/preview **2. Embedded System Design with ARM** https://onlinecourses.nptel.ac.in/noc20_cs15/preview **3. Embedded systems** https://nptel.ac.in/courses/108/102/108102045/ **Texas Instruments (TI) Trainings** https://e2e.ti.com/support/archive/universityprogram/educators/w/wiki/2103/training-support **Texas Instruments (TI) Teaching material/ text books** https://e2e.ti.com/support/archive/universityprogram/educators/w/wiki/2035/textbooks

Term Work:	
1	**Guideline to maintain quality of mini project are as follows :** 1. To achieve proper selection of Mini Projects. Students should do survey of different microcontroller board from given microcontroller series, tools and identify which is most suitable for their selected topic. They should consult with their Guide/Mentors / Internal committee to finalize it. 2. Students shall submit implementation plan in the form of Smart Report/Gantt/PERT/CPM chart, which will cover weekly activity of mini project. 3. A log book to be prepared by each group, wherein group can record weekly work progress. Guide/ supervisor will verify it and will put notes/comments. 4. Guide/supervisor guidance is very much important during mini project activities; however, focus shall be on self-learning. 5. The solution to be verified with standard tools and procedures and report to be compiled in standard format of University of Mumbai. 6. **Suggested steps for mini project selection and implementation** i. Mini project should be completely microcontroller based ii. Follow these steps a) Take specification, using these specifications design project. b) Select proper microcontroller board considering features and requirements of project. c) Program it using Embedded C and perform verification of each module (sensors/communication protocol) d) Test Functional Simulation and verify it using simulation tool. e) Make hardware connection on GPP of peripherals with microcontroller board and execute the program. f) Troubleshoot if not get expected result.
2	**Project Topic selection and approval :-** a. The group may be of **maximum FOUR (04)** students. b. Topic selection and approval by **2 Expert** faculty from department at the start of semester c. **Log Book** to be prepared for each group to record the work progress in terms of milestones per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signature in it per week. The log book can be managed **online** with proper authentication method using google sheets/forms or open source project management software.
3	**Project Report Format:** 1. Report should not exceed **30 pages**. Simply staple it to discourage use of plastic. 2. Report must contain block diagram, circuit diagram, screenshot of outputs and datasheets of microcontrollers and peripherals (Include **only required** information pages). 3. The recommended report writing format is in **LaTeX.**
4	**Term Work evaluation and marking scheme:** 1 The review/ progress monitoring committee shall be constituted by Head of Departments of each institute. 2 The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

	3 At end of semester the above 2 expert faculty who have approved the topic will internally **evaluate the performance**. 4 Students have to give presentation and demonstration on the Embedded Systems Mini Project- 2-A at end of semester before submission to above experts. 5 In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. Based upon it the marks will be awarded to student. **<u>Distribution of 25 Marks scheme</u> is as follows:** 1. Marks awarded by guide/supervisor based on log book and output : 10 2. Marks awarded by review committee : 10 3. Quality of Project report : 05
5	**Guidelines for Assessment of Mini Project Practical/Oral Examination:** **1** Report should be prepared as per the guidelines issued by the University of Mumbai. **2** Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and **External Examiners preferably from industry or research organisations** having experience of more than five years approved by head of Institution. **Students shall be motivated to present their mini project work done** 1. Participate in Project Competition 2. Publish paper in Conferences/Journals
Continuous assessment exam	
	In continuous assessment focus shall be on 1. Each individual student, assessment based on individual's contribution in group activity. 2. Their understanding and response to questions.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC601	Electromagnetics and Antenna	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC601	Electromagnetics and Antenna	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC601	Electromagnetics and Antenna	3

Prerequisite:
1. Vector Calculus
2. Fundamental concepts of electricity and magnetism

Course Objectives:

1	To study Maxwell's equation and its usefulness.
2	To study electromagnetic wave propagation in different media.
3	To study the radiation mechanism of an antenna and its various parameters.
4	To study the radiation principles of various Special types of Antennas.

Course Outcomes:

1	To understand electromagnetic fields including both static and dynamic in terms of Maxwell's equations.
2	To apply Maxwell's equation to solve various electromagnetic phenomenon such as electromagnetic wave propagation in free space, dielectric and conductor medium, Power in EM wave.
3	To derive the field equations for the basic radiating elements and define the basic antenna parameters like radiation pattern, directivity, gain etc.
4	To understand the radiation properties of Antenna Array and Special Antennas such as Yagi Uda Antenna, Horn Antenna, Reflector Antenna, Microstrip Antenna etc.

Module	Content		Hrs.
1	**Introduction to Static fields**		**06**
	1.1	Charge, Coulomb's law, Charge configurations, Electric field intensity, Electric flux density, Gauss's law and applications, Current density, and Continuity equation	
	1.2	Scalar Electric Potential, Potential gradient, Laplace's and Poison's equations	
	1.3	Biot Savart Law, Ampere Circuit law, Gauss's law for magnetic field, Vector magnetic potential	
2	**Electromagnetic Field and Maxwell's Equations**		**09**
	2.1	Faraday's Law, Displacement current density, Maxwell's equation for Time varying field, Boundary conditions	
	2.2	EM wave propagation through lossy, perfect dielectric and conducting medium	
	2.3	Power in EM Wave: Poynting theorem and Poynting vector	
3	**Basic of Antennas**		**08**
	3.1	Basic concepts: Radiation mechanism, Near field and Far field radiation, Retarded potential	
	3.2	Antenna Parameters: Isotropic antenna, Radiation pattern, radiation intensity, Beamwidth, directivity, Gain, Beam efficiency, Bandwidth, Polarization, Input impedance, Antenna efficiency, Radiation resistance, Loss resistance, aperture concept, FRII's transmission formula	
	3.3	Wire Elements: Infinitesimal dipole, Wire dipole, Monopole antennas: radiation field derivations and related parameters, Introduction to Loop antenna	
4	**Antenna Arrays**		**06**
	4.1	Linear arrays of two isotropic point sources, Linear array of N elements, Principle of pattern multiplication	
	4.2	Introduction to Planar array	
5	**Special Antennas – I**		**06**
	5.1	Yagi Uda antenna, Broadband antenna like Helical and Log Periodic antenna	
	5.2	Horn Antennas: E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn and Conical Horn	
6	**Special Antennas – II**		**04**
	6.1	Reflector Antennas: Plane Reflectors, Corner Reflectors and Parabolic Reflector Types	
	6.2	Patch Antenna: Microstrip antenna, Feeding Techniques, Introduction to design of Microstrip antenna (Rectangular patch)	
		TOTAL	**39**

Textbooks:	
1	Jordan and Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd edition, PHI, 2020.
2	Matthew N. O. Sadiku, S. V. Kulkarni, “Principles of Electromagnetics Engineering”, 6th edition , Oxford university press,
3	Costantine A. Balanis, “Antenna Theory: Analysis and Design”, 4th edition, John Wiley Publication, 2016.
4	John D Kraus, A S Khan, “Antenna and wave Propagation”, 4th edition , McGraw Hill, 2010.
Reference Books:	
1	William H. Hayt, John A. Buck, Jaleel M. Akhtar, “Engineering Electromagnetics”, 9th edition, Tata McGraw-Hill Publishing Company Limited, 2020.
2	Stutzman, Theile, “Antenna Theory and Design”, 3rd edition, John Wiley and Sons, 1981.
3	R. E. Collin, “Antennas and Radio Wave Propagation”, International Student Edition, McGraw Hill, 1985.

Internal Assessment:
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unab to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC602	Computer Communication Networks	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC602	Computer Communication Networks	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC602	Computer Communication Networks	3

Prerequisite: Principles of communication engineering ,Digital communication

Course Objectives:

1	To introduce networking architecture and protocols.
2	To understand and recognize the layer-wise functions, services, data formats, protocols, hardware devices and addresses in the TCP/IP architecture.
3	To build an understanding of application layer protocols.
4	To apply different addressing and routing schemes.

Course Outcomes:

1	Analyze network topologies, hardware devices, addressing schemes and the protocol stacks.
2	Compare various transmission media and broadband technologies.
3	Analyze the flow control, error control and the medium access control techniques.
4	Judge network layer addressing and routing schemes.
5	Analyze connection oriented and connectionless services.
6	Apply the knowledge of application layer protocols.

Module		Content	Hrs
1		**Introduction to Network Architectures, Protocol Layers, and Service models**	**6**
	1.1	Applications of computer networks. Network types: LAN, MAN, and WAN, Network topologies.	
	1.2	Protocols and standards, need of layered protocol architecture, OSI reference model	
	1.3	TCP/IP architecture: protocol suite, comparison of OSI and TCP/IP	
	1.4	Layer wise network hardware devices (NIC, Repeaters, Hubs, Bridges, Switches, Routers, Gateway and their comparison)	
	1.5	Addressing: physical / logical /port addressing/socket addressing.	
2		**Physical Layer**	**4**
	2.1	Guided transmission media: comparison among coaxial, optical fiber and twisted pair cables.	
	2.2	Unguided transmission media	
	2.3	Transmission impairments	
	2.4	Broadband standards: Cable modem, DSL, and HFC	
3		**Data Link Layer**	**7**
	3.1	Data link services: Framing, Flow control, Error control	
	3.2	ARQ methods: transmission efficiency, Piggybacking	
	3.3	High Level Data Link Control (HDLC): HDLC configurations, Frame formats, HDLC bit stuffing and de-stuffing, Typical frame exchanges.	
	3.4	Medium Access Control Protocols: ALOHA, Slotted ALOHA, CSMA, CSMA/CD	
4		**Network Layer**	**12**
	4.1	Difference between circuit switching and Packet switching networks	
	4.2	Network layer services and functions.	
	4.3	Internet Protocol: Principles of Internetworking, requirements, IPv4 packet, IPv4 addressing (classful and classless (CIDR))	
	4.4	Routing in Packet Switching Networks: Characteristics, Routing strategies	

	4.5	Routing algorithms: Link state Routing, Distance vector Routing and Path vector routing, Routing protocols: RIP, OSPF, BGP and EIGRP.	
	4.6	Subnetting, supernetting, VLSM, and NAT	
	4.7	Introduction to ICMP, ARP, RARP	
	4.8	IPv6 (IPv6 Datagram format, comparison with IPv4, and transition from IPv4 to IPv6)	
	4.9	Quality of service	
5		**Transport Layer**	**6**
	5.1	Connectionless and Connection–oriented services at transport layer, Transmission Control Protocol (TCP): TCP Services, TCP Segment, TCP three way handshake	
	5.2	User datagram Protocol (UDP), UDP Services, UDP Datagram	
	5.3	TCP and UDP checksum calculation	
	5.4	Flow control, error control and congestion control	
6		**Application Layer**	**4**
	6.1	Introduction to Application layer Protocols: HTTP, FTP, DNS, SMTP, TELNET, DHCP	
		Total	**39**

Textbooks:	
1	Data Communications and Networking – Behrouz A. Forouzan, Fifth Edition TMH, 2013
2	Computer Networks -- Andrew S Tanenbaum, 5th Edition, Pearson Education, 2013.
3	J J. F. Kurose and K. W. Ross," Computer Networking: A Top-Down Approach", Addison Wesley, 5th Edition, 2010.
Reference Books:	
1	Alberto Leon Garcia, "Communication Networks", McGraw Hill Education, Second Edition, Fourth Edition, 2008.
2	An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education, 2015.
3	Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning
4	Data and Computer Communications, William Stallings, 10th Edition, Pearson Education, 2014.

Internal Assessment:

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6.	GATE Based Assignment test/Tutorials etc	10 marks
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8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:	
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2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC603	Image Processing and Machine Vision	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC603	Image Processing and Machine Vision	20	20	60	2	--	--	100

Course Code	Course Title	Credit
ECC603	Image Processing and Machine Vision	3

Prerequisite:

1. Signals and Systems
2. Discrete Time Signal Processing
3. Python Programming Skill Lab

Course Objectives:

1	To teach the fundamentals and mathematical models in digital image processing and Machine Vision
2	To teach quality enhancement of image through filtering operations
3	To teach the students image morphology and restoration techniques
4	To expose the students to segmentation techniques in image processing and Machine Vision
5	To teach the techniques of extracting image attributes like regions and shapes
6	To learn classification and recognition algorithms for machine vision

Course Outcomes:

1	Understand fundamentals of image processing and machine vision.

2	Enhance the quality of image using spatial and frequency domain techniques for image enhancement
3	Learn image morphology and restoration techniques
4	Learn image segmentation techniques based on principle of discontinuity and similarity using various algorithms
5	Represent boundaries and shapes using standard techniques
6	Classify the object using different classification methods

Module		Content	Hrs.
1	**DIGITAL IMAGE FUNDAMENTALS AND POINT PROCESSING**		**04**
	1.1	Introduction –Steps in Digital Image Processing, concept of spatial and intensity resolution, Relationships between pixels	
	1.2	Point Processing: Image Negative, Log Transform, Power Law transform, Bit plane slicing, Contrast stretching, Histogram equalization and Histogram Specification	
2	**IMAGE ENHANCEMENT**		**08**
	2.1	Spatial Domain filtering: The Mechanics of Spatial Filtering, Smoothing Spatial Filters-Linear Filters-Averaging filter, Order-Statistic Filters- Median filter, Application of Median filtering for Noise removal Sharpening Spatial Filters- The Laplacian, Unsharp Masking and High boost Filtering, Using First-Order Derivatives —The Gradient- Sobel, Prewitt and Roberts	
	2.2	Frequency Domain Filtering: Introduction to 2-D DFT and its application in frequency domain filtering, Wavelet transform, Haar transform	
	2.3	Frequency Domain Filtering Fundamentals, Fourier Spectrum and Phase angle, Steps for Filtering in the Frequency Domain, Correspondence Between Filtering in the Spatial and Frequency Domains, Frequency domain Image Smoothing and sharpening filter - Ideal, Butterworth , Gaussian	
3	**IMAGE MORPHOLOGY AND RESTORATION**		**05**
	3.1	Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Boundary extraction, Hole filling, Thinning and thickening	
	3.2	Restoration: A Model of the Image Degradation/Restoration Process, Noise models, Removal periodic noise, Principle of Inverse filtering	
4	**IMAGE SEGMENTATION**		**08**
	4.1	Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, Canny's edge detection algorithm, Edge linking: Local processing and boundary detection using regional processing (polygonal fitting)	

	4.2	Thresholding: Foundation, Role of illumination and reflectance, Basic global thresholding	
	4.3	Region Based segmentation: Region Growing, Region Splitting and merging	
5	**INTRODUCTION TO IMAGE DESCRIPTORS**		**06**
	5.1	Introduction to Texture, Co-occurrence matrix, Chain code.	
	5.2	Image Feature Selection, Best Features and Their Properties, Feature Variance, Feature Correlation, Dimension Reduction.	
6	**MACHINE VISION ALGORITHMS**		**08**
	6.1	Knowledge representation, Object detection using Template Matching, Artificial Neural Networks for Image Classification, Feed-Forward Error Back Propagation based Classifier Learning, Class Separation Distance, Confusion Matrix.	
	6.2	K-means clustering algorithm, Support Vector Machine for binary classification case; Support Vectors and Hyperplane.	
		TOTAL	**39**

Textbooks:	
1	Milan Sonka , Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision” Cengage Engineering, 3rd Edition, 2013
2	Gonzales and Woods, “Digital Image Processing”, Pearson Education, India, Third Edition,
3	R. O. Duda and P. E. hart, Pattern classification and scene analysis, Wiley Interscience publication
4	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
5	Kenneth R. Castleman, Digital Image Processing, Pearson Publications, 2012.
Reference Books:	
1	Anil K. Jain, “Fundamentals of Image Processing”, Prentice Hall of India, First Edition, 1989.
2	W Pratt, “Digital Image Processing”, Wiley Publication, 3rd Edition, 2002
3	Forsyth and Ponce, Computer vision: A modern approach, PHI
4	Frank Y Shish, Image Processing and Pattern Recognition: Fundamentals and Techniques, Wiley Wiley-IEEE Press, 2010

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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:	
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2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECC604	Artificial Neural Network and Fuzzy Logic	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC604	Artificial Neural Network and Fuzzy Logic	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC604	Artificial Neural Networks and Fuzzy Logic	3

Prerequisite: Basic linear Algebra and Engineering Mathematics-I to IV	
Course Objectives:	
1	To introduce the concepts and understanding of artificial neural networks
2	To provide adequate knowledge about supervised and unsupervised neural networks
3	To introduce neural network design concepts
4	To expose neural networks based methods to solve real world complex problems
5	To study the architecture of CNN and its application in image classification
6	To introduce fuzzy logic and fuzzy inference systems
Course Outcomes:	
1	Comprehend the concepts of biological neurons and artificial neurons
2	Analyse the feed-forward and feedback neural networks and their learning algorithms.
3	Comprehend the neural network training and design concepts

4	Understand the applications of neural networks.
5	Build a simple CNN model and apply in image classification
6	Analyse the application of neural networks and fuzzy logic to real world problems.

Module		Content	Hrs
1		**Introduction to Neural Networks and their Basic Concepts**	**7**
	1.1	Biological neuron and Artificial neuron,	
	1.2	McCulloch-Pitts Model, Activation Function, various types of Activation Functions and types of Neural Network Architectures.	
	1.3	Prerequisites for Training of Neural Networks. Linearly Separable and Linearly Non-Separable Systems with examples, Concepts of Supervised Learning, Unsupervised Learning, and Reinforcement Learning.	
	1.4	Brief survey of applications of Neural Networks.	
2		**Supervised Learning Neural Networks**	**7**
	2.1	Perceptron - Single Layer Perceptron, Multilayer Perceptron and their Architecture.	
	2.2	Error Functions: Mean Square Error and Sum Squared Error. Gradient Descent, Generalized delta rule, Error back propagation, Stopping Criterions for Training.	
3		**Unsupervised Learning Neural Networks**	**7**
	3.1	Competitive Learning Network – Kohonen Self-Organizing Networks – Architecture, Training Algorithm.	
	3.2	Discrete Hopfield Network- Hopfield Matrix, Testing Algorithm, K-Means Clustering Algorithm.	
4		**Algorithms of Neural Networks**	**4**
	4.1	Basic concept of Machine Learning, Support Vector Machine (SVM) - Introduction and SVM based Binary Classifier.	
	4.2	LMS Algorithm.	
5		**Convolution Neural Network (CNN)**	**7**
	5.1	Basic concept of Deep Learning, Convolution Operation, Overview of CNN Architecture, Input layer, Convolution layers, Pooling layers, Padding, Strided Convolutions, Rectified Linear Unit (ReLU), One Layer	

		of a Convolutional Network, Fully Connected Layers.	
	5.2	Complex Image Classification using CNN.	
6		**Introduction to Fuzzy Inference System**	**7**
	6.1	Introduction to Fuzzy Logic, Fuzzy Rules, Fuzzy Properties - Operations, Membership Functions, Fuzzification - Membership Value Assignments using Intuition Method.	
	6.2	Defuzzification Methods -- Mean of Maxima and Centroid (Centre of Area) Methods, Fuzzy Inference System with reference to Mamdani Model.	
	6.3	Brief Review of Applications of Fuzzy Logic to Speed Control of DC Motor, Train Break, and Washing Machine.	
		Total	**39**

Textbooks:	
1	S. N. Sivanandam and S. N. Deepa, Introduction to Soft Computing, Wiley India Publications, 3rd Edition.
2	Simon Haykin, Neural Networks and Learning Machines, Pearson Prentice Hall, 3rd Edition
3	S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI Learning Pvt. Ltd, 2003.
4	Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, Packt Publishing, 2018.
5	Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India Publications, 3rd Edition.
6	Ahmad M. Ibrahim, Introduction to Applied Fuzzy Electronics, PHI, 2004.
Reference Books:	
1	Hagan, Demuth, and Beale, Neural Network Design, Thomson Learning, 2nd Edition.
2	Simon Haykin, Neural Network- A Comprehensive Foundation, Pearson Education, 2nd Edition.
3	Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2005.
4	William W. Hsieh, Machine Learning Methods in the Environmental Sciences: Neural Network and Kernels, Cambridge University Press, 2009.

5	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
6	S. N. Sivanandam, S. Sumathi, and S. N. Deepa, Introduction to Neural Network using Matlab, Tata McGraw-Hill Publications, 2006.
7	Mehrotra Kishan, Mohan C. K. Ranka Sanjay, Elements of Artificial Neural Networks, Penram International Publishing Pvt. Ltd, 2nd Edition.
8	J. M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishers, 2006.
9	Bart Kosko, Neural Networks and Fuzzy Systems, Pearson Education, 2007.

Recommended NPTEL / Swayam Course and Online resources:	
1.	Course: Fuzzy Logic and Neural Networks by Prof. Dilip Kumar Pratihar, IIT Kharagpur
2.	Course: Neural Network and Applications by Prof. Somnath Sengupta, IIT Kharagpur
3.	Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015. http://neuralnetworksanddeeplearning.com/
List of Suggested Experiments to be conducted in IPMV Laboratory (ECL 603):	
1.	Classification of Non-linearly Separable Binary Pattern using Multilayer Perceptron Neural Network.
2.	Pattern Clustering using K-means Algorithm.
3.	Binary Pattern Restoration using Discrete Hopfield Neural Network.
4.	Image Classification using Support Vector Machine.
5.	Object Recognition using Convolutional Neural Network.
6.	Design Fuzzy Controller for Washing Machine

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End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6011	Mixed signal VLSI	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6011	Mixed signal VLSI	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO6011	Mixed signal VLSI	3

Prerequisite: Electronic Devices and Circuits , Digital System Design, Linear Integrated Circuits, Digital VLSI	
Course Objectives:	
1	To know importance of Mixed Signal VLSI design in the field of Electronics and Telecommunication and emerging technologies.
2	To understand various methodologies for analysis and design of fundamental CMOS analog and mixed signal Circuits.
3	To learn various issues associated with high performance Mixed Signal VLSI Circuits
4	To design, implement and verify various mixed signal VLSI circuits using open source tools like Ngspice and Magic
Course Outcomes:	
1	Know operation of the various building blocks of analog and mixed signal VLSI circuits.
2	Demonstrate the understanding of various building blocks and their use in design of analog and mixed signal circuits.
3	Derive expression for various performance measures of analog and mixed signal

	circuits in terms of parameters of various building blocks used to build the circuit.
4	Analyze and relate performance of analog and mixed signal VLSI circuits in terms of design parameters.
5	Evaluate and select appropriate circuit/configuration for given application.
6	Design analog and mixed signal VLSI circuits for given application.

Module		Content	Hrs
1		**Integrated Circuit Biasing Techniques**	**6**
	1.1	Active resistance, current source, current sink, simple current mirror, cascode current mirror	
	1.2	Current and voltage references, Band gap reference generator	
2		**Single Stage MOS Amplifiers**	**8**
	2.1	Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascade stage, simulation of CMOS amplifiers using SPICE	
	2.2	Single-ended operation, differential operation, basic differential pair, large-signal and small-signal behaviour, common-mode response, differential pair with MOS loads, simulation of differential amplifiers using SPICE	
3		**Noise in MOS Circuits**	**6**
	3.1	Noise spectrum, correlated and uncorrelated noise sources, thermal noise, flicker noise, shot noise	
	3.2	Representation of noise in circuits, noise in single stage CS, CD and CG amplifier	
	3.3	Noise in differential pairs, noise bandwidth	
4		**CMOS Operational Amplifier**	**5**
	4.1	Design of Current Mirror Load Differential Amplifier	
	4.2	Design of two stage Operational Transconductance Amplifier, OpAmp Compensation techniques	
5		**Data Converter Fundamentals**	**6**
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics	
	5.2	Mixed signal Layout issues, Floor planning, power supply and Ground issues, other interconnect Considerations	

6		**Data Converter Architectures**	**8**
	6.1	DAC architectures, digital input code, charge scaling DACs, Cyclic DAC, pipeline DAC	
	6.2	ADC architectures, flash, pipeline ADC, integrating ADC, and successive approximation ADC	
		Total	**39**

Textbooks:	
1	B. Razavi, **"***Design of Analog CMOS Integrated Circuits***"**, first edition, McGraw Hill, 2001.
2	P.E.Allen and D R Holberg, **"***CMOS Analog Circuit Design***"**, second edition, Oxford University Press, 2002.
3	R. Jacob Baker, "*CMOS Circuit Design, Layout and Simulation*", Wiley, 2nd Edition, 2013.
Reference Books:	
1	Adel S. Sedra, Kenneth C. Smith, A.N. Chandorkar, *"Microelectronics Circuits Theory and Applications"*, Fifth Edition, Oxford University Press.
2	Gray, Meyer, Lewis and Hurst **"***Analysis and design of Analog Integrated Circuits***"**, 4th Edition, Willey International, 2002.
3	Tony Chan Carusone, David Johns, Kenneth Martin, *"Analog Circuit Design"*, Second Edition, Wiley.
NPTEL course:	
https://nptel.ac.in/courses/117/101/117101105/	

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks
*For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.		

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6012	Computer Organization and Architecture	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6012	Computer Organization and Architecture	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO6012	Computer Organization and Architecture	3

Prerequisite: Digital System Design, Microcontrollers	
Course Objectives:	
1	To have a thorough understanding of the basic structure and operation of a digital computer.
2	To understand memory systems, processor organization and generation of control unit signals
3	To understand memory systems, processor organization and generation of control unit signals
4	To understand the working principles of multiprocessor and parallel organization's as advanced computer architectures.
Course Outcomes:	
1	Describe Computer system along with I/O operations and performance measures.
2	Demonstrate data representation and different arithmetic algorithm for solving ALU operations.
3	Categorize memory organization and identify the function of each element of memory hierarchy.

4	Demonstrate control unit operations.
5	Articulate design issues in the development of Multiprocessor organization & architecture

Module		Content	Hrs
1		**Computer Organization, Architecture and Performance**	**08**
	1.1	Organization and Architecture	
	1.2	Structure and Function	
	1.3	Designing for Performance	
	1.4	Two Laws that Provide Insight: Amdahl's Law and Little's Law	
	1.5	Basic Measures of Computer Performance	
2		**Computer System**	**06**
	2.1	Computer Components	
	2.2	Computer Function	
	2.3	Interconnection Structures	
	2.4	Bus Interconnection	
3		**Data Representation and Arithmetic Algorithm**	**05**
	3.1	Unsigned & Signed multiplication- Add & Shift Method, Booth's algorithm. Unsigned & Signed division, Restoring and non-restoring division.	
	3.2	Integer and floating point representation, IEEE 754 standard for floating point (Single & double precision) number representation.	
4		**Memory System Organization**	**07**
	4.1	Classification and design parameters, Memory Hierarchy ,Internal Memory: RAM, SRAM and DRAM	
	4.2	Cache Memory: Characteristics of Memory Systems, Cache Memory Principles, Elements of Cache, Cache Coherence. Design problems based on mapping	
	4.3	Virtual Memory, External Memory : Magnetic Discs, Solid State Drive, Optical Memory, Flash Memories, RAID Levels	
5		**Control Unit Design**	**06**
	5.1	Micro- Operations: The Fetch Cycle, The Indirect Cycle, The Interrupt Cycle, The Execute cycle, The Instruction Cycle	

	5.2	Control of the Processor: Functional Requirements, Control Signals, Internal Processor Organization	
	5.3	Hardwired Control Unit	
	5.4	Microinstructions Microprogrammed Control Unit, Advantages & disadvantages	
6		**Fundamentals of Advanced Computer Architecture**	**07**
	6.1	Supersclar Architecture	
	6.2	Hazards: Data Hazard, Control Hazard, Structural Hazard	
	6.3	Parallel Architecture: Classification of Parallel Systems	
	6.4	Flynn's Taxonomy, Array Processors, Clusters, and NUMA Computers	
		Total	**39**

Textbooks:	
1	T. L. Singal "wireless communications", Mc Graw Hill Education
2	Theodore S. Rappaport "wireless communications - principles and practice", PEARSON, Second edition.
3	Andreas F. Molisch "wireless communications" WILEY INDIA PVT LTD, Second edition.
Reference Books:	
1	Upena Dalal "Wireless and Mobile Communications‖", Oxford university Press
2	Vijay K.Garg "Wireless Communications and Networking",Morgan–Kaufmann series in Networking-Elsevier.
3	J. H. Reed, "Software-Defined Radio", Prentice-Hall, 2002
4	W. C. Y. Lee, "Mobile Communication", Wiley
5	David Tse, Pramod Viswanath "Fundamentals of Wireless Communication" published by Cambridge University Press

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4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6013	Digital Forensic	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6013	Digital Forensic	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO6013	Digital Forensic	3

Prerequisite: Computer Communication Networks	
Course Objectives:	
1	To understand cyber attacks and various categories of Cybercrime.
2	To discuss the need and process of digital forensics and Incident Response Methodology.
3	To explore the procedures for identification, preservation, and extraction of digital evidence.
4	To explore techniques and tools used in digital forensics for system investigation.
5	To discuss the investigation process of network and host based system intrusions.
6	To understand the laws related to Cybercrime.
Course Outcomes:	
1	Study the various cybercrimes and its prevention methods.
2	Discuss the phases of Digital Forensics and methodology to handle the computer security incident.

3	Understand the process of collection, analysis and recovery of the digital evidence.
4	Explore various tools to perform the investigation of the crime scenario.
5	Investigate the process of monitoring and analysis of computer network traffic for network investigation.
6	Discuss the legal issues associated with the cyber laws.

Module		Content	Hrs
1		**Introduction to Cybercrime and Hacking**	**4**
	1.1	Cybercrime, Categories of Cybercrime (Cybercrime against people, Cybercrime Against property, Cybercrime Against Government), Types of cybercrime (Violent- Cyber terrorism, Assault by Threat, Cyberstalking, Child Pornography, Non-violent - Cybertrespass, Cyber Theft, Cyberfraud, Destructive Cybercrimes), Computers' role in crimes	
	1.2	Hacking, Life cycle of Hacking, Types of Hackers (White Hat hackers, Black Hat hackers, Grey Hat hackers), Hacking techniques, Passive and Active Attacks, Social Engineering, Attacks vs Vulnerabilities, Prevention of Cybercrime	
		Self-learning topics: Distinction between computer crimes and conventional crimes.	
2		**Introduction to Digital Forensics**	**4**
	2.1	Objectives of digital forensics, Process of digital forensics, Types of digital forensics, Challenges faced by digital forensics	
	2.2	Introduction to Incident - Computer Security Incident, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident	
		Self-learning topics: Distinction between Computer virus, worm, Trojan horse and trap door	
3		**Digital Evidence and Forensics Duplication**	**10**
	3.1	Digital evidence, Admissibility of evidence, Challenges in evidence handling, collecting digital evidence, Preserving digital evidence, Documenting evidence	
	3.2	Necessity of forensic duplication, Forensic duplicates as admissible evidence, Forensic image formats, Forensic duplication techniques, Disk imaging, Analysis of forensic images using FTK Imager	
		Self-learning topics: Digital Evidence Investigation using Autopsy	

4		**System Investigation**	**8**
	4.1	Live/volatile data collection from Windows and Unix Systems	
	4.2	Investigating Windows systems, Investigating UNIX systems, Investigating applications, Web browsers, Email tracing	
	4.3	Recovering digital evidence, Acquiring, Analyzing and duplicating data: dd, dcfldd, foremost, scalpel	
		Self-learning topics: Methods of storing data (RAM and Hard disk)	
5		**Network and Mobile Forensics**	**7**
	5.1	Analyzing network traffic, collecting network based evidence, Evidence handling. Investigating routers	
	5.2	Mobile Forensic: Introduction, definition, process	
		Self-learning topics: Use of packet sniffing tools like Wireshark	
6		**Laws related to cyber crime**	**6**
	6.1	Constitutional law, Criminal law, Civil law, Levels of law: Local laws, State laws, Federal laws, International laws. Levels of culpability: Intent, Knowledge, Recklessness, Negligence. CFAA, DMCA, CAN Spam	
		Self-learning topics: Relevant law to combat computer crime – Information Technology Act	
		Total	**39**

Textbooks:	
1	Nilakshi Jain & Kalbande,"Digital Forensics", Wiley Publication, 1st edn,Kindle Edition
2	"Scene of the Cybercrime: Computer Forensics" Handbook 1st Edition, Kindle Edition
3	Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGrawHill, 2006
4	Nina Godbole, Sunit Belapure, "Cyber Security", Wiley Publication, 2011
Reference Books:	
1	Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, 2014

2	Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.
3	Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Suggested MOOCs for Self-Learning:	
1	Course on "Ethical Hacking" https://nptel.ac.in/courses/106/105/106105217/
2	Course on "Digital Forensics" https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3	Course on "Computer Forensics" https://www.edx.org/course/computer-forensics
4	Course on Cyber Incident Response https://www.coursera.org/learn/incident-response
5	Course on "Penetration Testing, Incident Responses and Forensics" https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6014	Database Management System	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6014	Database Management System	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO6014	Database Management System	3

Prerequisite: C Programming, Skill Lab :- C++ and Java Programming, Skill Lab :- Python Programming	
Course Objectives:	
1	Learn and practice data modeling using the entity-relationship and developing database designs
2	Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3	Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access
4	Understand the concept of database security and privacy
Course Outcomes: After successful completion of the course student will be able to:	
1	Describe the fundamentals of database systems, different data models and design issues in databases.
2	Understand the different types of data models.

3	Design ER diagram, relational schemas, apply concepts of normalization to relational database design.
4	Understand the basics of relational Algebra and calculus.
5	Implement views, triggers and querying the database using SQL.
6	Understand transaction management and concurrency control.

Module		Content	Hrs
1		**Introduction to Databases**	**5**
	1.1	Introduction to databases, History of database system, Benefits of Database system over traditional file system, relational databases, Three tier database architecture, Data independence	
2		**Data Models**	**10**
	2.1	Introduction, architecture, basic building blocks, overview, business rules and constraints of data models- Hierarchical, Network, Relational, Entity-Relationship, Object oriented model, Semi-structured model	
	2.2	Database design: ER-Model and its Constraints, ER-Diagrams, ERD Issues	
3		**CODD's rules and Unified Modeling Language**	**6**
	3.1	Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain	
4		**Relational Algebra and Calculus**	**8**
	4.1	Relational algebra: Introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics.	
	4.2	Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	
	4.3	Normalization methods : 1NF, 2NF, 3NF, BCNF, 4NF, 5NF	
5		**Constraints, Views and SQL**	**6**
	5.1	What is constraints, types of constraints, Integrity constraints	
	5.2	SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers	
	5.3	Views: Introduction to views, data independence, security, updates on	

		views, comparison between tables and views	
	5.4	** SQL Tools : MySQL, ORACLE 10G, POSTGRESQL	
6		**Transaction management and Concurrency control**	**4**
	6.1	Transaction management: ACID properties, serializability	
	6.2	Concurrency control: Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management, Shadow paging, deadlock handling	
		Total	**39**

Textbooks:	
1	A Silberschatz, H Korth, S Sudarshan, *"Database System and Concepts"*, McGraw-Hill, Fifth Edition
2	Rob, Coronel, *"Database Systems"*, Cengage Learning, Seventh Edition.
3	Ramez Elmasri, Shamkant B. Navathe, *"Fundamentals of Database System",* Person Seventh Edition,
4	G. K. Gupta, *"Database Management Systems"*, McGraw – Hill, First Edition, 2011
Reference Books:	
1	Peter Rob and Carlos Coronel, *"Database Systems Design, Implementation and Management"*, Thomson Learning, 5th Edition
2	P.S. Deshpande, *"SQL and PL/SQL for Oracle 11g, Black Book"*, Dreamtech Press, 2011
3	Mark L. Gillenson, Paulraj Ponniah, *"Introduction to Database Management"*, Wiley, First Edition, 2007
4	Raghu Ramkrishnan and Johannes Gehrke, *"Database Management Systems"*, TMH, Third Edition
5	Debabrata Sahoo *"Database Management Systems*", Tata McGraw Hill, Schaum's Outline
E-Resources:	
1	https://www.w3schools.in/dbms/
2	https://www.tutorialspoint.com/dbms/index.htm
3	https://www.studytonight.com/dbms/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6015	IoT and Industry 4.0	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6015	IoT and Industry 4.0	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO6015	IoT and Industry 4.0	3

Prerequisite:

Mini Project – 1 B
Microcontrollers
Skill based Lab Course
Mini Project 2A Embedded System Project

Course Objectives:	
1	To offer introduction to Internet of Things and industry 4.0 standard
2	To understand the design features of Internet of Things (IoT)
3	To understand concepts of data management and data analytics in IoT
4	To understand the concept and framework of industry 4.0 standard
5	To understand the application of IoT and Industry 4.0 standard.

Course Outcomes:	
1	Discuss case studies and use cases of IoT design.
2	Illustrate various protocols of web connectivity.

3	Understand and use tools for data management and analytics in IoT.
4	Explain various frameworks for industry 4.0 standards.
5	Prepare case studies on applications of IIOT.
6	Understand advanced concepts and applications of industry 4.0

Module	Content		Hrs.
1	**Introduction to IoT**		**04**
	1.1	Introduction - Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Sources of IoT, IoT and M2M - IoT/M2M System layers and Design standardization, Difference between IoT and M2M	
	1.2	Defining Specifications About - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, Application Development, Case Study	
2	**Data Models**		**08**
	2.1	Design Principles & Web Connectivity - Web Communication Protocols for connected devices, Web connectivity using Gateway, SOAP, REST, HTTP, RESTful and Web Sockets (Publish —Subscribe), MQTT, AMQP, CoAP Protocols	
	2.2	Internet Connectivity: - Internet connectivity, Internet based communication, IP addressing in IoT, Media Access Control, Application Layer Protocols. LPWAN Fundamentals: LORA, NBIoT, CAT LTE Ml, SIGFOX, Case Study	
3	**Data Management and Analytics for IoT**		**08**
	3.1	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, ApacheStorm, Using Apache Storm for Real-time Data Analysis	
	3.2	Analysis, Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study- Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator	
4	**Introduction to Industry 4.0**		**08**
	4.1	Industry 4.0: Managing the Digital Transformation, Conceptual framework for Industry 4.0, Industrial IoT (IIoT) - Introduction, Business Model and Reference Architecture, Industrial IoT Layers, Sensing, Processing, Communication.	
	4.2	Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality	

5	**Introduction to Industrial IoT (IIoT)**		**06**
	5.1	Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Facility Management.	
	5.2	Artificial Intelligence, Cybersecurity in Industry 4.0, Internet of Things for Industry 4.0 Design, Challenges and Solutions	
6	**Industry 4.0 Technologies and Applications**		**05**
	6.1	Internet of Things and New Value Proposition.: Examples for IoTs Value Creation in Different Industries., IoTs Value Creation Barriers: Standards, Security and Provacy Concerns	
	6.2	Introduction to Industry 5.0, Human Machine Interaction, cognitive computing with human intelligence, Case study on AI based solutions	
		TOTAL	**39**

Textbooks:	
1	ArshdeepBahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, Universities Press.
2	Raj Kamal, Internet of Things: Architecture and Design Principles”, McGraw Hill Education, First edition
3	Radha Shankarmani, M Vijayalakshmi,”Big Data Analytics”, Wiley Publications
4	Andrew Minteer,” Analytics for the Internet of Things(IoT)”,Kindle Edition
5	Giacomo Veneri, Antonio Capasso,” Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0”, Packt .
Reference Books:	
1	Alp Ustundag Emre Cevikcan,” Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing
2	G. R. Kanagachidambaresan, R. Anand, E. Balasubramanian, V. Mahima, Internet of Things for Industry 4.0. EAI/Springer Innovations in Communication and Computing
3	The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
4	The Internet of Things (MIT Press) by Samuel Greengard
5	Adrian McEwen, Hakim Cassimally,: Designing the Internet of Things”, Paperback, First Edition

Suggested reference material (research papers)	
1.	1. https://www.mdpi.com/2071-1050/11/16/4371/pdf - Industry 5.0—A Human-Centric Solution – MDPI (open access)
2.	2. https://www.researchgate.net/profile/Mary-DoyleKent/publication/336819748_Industry_50_Is_the_Manufacturing_Industry_on_the_Cusp _of_a_New_Revolution/links/5e84b810a6fdcca789e5ff75/Industry-50-Is-theManufacturing-Industry-on-the-Cusp-of-a-New-Revolution.pdf Industry 5.0: Is the Manufacturing Industry on the Cusp of a New Revolution?
Self-Learning: Recommended list of tools for self-learning 1. Node Red - https://nodered.org/ 2. M2MLabs Mainspring - http://www.m2mlabs.com/ 3. Tensor Flow - https://www.tensorflow.org/ 4. Things Speak - https://thingspeak.com/	

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:-

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECCDLO 6016	Radar Engineering	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO 6016	Radar Engineering	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO5016	Radar Engineering	3

Prerequisite: Principles of Communication Engineering	
Course Objectives:	
1	To interpret Radar equations
2	To explain different types of radar
3	To introduce RADAR transmitters and receivers for given conditions
4	To understand/ implement the plotting for given RADAR target
Course Outcomes:	
1	Explain generalized concept of RADAR.
2	Solve problems using radar equations.
3	Describe different types of radar for specific application.
4	Explain concept of tracking radar.
5	Plot the RADAR target from given specification.

Module	Content		Hrs.
1	**Introduction to Radar and Radar Equation**		**08**
	1.1	Basics Radar, Radar equation, Block Diagram, Radar Frequencies	
	1.2	Detection of signal in noise, Receiver Noise and Signal-to-noise Ratio	
	1.3	Probability of detection and false alarm: Simple, complex Targets, Pulse Repetition	
2	**MTI and Pulse Doppler Radar**		**08**
	2.1	Introduction to Doppler and MTI radar, Doppler frequency shift	
	2.2	Simple CW Doppler radar, MTI radar block diagram	
	2.3	Delay line canceler	
	2.4	Moving-target-detection	
	2.5	Pulse Doppler radar	
3	**Tracking Radar**		**06**
	3.1	Monopulse tracking	
	3.2	Conical scan and sequential lobbing	
	3.3	Limitation of tracking accuracy, Low angle tracking	
4	**Radar Transmitters and Receviers**		**06**
	4.1	Radar RF power sources: Klystron	
	4.2	Travelling wave tube	
	4.3	Magnetron	
	4.4	Radar Receiver: Superheterodyne Receiver	
5	**Radar Clutters and landing system**		**06**
	5.1	Types of clutter: surface clutter, sea clutter, land clutter	
	5.2	Instrument landing system	
	5.3	Ground controlled approach, Microwave landing system	
	5.4	Radar altimeter	
6	**General ideas on RADAR plotting**		**05**
	6.1	Radar plotting -general ideas	
	6.2	Relative plotting (passive derivations), Relative plotting (action taken by target)	
	6.3	Radar Display: Types of displays	
		TOTAL	**39**

Textbooks:	
1	Merill Skolnik,—Introduction to RADAR Systems, Tata McGrawHill, Third Edition
2	Merill Skolnik,—Radar Handbook, TataMcgrawHill, Second Edition
3	Dr. A. K. Sen, Dr. A. B. Bhattacharya- Radar Systems and Radio Aids to Navigation Khanna Publishers
Reference Books:	
1	Mark A.Richards, James A.Scheer, William A.Holm, —Principles of Modern Radar Basic Principals, Scitech Publishing.
2	Simon Kingsley, Shaun Quegon,—Understanding Radar Systems, ScientechPublishing Inc.
3	G.S. N.Raju, —Radar Engineering and Fundamentals of Navigational Aids‖, I. K International publishing House Pvt. Ltd.
4	Dr. Arjun Singh -Radar Systems and Radio Aids to Navigation, McGraw-Hill Education Private Limited
5	CAPT. H. SUBRAMANIAM- Shipborne Radar And Arpa Nutshell Series Book3
Online Resource:	
1.	**NPTEL online Course: https://nptel.ac.in/courses/108/105/108105154/**

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

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4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL601	Electromagnetics and Antenna Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL601	Electromagnetics and Antenna Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL601	Electromagnetics and Antenna Laboratory	**1**

Pre-requisite : Electromagnetics and Antenna Laboratory
1. Vector Calculus
2. Fundamental concepts of electricity and magnetism

Lab Objectives:

1	To study Maxwell's equation and its usefulness.
2	To study the radiation mechanism of an antenna and its various parameters.
3	To study the radiating principles of various Special types of Antennas.

Lab Outcomes:

1	To understand electromagnetic fields including both static and dynamic in terms of Maxwell's equations.
2	To understand the radiation mechanism of an antenna and its basic parameters like radiation pattern, directivity, gain etc.
3	To understand the radiation properties of Antenna Array and Special Antennas such as Yagi Uda Antenna, Horn Antenna, Reflector Antenna, Microstrip Antenna etc.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Sr. No.	**Name of the Experiment**
1	Introduction to Different types of Antennas
2	Simulate the Dipole Antenna using 4NEC2
3	Simulation of Friis Transmission Equation using Scilab
4	Plot the radiation pattern of $\lambda/2$ Dipole antenna.
5	Plot the radiation pattern of Loop antenna.
6	Plot radiation pattern of Yagi Uda Antenna
7	Simulation of Principle of Pattern Multiplication using Scilab
8	Simulation of Radiation Pattern of Linear Uniform Broadside and its array parameters
9	Simulation of Radiation Pattern of Endfire Array and its Array Parameters
10	Plot Radiation Pattern of Parabolic Reflector Antenna.
11	Plot Radiation Pattern of Horn Antenna.
12	Plot Radiation Pattern of Microstrip Antenna.
13	Mini Project on Design, Fabrication and Testing of Microstrip Antenna

Term Work:	
1	Term work should consist of 8 to 10 experiments.
2	Journal must include Mini Project / Extra Experiments/ Virtual Lab.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 10-marks, Attendance Theory & Practical: 05-marks, Miniproject: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL602	Computer Communication Networks Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL602	Computer Communication Networks Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL602	Computer Communication Networks Lab	1

Prerequisite:	
Lab Objectives:	
1	To introduce networking architecture and protocols.
2	To understand and recognize the layer-wise functions, services, data formats, protocols, hardware devices and addresses in the TCP/IP architecture.
3	To build an understanding of application layer protocols.
4	To apply different addressing and routing schemes.
Lab Outcomes:	
1	Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer‘s specific needs.
2	Perform configurations on routers and Ethernet switches.
3	Demonstrate knowledge of programming for network communications.
4	Simulate computer networks and analyze the simulation results.

5	Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model.
6	Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Suggested Experiments: Students are required to complete at least 8 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	To study basic networking commands. (Linux/Netkit)
2	To prepare a patch cable (straight-through, crossover, rollover) using UTP, RJ-45 and crimping tool. Test the cable using a cable tester and use it in LAN.
3*	To configure and compare different network topologies using Cisco Packet Tracer.
4 *	To study and compare network hardware components using Cisco Packet Tracer.
5*	To configure static routes in a network using Cisco Packet Tracer.
6*	To configure a network with Open shortest path first-OSPF using Cisco Packet Tracer and check the updated routing tables.
7	To configure a network with Path Vector Routing Protocol- BGP using Cisco Packet Tracer and check the updated routing tables..
8	To configure a network with Link state Routing Protocol- OSPF using Cisco Packet Tracer and check the updated routing tables.
9	To configure a network with Hybrid Routing Protocol- EIGRP using Cisco Packet Tracer and check the updated routing tables.
10	To perform subnetting using Cisco Packet Tracer/Netkit
11*	To configure DNS, DHCP, TELNET, FTP, SMTP server (any one) on Cisco Packet Tracer
12	To Simulate and study stop and Wait protocol using NS 2.35/ C++
13	To Simulate Sliding Window protocol using NS 2.35/C++
14 *	To Simulate and study the implementation of TCP/IP stack using wireshark (observe the protocols, data formats, header structures, addresses, payload sizes and encapsulation at each layer)
15*	To perform HDLC bit stuffing and de-stuffing using C++
16	To compare performance of ALOHA and Slotted ALOHA using Netsim.

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL603	Image Processing and Machine Vision Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL603	Image Processing and Machine Vision Lab	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECL603	Image Processing and Machine Vision Lab	**1**

Prerequisite: Python Programming Skill Lab	
Lab Objectives:	
1	To teach implementing basic theoretical concepts in Image Processing and Machine Vision using relevant software
2	To give an exposure to students to object recognition/ classification techniques in Machine Vision.
3	To facilitate students for understanding practical aspects of Image Processing and Machine Vision through an application.
Lab Outcomes:	
1	Perform enhancement of digital images in spatial and frequency domain
2	Perform edge detection and morphological operations on digital images
3	Classify patterns using standard Machine vision classification techniques like SVM
4	Apply theoretical knowledge in image processing and machine vision to practical case studies

Suggested Experiments: 1. Eight experiments covering the whole syllabus with proportional weightage to Image Processing and Machine Vision, to be set with predefined and concrete objective problem statement.
2. At least 5 programs to be conducted in python programming
3. At least 1 case study from suggested ones to be conducted in lab.
4. An attempt should be made to make experiments more meaningful, interesting and innovative.
5. Conduct three experiment based on application of Neural Network and Fuzzy logic for Image Processing.
.

Sr. No.	Name of the Experiment
1	Point Processing Methods - Negative, Log, Power law, Contrast stretching, Bit plane Slicing
2	Histogram calculation and equalization
3	Spatial Domain Filtering: 1. Smoothening filters 2. Sharpening with Laplacian 3. Unsharp masking & high boost filtering 4. Edge detection using 1 st and 2 nd order derivatives
4	Frequency Domain Filtering : Ideal, Butterworth and Gaussian
5	Morphological operation – Erosion, dilation, opening, closing, hit-miss transform, Boundary extraction
6	Image segmentation using global Thresholding Algorithm
7	Shape representation using chain code
8	Canny edge detection
9	Feature extraction using co-occurrence matrix
10	Classification using k-means algorithm
11	Classification using Basiyan classifier
12	Basic binary classification of any data or pattern using Support Vector Machine.
13	Case Study : 1. Face recognition 2. Finger print identification 3. License plate recognition

Term Work:	
1	Term work should consist of 8 to 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECL604	Skill Lab: Linux and Networking and Server Configuration	--	4	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL604	Skill Lab: Linux and Networking and Server Configuration	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECL604	Skill Laboratory: Linux & Networking & Server Configuration	2

Prerequisite: C-Programming	
Course Objectives:	
1	Install Linux and implement standard Linux commands
2	To write shell script programs to solve problems
3	Study basic theory of Linux Operating System
4	Implement the system administrative functionality
5	Study basic commands of networking
6	Develop implementation skill of different servers on Linux
Course Outcomes:	
1	Install Linux using a different platform and execute standard Linux commands.
2	Solve the problems using shell script programming

3	Describe the basic knowledge of Linux Operating System
4	Deploy the system administrative functionality
5	Develop network based applications
6	Apply the Linux commands using programming skill to deploy different servers like ftp, telnet etc.

Module		Content	Hrs
1		**Overview of Linux**	8
	1.1	Installing Software on Debian Based Linux: Debian, Ubuntu, Kali Linux/Red Hat Enterprise Linux (RHEL)/CentOS	
	1.2	Overview of Unix and Linux architectures, Linux files system, Linux standard directories, Linux Directory Structure, Basic Linux Commands, Viewing Files and the Nano Editor, Editing Files in Vi, Graphical Editors, Deleting, Copying, Moving, and Renaming Files	
2		**Shell programming**	12
	2.1	Basics of shell programming, various types of shell available in Linux, Shell programming in bash, Conditional statements, Looping statements, Case statements, Parameter passing and arguments	
	2.2	System shell variables, Shell variables, shell keywords, Creating Shell programs for automating system tasks, Scheduling repetitive jobs using cron.	
3		**Linux OS**	6
	3.1	Linux Design Principles, Linux Booting Process, Kernel Modules, Process Management, Scheduling, Memory Management, Input and Output, Inter-process Communication	
4		**System Administration**	8
	4.1	Common administrative tasks, Configuration and log files, Role of system administrator, Managing user accounts –adding, deleting users, Changing permissions and ownerships, Creating and managing groups, Modifying group attributes	
	4.2	Temporary disabling of users accounts, Creating and mounting file system, becoming super user using su, Getting system information with uname, host name. Disk partitions & sizes, users, kernel, installing and removing packages, rpm command.	
5		**Linux Networking**	8
	5.1	Linux Networking commands, Network Monitoring tools, TCP/IP Networking for Linux, TCP/IP Configuration address, Hostname Configuration.	

	5.2	Remote system administration with OpenSSH-server & Putty.	
6		**Servers and Configurations**	10
	6.1	Create and configure DHCP, Mail, DNS, FTP, Telnet, Squid, Apache & Telnet servers	
		Total	**52**

Textbooks:	
1	Yeswant Kanethkar, "UNIX Shell Programming", First edition, BPB, 2003
2	Cristopher Negus ,"Red Hat Linux Bible", Wiley Dreamtech India 2005 edition
3	Jason Cannon,"Linux for Beginners: An Introduction to the Linux Operating System and Command line". 2014 edition
4	W. Stevens , Stephen Rago , "Advanced Programming in the UNIX Environment", Addison Wesley Professional Computing Series, 2005 edition
5	Dayanand Ambawade, Deven N. Shah, " Linux Lab: Hands on Linux" Dreamtech press, 2013
Reference Books:	
1	Official Red hat Linux User Guide by Redhat, Dreamtech India
2	Graham Glass & King Ables, "UNIX for Programmers & Users", Third Edition, Pearson Education, 2003.
3	Neil Mathew & Richard Stones, "Beginning Linux Programming", Fourth Edition, Wiley Dreamtech India, 2004.
4	Richard Petersen, "Linux: The Complete Reference", Sixth Edition, 2007

Lab Work

Useful Links and Software Tools:	
1	Install Ubuntu desktop | Ubuntu
2	Chapter 4. Quick Installation Guide Red Hat Enterprise Linux 7 | Red Hat Customer Portal
3	Installation | Kali Linux Documentation
Online Repository:	
1	How to Install a DHCP Server in Ubuntu and Debian (tecmint.com)
2	How to Install and Configure Postfix as a Send-Only SMTP Server on Ubuntu 16.04 | DigitalOcean
3	Network - DHCP | Ubuntu

Suggested Experiments: At least 12 experiments covering the entire syllabus should be set to have well predefined inference and conclusion. Teachers should refer to the suggested experiments and can design additional experiments to maintain better understanding and quality. The experiments should be student centric as well as real time and attempts should be made to make experiments more meaningful, interesting and innovative.

Note: *Before performing practical necessary Theory will be taught by concern faculty*

Sr. No.	Name of the Experiment
1	Linux Installation process using following method CD-ROM, Network Installation or Kickstart Installation.
2	Basic commands to create users, change permission, software selection and installation and do changes in Grub file.
3	Study of essential commands.
4	Study experiment on configuration of Linux disk Management such as SWAP, LVM, RAID, Primary Partition, Extended Partition and Linux files system.
5	Write a shell script to show various system configuration like currently logged user and his logname, your current shell, home directory, operating system type, current path setting, current working directory, show currently logged number of users, show memory information, Hard disk information like size of hard-disk, cache memory, model etc, and file system mounted.
6	Write a shell script to add user and password on Linux system.
7	Write a shell script to print last login details.
8	Write a shell script to upgrade and cleans the system automatically instead of doing it manually.
9	Write a shell script to delete all log files present inside your var/log directory.
10	Write a script that accepts the hostname and IP address as command-line arguments and adds them to the /etc/hosts file.
11	Write a awk script to find the number of characters, words and lines in a file?
12	Write a shell script that delete all lines containing a specified word
13	Write a shell script to find the factorial of given integer
14	Configuration of DHCP Server and Client
15	Configuration of DNS Server with Domain Name.
16	Configuration of NFS File server and transfer files to a windows client.

17	Configuration of FTP server and transfer files to demonstrate the working of the same.
18	Configuration of Internet Server by creating a Proxy Server and configuring the browser to use as a proxy.
19	Configuration of Mail Server
20	Configuration of Web Server.

Term Work:	
1	Term work should consist of 12 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ECM601	Mini Project 2B FPGA based Project	--	4[$]	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)	Term Work	Pract & oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECM601	Mini Project 2B FPGA based Project	--	--	--	--	25	25	50

Course Code:	Course Title	Credit
ECM601	**Mini Project-2b : FPGA based project**	2

Prerequisite: Digital Design, Mini Project 1a: PCB design, Digital VLSI	
Course Objectives:	
1	To train students for FPGA based project implementation and management
2	To make students VLSI industry ready
3	To make students familiar with the Verilog Programming
4	To make students familiar with the targeted FPGA design and implementation
5	To familiarize students with the numerous FPGA solutions available in Market
6	To familiarize the students with the Interfacing of FPGA boards
Course Outcomes:	
1	Understand various FPGA families and method of FPGA synthesis and implementation and to learn the working of basic EDA tools like Xilinx, Modelsim cadence , etc
2	Able to program, simulate and synthesize circuits in Verilog HDL.
3	Learn the technique of interfacing of LED, switches and seven segment with FPGA.
4	Learn the project documentation, designing and handling techniques
5	Analysis of FPAG fault detection and verification principles

Module		Content	Hrs
1		**Introduction to FPGA and Synthesis**	**8**
	1.1	Compare FPGA, ASIC, SOC, Basic FPGA architecture, Compare various FPGA Boards**, Understanding VLSI Design flow	
	1.2	**Understanding Tools :** Functional simulation , Synthesis and implementation, Synthesis tool flow, Implementation and bit generation, making User constraint files (UCF) **Study Material** : https://www.xilinx.com/support/university/ise/ise-workshops/ise-fpgadesign-flow.html	
2		**Writing First program in Verilog**	**8**
	2.1	**Introduction to Verilog**: Module definition, port declaration, connecting ports, Writing first Testbench	
	2.2	**Exercise :** Program for All gates, Writing Test bench and UCF	
	2.3	**Study Material**: https://www.xilinx.com/support/university/ise/ise-teaching-material/hdldesign.html	
3		**Combinational design Using VERILOG**	**8**
	3.1	Gate Level Modelling, hierarchical name referencing, **Data Flow Modelling**: Continuous assignments, delay specification, expressions, operators, operands, operator types	
	3.2	**Exercise:** Programming and FPGA implementation of Adders, 4-bit adders, Mux and decoders, **Interfacing** LED, switches with FPGA	
	3.3	**Study Material :** https://onlinecourses.nptel.ac.in/noc20_cs63/preview	
4		**Sequential design Using VERILOG**	**8**
	4.1	**Behavioral Modelling :** Structured procedures, initial and always, blocking 'and nonblocking statements, delay control, event control, conditional statements, multi way branching, loops, sequential and parallel blocks **Advanced topics:** Tasks and Functions, generic programming with parameters.	
	4.2	**Exercise:** Programming and FPGA implementation of Counters FFs and Shift registers Interfacing Seven Segment Display, UART with FPGA	
5		**Project Outline**	**8**
	5.1	Clocked Synchronous State-Machine Analysis, State-Machine Structure, Output Logic, Characteristic Equations Analysis of State Machines with D Flip-Flops, Clocked Synchronous State-Machine Design, Designing State Machines Using State Diagrams, State Tables	

	5.2	**Project Design Steps**: Designing state diagram, block diagram of project, Selection of FPGA for project, Selection of synthesis and simulation tool.	
6		**Project Implementation and management**	**8**
	6.1	Git Repositories, Learning of Project management software's like CVS, SVN etc	
	6.2	Project Implementation: Verilog coding, simulation, Synthesis, Bit generation and downloading on FPGA. .	
	6.3	Result verification and testing	
		Total	**48**

Textbooks:	
1	Samir Palnitkar, "Verilog HDL A guide to Digital Design and Synthesis" , 2nd Edition, Pearson Education, 2009
2	Simon D Monk, "Programming FPGAs : Getting started with Verilog", 1st Edition, McGraw Hill Eduction2016
3	M. Morris Mano, Michael D. Ciletti , "Digital Design: With a Introduction to the Verilog Hdl", Pearson Prentice Hall, 2013
4	David Romano, "Make: FPGAs: Turning Software into Hardware with Eight Fun and Easy DIY", Shroff/Maker Media; First edition,2016
5	Frank Vahid, "Digital Design", Wiley India Private Limited; Preview edition, 2009
6	Behrooz Parhami ,"COMPUTER ARITHMETIC Algorithms and Hardware Designs", , Oxford University Press, 2010
7	Clive Maxfield ,"Design Warrior's Guide to FPGA", 2004, Elsevier

Useful Softwares:	
7.	****Suggested FPGA Hardware Boards:** 1. Numato FPGA boards - https://numato.com/shop/ 2. Papilio FPGA boards - http://store.gadgetfactory.net/fpga/ 3. CMOD s6 - https://store.digilentinc.com/cmod-s6-breadboardable-spartan-6-fpga-module/ 4. TinyFPGA - https://tinyfpga.com/ 5. Zync,Zed Board - https://www.xilinx.com/products/silicon-devices/soc/zynq-7000.html 6. Artix -7, Kinetex Boards - https://store.digilentinc.com/arty-a7-artix-7-fpga-development-board/

8.	**Suggested Software tools:** 1. Xilinx ISE Webpack 2. Modelsim/Questasim 3. Leonardo spectrum 4. MATLAB 5. Quartus 6. Actel 7. Icarus Verilog Simulator
Online repositories:	
1	https://www.sanfoundry.com/vlsi-questions-answers-aptitude-test/
2	Free Tool : https://www.edaplayground.com/
3	https://github.com/
NPTEL courses	
	1. NPTEL Verilog Programming - Free 2. Workshops -Xilinx University Program- Freely available

Term Work:	
1	**Guideline to maintain quality of mini project are as follows :** 1. To achieve proper selection of Mini Projects. Students should do survey of FPGA boards, tools and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/ internal committee of faculties. 2. Students shall submit implementation plan in the form of Smart Report/Gantt/PERT/CPM chart, which will cover weekly activity of mini project. 3. A log book to be prepared by each group, wherein group can record weekly work progress, guide/ supervisor can verify and record notes/comments. 4. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning. 5. The solution to be verified with standard tools and procedures and report to be compiled in standard format of University of Mumbai. 6. **Suggested steps for mini project selection and implementation** a Mini project should be completely FPGA based b Follow these steps i Take specification, using these specifications design project. ii Select proper FPGA considering features and requirements of project. Create UCF file iii Program it using Verilog and write test benches for verification of each module iv Test Functional Simulation and verify it using simulation tool v Synthesize, map and place and rout the design using synthesis tool vi Generate bit stream and download on FPGA vii Verify results on FPGA hardware/hardware setup made for project
2	**Project Topic selection and approval :-**

	1. The group may be of maximum **FOUR (04)** students. 2. Topic selection and approval by **2 Expert** faculty from department at the start of semester 3. **Log Book** to be prepared for each group to record the work progress in terms of milestones per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signature in it per week. The log book can be managed **online** with proper authenticationmethod using google sheets/forms or open source project management software. **Project Report Format:** 4. Report should not exceed **15 pages**. Simply staple it to discourage use of plastic. 5. The recommended report format is in LaTeX.
3	**<u>Term Work:</u>** 1. **Term Work evaluation and marking scheme:** a. The review/ progress monitoring committee shall be constituted by Head of Departments of each institute. b. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester. c. At end of semester the above 2 expert faculty who have approved the topic will internally **evaluate the performance**. d. Students have to give presentation and demonstration on the FPGA Based Mini Project- 2-B e. In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. Based upon it the marks will be awarded to student. f. **<u>Distribution of 25 Marks scheme</u> is as follows:** i. Marks awarded by guide/supervisor based on log book : 10 ii. Marks awarded by review committee : 10 iii. Quality of Project report : 05
4	**Guidelines for Assessment of Mini Project Practical/Oral Examination:** a Report should be prepared as per the guidelines issued by the University of Mumbai. b Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and **External Examiners preferably from industry or research organisations** having experience of more than five years approved by head of Institution. c Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
Continuous assessment exam	
	In continuous assessment focus shall be on 3. Each individual student, assessment based on individual's contribution in group activity. 4. Their understanding and response to questions.

Vivekanand Education Society's

Institute of Technology

Bachelor of Engineering (B.E.)

Department of Electronics and Telecommunication Engineering

(Semester – VII & VIII)

Program Structure for Final Year

Electronics & Telecommunication Engineering

Scheme for Autonomous Program Semester VII & VIII

(With Effect from 2023-2024)

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECC701	Microwave Engineering	3	--	3	--	--	3
ECC702	Mobile Communication System	3	--	3	--	--	3
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3
ECCDLO702X	Department Optional Course-4	3	--	3	--	--	3
ILO701X	Institute Level Optional Course-1	3	--	--	--	--	3
ECL701	Microwave Engineering Laboratory	--	2*	--	1	--	1
ECL702	Mobile Communication System Laboratory	--	2*	--	1	--	1
ECP701	Major Project-I*	--	6$	--	3	--	3
Total		12	10	12	7	--	19

*Should be conducted batch wise $ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC701	Microwave Engineering	20	20	60	2	--	--	100
ECC702	Mobile Communication System	20	20	60	2	--	--	100
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100
ECCDLO702X	Department Optional Course-4	20	20	60	2	--	--	100
ILO701X	Institute Level Optional Course-1	20	20	60	2	--	--	100
ECL701	Microwave Engineering Laboratory	--	--	--	--	25	25	50
ECL702	Mobile Communication System Laboratory	--	--	--	--	25	25	50
ECP701	Major Project-I	--	--	--	--	50	100	150
Total		100	100	300	--	100	150	750

Department Level Optional Course-3

Course Code	Course Name
ECCDLO 7011	Efficient Architectures for DSP Algorithms
ECCDLO 7012	Deep Learning
ECCDLO 7013	Cloud Computing and Security
ECCDLO 7014	Big Data Analytics
ECCDLO 7015	Software Defined Radio

Department Level Optional Course-4

Course Code	Course Name
ECCDLO 7021	Robotics
ECCDLO 7022	5G Technology
ECCDLO 7023	Internet Communication Engineering
ECCDLO 7024	Advanced Digital Signal Processing
ECCDLO 7025	Quantum Computing

Institute Level Optional Course-1

Course Code	Course Name
ILO 7011	Product Lifecycle Management
ILO 7012	Reliability Engineering
ILO 7013	Management Information System
ILO 7014	Design of Experiments
ILO 7015	Operation Research
ILO 7016	Cyber Security and Laws
ILO 7017	Disaster Management and Mitigation Measures
ILO 7018	Energy Audit and Management
ILO 7019	Development Engineering

Program Structure for Final Year

Electronics & Telecommunication Engineering

Scheme for Autonomous Program Semester VII & VIII

(With Effect from 2023-2024)

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECC801	Optical Communication and Networks	3	--	3	--	--	3
ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3
ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3
ILO801X	Institute Level Optional Course-2	3	--	3	--	--	3
ECL801	Optical Communication and Networks Laboratory	--	2*	--	1	--	1
ECP801	Major Project-II	--	12$	--	6	--	6
Total		12	14	12	7	--	19

*Should be conducted batch wise $ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC801	Optical Communication and Networks	20	20	60	2	--	--	100
ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100
ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100
ILO801X	Institute Level Optional Course-2	20	20	60	2	--	--	100
ECL801	Optical Communication and Networks Laboratory	--	--	--	--	25	25	50
ECP801	Major Project-II	--	--	--	--	50	100	150
Total		--	--	240	--	75	125	600

Department Level Optional Course-5

	Course Name
ECCDLO 8011	System On Chip Design
ECCDLO 8012	Natural Language Processing
ECCDLO 8013	Wireless Networks
ECCDLO 8014	Web Design
ECCDLO 8015	RF Design

Department Level Optional Course-6

Course Code	Course Name
ECCDLO 8021	Autonomous Vehicle
ECCDLO 8022	Satellite and Nano Satellite Communication
ECCDLO 8023	Network Management in Telecommunication
ECCDLO 8024	Microstrip Antenna
ECCDLO 8025	Augmented Reality and Virtual Reality

Institute Level Optional Course-1

Course Code	Course Name
ILO 8011	Project Management
ILO 8012	Finance Management
ILO 8013	Entrepreneurship Development and Management
ILO 8014	Human Resource Management
ILO 8015	Professional Ethics and CSR
ILO 8016	Research Methodology
ILO 8017	IPR and Patenting
ILO 8018	Digital Business Management
ILO 8019	Environmental Management

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECC701	Microwave Engineering	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration(in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC701	Microwave Engineering	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC701	Microwave Engineering	3

Prerequisite: Knowledge of Electromagnetic Engineering

Course Objectives:

1	Perceive the concepts of waveguides and analyze the field components in different types of Waveguides.
2	Categorize different types of microwave components based on their applications.
3	Imbibe knowledge to use microwave oscillators & amplifiers in microwave communication and compare their characteristics.
4	Demonstrate the ability to measure different microwave parameters using microwave bench setup.

Course Outcomes:

1	Describe the types of waveguides, rectangular waveguides and field equations.
2	Understand the coupling mechanisms in waveguides and analyze the waveguide multiport junctions.
3	Explore the microwave linear tubes and analyze with microwave cross field tubes.

4	Understand the microwave solid state devices and avalanche transit time devices.
5	Demonstrate the microwave bench set up and conducting measurements of different parameters.

Module		Content	Hrs
1		**TRANSMISSION LINES**	**06**
	1.1	Transmission line equations, open and short circuit transmission lines, variation of impedance over length of line, Smith chart, use of Smith chart in impedance matching	
	1.2	Planar transmission lines: microstrip line, strip line and coplanar lines	
2		**WAVEGUIDES**	**07**
	2.1	Introduction, microwave spectrum and bands, applications of microwaves, Types of waveguides, rectangular waveguides, field equations in rectangular waveguide, field components of TM and TE waves for rectangular waveguide, modes of TM and TE waves in rectangular waveguide, impossibility of TEM waves, cut off frequency of rectangular waveguide, Wave impedance in rectangular waveguide: Wave impedance for a TM and TE wave in rectangular waveguide, Dominant mode and degenerate modes, mode characteristics of phase velocity, group velocity, wavelength and impedance relations; Illustrative problems	
	2.2	Cavity resonators: Types of cavity resonators; Rectangular cavity resonator: Dominant modes and resonant frequencies, illustrative problems.	
3		**WAVEGUIDE COMPONENTS**	**06**
	3.1	Coupling mechanisms: Probe, loop, coupling to a cavity resonator, waveguide discontinuities, waveguide irises, tuning screws and posts, matched loads; Waveguide attenuators; Waveguide phase shifters; waveguide	
	3.2	multiport junctions: E plane Tee, H plane Tee, Magic Tee, applications of Magic Tee, hybrid ring; Ferrites, Faraday rotation principle, gyrator, isolator, circulator	
4		**MICROWAVE TUBES**	**10**
	4.1	Microwave linear beam tubes (O type): Limitations of conventional tubes at microwave frequencies; Klystron: Velocity modulation process, bunching process, output power and beam loading; Multicavity Klystron amplifiers: Beam current density, output current and output power of	

		two cavity Klystron; Reflex Klystron: Velocity modulation, power output and efficiency.	
	4.2	Helix Traveling Wave tube: Slow wave structures, amplification process, conventional current, Microwave cross field tubes (M type): Introduction, cr.oss-field effects; Magnetrons: Different types, 8-cavity cylindrical travelling wave Magnetron, Hull cut-off and Hartree conditions, modes of resonance and PI-mode operation	
5		**MICROWAVE SEMICONDUCTOR DEVICES**	**06**
	5.1	Microwave solid-state devices: Microwave tunnel diode; Pin diodes, varactor diodes, crystal detectors. Transferred electron devices Gunn-effect diodes, RWH theory, modes of operations, Avalanche transit time devices: IMPATT diode, TRAPATT diode, BARITT diode,	
6		**MICROWAVE MEASUREMNETS**	**04**
	6.1	Description of microwave bench: Different blocks and their features, precautions; Microwave power measurement Bolometers; Measurement of attenuation; Frequency standing wave measurements: measurement of low and high VSWR; Cavity Q; Impedance measurements.	
		Total	**39**

Textbooks:

1	Samuel Y. Liao, —Microwave Devices and Circuits, Pearson, 3rd Edition, 2003.
2	Peter A. Rizzi, —Microwave Engineering Passive Circuits, PHI, 3rd Edition, 1999
3	M.L. Sisodia, G.S.Raghuvanshi, —Microwave Circuits and Passive Devices, Wiley Eastern Ltd., New Age International Publishers Ltd, 1stEdition, 1995.

Reference Books:

1	R.E. Collin —Foundations for Microwave Engineering, IEEE Press, John Wiley

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECC702	Mobile Communication System	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC702	Mobile Communication System	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC702	Mobile Communication System	3

Prerequisite: Principles of Communication Engineering, Digital Communication, Computer Communication and Networks

Course Objectives:

1	To understand the cellular fundamentals and different types of radio propagation models.
2	To study evolution of 2G and 3G mobile technologies.
3	To illustrate the working principle of LTE
4	To learn the concepts of emerging technologies for 4 G standards and beyond

Course Outcomes:

1	Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.
2	Classify different types of propagation models and analyse the link budget.
3	Compare and contrast GSM, GPRS, HSCSD, EDGE and IS-95 Technologies.

4	Apply the concepts of 3G technologies for UMTS and CDMA 2000.
5	Describe the features and working principle of 3GPP LTE
6	Discuss the emerging technologies for upcoming mobile communication systems

Module		**Content**	**Hrs**
1		**Fundamentals of Mobile Communications**	**07**
	1.1	The Cellular Concept System Design Fundamentals: Evolution of Cellular Technology, Frequency Reuse, Channel assignment Strategies, Handoff, Interference and system Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems and related problems	
	1.2	Features of all conventional multiple access Techniques: Frequency Division Multiple access, Time Division Multiple access, Spread Spectrum Multiple access (SSMA), Space Division Multiple access (SDMA), and Orthogonal Frequency Division Multiple Access (OFDMA), OFDM-PAPR	
2		**Mobile Radio Propagation**	**08**
	2.1	Large scale fading: Introduction to radio wave propagation, Free space Propagation model, Basic propagation mechanisms: reflection (Ground Refection (two- ray) Model), diffraction (Knife edge and multiple Knife edge Diffraction Model), scattering (Radar Cross Section Model), Practical Link budget design using path loss models and related problems.	
	2.2	Outdoor Propagation Model: Longley Rice Model, Durkin's Model Indoor Propagation Model: Partition losses (same floor and between floors), Ericsson Multiple Breakpoint Model	
	2.3	Small scale fading: small Scale multipath Propagation, parameter of multi-path channels, types of small-scale fading, Rayleigh and Ricean distributions.	
3		**2G Technologies**	**08**
	3.1	Global System for Mobile Communication (GSM): GSM Network architecture, air interface specifications, GSM signalling protocol architecture, identifiers, GSM channels, GSM Multiframe structure, authentication and security in GSM, handoff procedures in GSM	
	3.2	GSM evolution: GPRS, HSCSD and EDGE Architecture, radio specifications	
	3.3	IS-95 : CDMA Air interface, CDMA channels, power control in CDMA system handoff, and RAKE receiver	
4		**3G Technologies**	

	4.1	Universal Mobile Telecommunication System (UMTS): Objective, standardization and releases, network architecture, air interface specifications, channels, security procedure, W-CDMA air interface, attributes of W-CDMA system, Overview of W-CDMA channels	**06**
	4.2	cdma2000 cellular technologies: Forward and Reverse channels, Handoff and Power control	
5		**Long Term Evolution**	**05**
	5.1	Introduction, System Overview: Frequency bands and spectrum flexibility, network structure, protocol structure	
	5.2	Physical Layer: Frames, Slots and Symbols, modulation, Coding, Power control and handover.	
6		**Advanced Techniques for 4G Deployment and beyond**	**05**
	6.1	Multi-antenna Techniques: Smart antennas, Multiple input Multiple Output systems.	
	6.2	Cognitive Radio: Architecture, Spectrum sensing Software Defined Radio (SDR): Components and Applications	
	6.3	Introduction to 5G network and technologies used in 5G such as small cell concept, Massive MIMO, Beamforming, NOMA and mm wave.	
		Total	**39**

Textbooks:

1	T. L. Singal “wireless communications”, Mc Graw Hill Education.
2	Theodore S. Rappaport “wireless communications - principles and practice”, PEARSON, Second edition.
3	Andreas F. Molisch “wireless communications” WILEY INDIA PVT LTD, Second edition.

Reference Books:

1	Upena Dalal “Wireless and Mobile Communication”, Oxford university Press
2	Vijay K. Garg “Wireless Communications and Networking”, Morgan–Kaufmann series in Networking-Elsevier.

3	J. H. Reed, Software-Defined Radio, Prentice-Hall, 2002
4	W. C. Y. Lee, Mobile Communication, Wiley
5	David Tse, Pramod Viswanath "Fundamentals of Wireless Communication" published by Cambridge University Press

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7011	Efficient Architectures for DSP Algorithms	3

Prerequisite: Digital VLSI, Digital System Design, Signal and systems, Discrete Time signal Processing, Mini Project 2B: FPGA project Design

Course Objectives:

1	To describe the characteristics of computationally intensive algorithms
2	To identify the bottlenecks of intensive computations.
3	To learn various techniques to map DSP algorithms on hardware to improve performance.

Course Outcomes:

1	Explain various typical DSP algorithms and their applications
2	Describe various methodologies/techniques to map DSP algorithms on Hardware
3	Analyze various hardware architectures available to implementation DSP algorithms
4	Evaluate and select efficient hardware architecture for implementation of given DSP algorithm.

5	Design/propose hardware architecture for effective implementation of given DSP algorithm.

Module		Content	Hrs
1		**Introduction to DSP Systems**	**6**
	1.1	Typical DSP Algorithms, Graphical representation of DSP Algorithms.	
	1.2	Signal flow graph (SFG), data flow graph (DFG) and dependence graph (DG), high level transformation, critical path.	
2		**Efficient Algorithm to Architecture Mapping**	**7**
	2.1	Design of N-bit incrementer, decrementer, complimenter	
	2.2	Techniques to enhance circuit performance, pipelining and parallel processing, circuit design for N bit natural numbers, optimized circuit design for different functions	
3		**Efficient Adder Architecture**	**7**
	3.1	Introduction to Adder design, Variable Block Adder circuit design, Delay optimized Carry Look Ahead Adder	
	3.2	Carry Select Sum Adder, Conditional Sum Adder, Ling's Adder	
	3.3	Prefix and Parallel prefix adders, Running Average Circuit	
4		**Efficient Multiplier and divider Design**	**7**
	4.1	Array Multiplier, Signed and Unsigned Multiplier, Booths Multiplier, Bough-Wooley Multiplier.	
	4.2	Architecture of Squaring Circuit, Reconfigurable Constant Multiplier Design.	
	4.3	Shift/Subtract division algorithm, Programmed Division, Radix-2 SRT division.	
5		**DSP Architecture Design**	**6**
	5.1	Floating point representation IEE754, floating point operations-2's compliment representation, adder, subtractor, multiplier	
	5.2	CORDIC Architecture, FFT Architecture, FIR filter	
6		**Efficient Design of Machine Learning Hardware** Cyber Security and Laws	6

	6.1	Artificial Intelligence and Machine Learning,	
	6.2	Software and Co-design Optimizations, Pruning, Systolic array convolution	
		Total	**39**

Textbooks:	
1	VLSI Digital Signal Processing Systems Design and Implementation – Khesab Parhi
2	Computer arithmetic Algorithms and Hardware Designs-Behrooz Parhami
3	Machine Learning in VLSI-Ibrahim (Abe) M. Elfadel, Duane S. Boning, Xin Li Computer-Aided Design
Reference Books:	
1	Bill Franks, —Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley
2	Chuck Lam, —Hadoop in Action‖, Dreamtech Press
NPTEL course	
	https://nptel.ac.in/courses/108105118 https://nptel.ac.in/courses/108106149 https://nptel.ac.in/courses/108105157

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

ourse Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7012	Deep Learning	3

Prerequisite:

Artificial Neural Networks and Fuzzy logic

Course Objectives:

1	Learn how to use TensorFlow for building and testing Deep Learning models
2	Compare various CNN architectures
3	Know the importance of Regularisation and Optimization techniques in Deep Learning networks
4	Learn Deep Learning models for working with sequential data
5	Understand motivation and functioning of the most common types of Autoencoders and apply such mechanisms to various learning problems.

Course Outcomes:

1	Understand the fundamentals of Deep Learning
2	Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
3	Improve deep learning models using Regularization and Optimization techniques
4	Compare the Convolution Neural Network architectures and use them as per the application
5	Design and implement Sequence Neural Network systems and solve real-world problems
6	Illustrate the working of Autoencoders and use them for real-life applications

Module no.	**Unit no.**	**Topics**	**Hrs.**
1.0	**Introduction to Deep Learning**		**03**
	1.1	History of Deep Learning- A Probabilistic Theory of Deep Learning	
	1.2	Introduction to Deep Feedforward Networks, Gradient Based Learning, Hidden Units	
	1.3	Architecture Design, Backpropagation Algorithm	
2.0	**TensorFlow for Deep learning**		**06**
	2.1	Introduction to TensorFlow using Python: Computational Graph, Key Highlights, Creating a Graph	
	2.2	Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras	
	2.3	Preprocessing and Data Augmentation of Images and Datasets using TensorFlow	
3.0	**Regularization and Optimization Techniques**		**06**
	3.1	Regularization: Need of Regularization, L2 Regularization, L1 Regularization, Early Stopping and Dropout	
	3.2	Optimization: Challenges in NN Optimization, Gradient Descent Approaches, Parameter Initialization Approach, Adaptive Approaches - AdaGrad, RMSProp and Adam	

	3.3	Introduction to Batch Normalization	
4.0	**Evolution of CNN in Deep Learning**		**08**
	4.1	Review of CNN Architecture, Introduction of various CNN Architectures: LeNet, AlexNet, VGG, GoogleNet, ResNet and UNet	
	4.2	Comparison of CNN Architectures, Evaluation Parameters	
	4.3	Applications of CNN in Image Classification and Object Detection	
5.0	**Sequence Modeling**		**08**
	5.1	Recurrent and Recursive Nets: Recurrent Neural Networks, Bidirectional RNN, Encoder Decoder Architectures	
	5.2	Introduction to Long Short-Term Memory (LSTM) and Temporal Dependencies	
	5.3	Gated Recurrent Units (GRUs)	
	5.4	Applications of RNN in Real World- Image Captioning and Time Series Forecasting and Prediction	
6.0	**Encoder Decoder Models**		**08**
	6.1	Autoencoder: Encoder-Decoder Model, Training & Learning Manifold Space	
	6.2	Regularized Autoencoders: Sparse, De-noising and Contractive	
	6.3	Deep Autoencoder: Architecture and Working	
	6.4	Variational Autoencoders: Limitations of Autoencoders, Loss Function, Reparameterization Trick, Latent Space Visualization	
	6.5	Applications of Autoencoders and Variational Autoencoders- Dimensionality Reduction, Image De-noising and Compression	
		TOTAL	**39**
Self-learning Topics*:** Deep learning applications in Object Localization, Video Classification, Content based Image Retrieval, Recommender System, End-to-End Speech Recognition and Machine Translation *** No questions to be asked in exams			
Textbooks:			

1	Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing, 2018.
2	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
Reference Books:	
1	Christopher M. Bishop, Pattern Recognition and Machine Learning, SpringerVerlag, 2006.
2	Duda, Richard, Peter Hart, and David Stork, Pattern Classification, 2 nd edition, Wiley-Interscience, 2000.
3	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
4	Reza Zadeh, Bharath Ramsundar, TensorFlow for Deep Learning, 1st edition, O'Reilly Media Inc, 2018.
5	Zaccone, Giancarlo, Deep Learning with TensorFlow, 2 nd edition, Packt Publishing, 2018.
NPTEL / Swayam Courses:	
1	NPTEL course on Deep learning by Prof. Sudarshan Iyengar, IIT Ropar. https://nptel.ac.in/courses/106/106/106106184/
2	NPTEL course on Deep learning by Prof. Prabir Kumar Biswas, IIT Kharagpur. https://nptel.ac.in/courses/106/105/106105215/
3	NPTEL Course on Practical Machine Learning with TensorFlow by Prof. Balaraman Ravindran, IIT Chennai. https://nptel.ac.in/courses/106/106/106106213/
Online Courses	
1	https://www.tensorflow.org/tutorials/images/data_augmentation

2	https://towardsai.net/p/machine-learning/improving-artificial-neural-networkwith-regularization-and-optimization
3	https://towardsdatascience.com/regularization-techniques-for-neural-networkse55f295f2866
4	https://www.kaggle.com/sid321axn/regularization-techniques-in-deep-learning
5	https://medium.com/@minions.k/optimization-techniques-popularly-used-indeep-learning-3c219ec8e0cc
6	https://www.jeremyjordan.me/variational-autoencoders

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

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2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
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4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO7013	Cloud Computing and Security	3

Prerequisite: Computer Communication Network, Data Compression & Cryptography, Database Management System

Course Objectives:

1	Understand the fundamentals of cloud computing.
2	Appreciate the importance of virtualization in cloud computing
3	Understand various cloud computing services and platforms
4	Understand application design concepts in cloud
5	Understand the security aspects of cloud computing
6	Understand the advances in cloud computing

Course Outcomes: After successful completion of course student will be able to;

1	Explain the fundamentals of cloud computing.

2	Interpret the significance of virtualization in the context of cloud computing and understanding the significance of docker
3	Describe cloud computing services working on AWS, Azure and Google cloud platforms
4	Explain application design aspects of cloud computing.
5	Interpret security aspects to cloud computing.
6	Explain advances in cloud computing in terms of multimedia cloud, fog, edge computing and real applications of cloud.

Module		**Content**	**Hrs**
1		**Introduction to Cloud**	**04**
	1.1	Introduction to Cloud Computing, Cloud Characteristics, Cloud Computing Components, Comparing of Cloud Computing with Peer to Peer architecture, Client Server, Distributed, Grid, Cloud Deployment model (Cloud types- Public, Private, Community, Hybrid), Service Models-(IaaS, PaaS, SaaS,)	
2		**Virtualization**	**07**
	2.1	Introduction and need of Virtualization, Implementation levels of Virtualization-design requirements and providers	
	2.2	Virtualization structure -Hosted & Bare metal structure, KVM, Xen Hypervisor	
	2.3	Types of virtualizations- Full Virtualization & Paravirtualization, Virtualization of CPU, Memory and I/O Devices	
	2.4	Docker- Introduction to docker, Docker & Containers, Containers vs Hypervisors, Listing of docker image	
3		**Cloud Computing Services**	
	3.1	Compute Services - Amazon Elastic Compute Cloud, Google Compute Engine, Windows Azure Virtual Machines Storage Services - Amazon Simple Storage Service, Google Cloud Storage, Windows Azure Storage Database Services - Amazon Relational Data Store, Amazon DynamoDB, Google Cloud SQL, Google Cloud Datastore, Windows Azure SQL Database, Windows Azure Table Service Application Services - Application Runtimes & Frameworks, Queuing Services, Email Services, Notification Services, Media Services Anything as a service or Everything as a service (XaaS)	**10**

	3.2	Content Delivery Services - Amazon CloudFront, Windows Azure Content Delivery Network Analytics Services - Amazon Elastic MapReduce, Google MapReduce Service, Google BigQuery, Windows Azure HDInsight Deployment & Management Services - Amazon Elastic Beanstalk, Amazon CloudFormation	
4		**Cloud Application Design**	**06**
	4.1	Design Considerations for Cloud Applications - Scalability, Reliability & Availability, Security, Maintenance & Upgradation, Performance	
	4.2	Cloud Application Design Methodologies - Service Oriented Architecture, Cloud Component Model, IaaS, PaaS and SaaS services for cloud applications, Model View Controller, RESTful Web Services, Data Storage Approaches- Relational (SQL) Approach, Non-Relational (No-SQL) Approach	
5		**Cloud Security**	**06**
	5.1	Security for Virtualization Platform – Host security for SaaS, PaaS and IaaS – Data Security – Data Security Concerns – Data Confidentiality and Encryption – Data Availability –Data Integrity – Cloud Storage Gateways – Cloud Firewall	
	5.2	AAA Administration for Clouds -AAA model – SSO for Clouds – Authentication management and Authorization management in clouds – Accounting for Clouds Resource utilization.	
6		**Cloud Computing Applications**	**06**
	6.1	Cloud Computing for Health care, Education, Transportation, Manufacturing Industry, Energy System, Mobile Computing	
	6.2	Multimedia Cloud - Introduction, Streaming Protocols - RTMP Streaming, HTTP Live Streaming, HTTP Dynamic Streaming	
	6.3	Case Studies - Live Video Streaming App , Video Transcoding App, Edge Computing, FOG Computing	
		Total	**39**

Textbooks:	
1	Arshdeep Bahga and Vijay K. Madisetti, “Cloud Computing - A Hands-on Approach”
2	Rajkumar Buyya , Christian Vecchiola , S.Thamarai Selvi, “Mastering Cloud Computing: Foundations and Applications Programming” , Publisher: Morgan Kaufmann
3	Bernard Golden, “Amazon Web Services For Dummies (For Dummies Series)”, Paperback, Publisher: John Wiley & Sons
4	Douglas E. Comer, “The Cloud Computing Book: The Future of Computing Explained”.
5	Judith Hurwitz Daniel Kirsch, “Cloud Computing for Dummies”.
6	James Turnbull, "The Docker Book"
Reference Books:	
1	Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, “Cloud Computing Black Book”, Kogent Learning Solutions , Publisher : Dreamtech Press
2	Cloud Computing Concepts Technology and Architecture - Erl second hand book online from UsedBooksFactory
3	Chris Dotson, “Practical Cloud Security”, Publisher(s): O'Reilly Media, Inc. ISBN: 9781492037514
4	AWS Whitepapers & Guides https://aws.amazon.com/whitepapers/
5	Azure whitepapers https://azure.microsoft.com/en-in/resources/whitepapers/
6	Google Cloud whitepapers https://cloud.google.com/whitepapers
7	Adrian Mouat, "Using Docker-Developing & Deploying Software with Containers"

Internal Assessment:

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO7014	Big Data Analytics	3

Prerequisite: Basic knowledge of Database Management System

Course Objectives:

1	To Provide an Overview of an exciting growing field of Big Data Analytics.
2	To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
3	To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

Course Outcomes:

1	Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2	Acquire fundamental enabling techniques and scalable algorithms like Hadoop, MapReduce and NoSQL in big data analytics.

3	Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4	Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
5	Develop applications for Big Data analysis using Hadoop and NoSQL etc.

Module no.	Unit no.	Topics	Hrs.
1.0	**Introduction to Big Data Analytics**		**03**
	1.1	Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data a business approach	
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.	
2.0	**Hadoop**		**05**
	2.1	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem- Apache HBase, Hive, HCatalog, Pig, Mahout, Oozie, Zookeeper, Sqoop, Physical Architecture, Hadoop limitations.	
3.0	**NoSQL**		**06**
	3.1	Introduction to NoSQL, NoSQL business drivers, NoSQL database case studies.	
	3.2	NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns	
	3.3.	Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems Managing MongoDB database with CRUD operations.	
4.0	**MapReduce**		**06**
	4.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.	

	4.2	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures	
	4.3	Algorithms Using MapReduce: MapReduce Wordcount Program, Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce.	
5.0	**Techniques in Big Data Analytics**		**13**
	5.1	Finding Similar Item: Nearest Neighbour Search, Similarity of Documents, Distance Measures: Euclidean, Jaccard , Cosine , Edit and Hamming Distance with its Examples	
	5.2	Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis Filtering streams: The Blooms filter.	
	5.3	Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce	
	5.4	Frequent Itemset Mining: Market-Basket Model, Apriori Algorithm, Algorithm of Park- Chen-Yu	
6.0	**Big Data Analytics Applications**		**06**
	6.1	Recommendation Systems: Introduction, A Model for Recommendation Systems: Collaborative-Filtering System, Content based system and its Examples.	
	6.2	Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Networks. Clustering of Social Graphs: Applying Standard Clustering Techniques, counting triangles using MapReduce.	
		TOTAL	**39**

Textbooks:

1	Radha Shankarmani and M Vijayalakshmi —Big Data Analytics, Wiley, 2019
2	Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press, 2014

3	Dan McCreary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us,Manning Press, 2013
Reference Books:	
1	Bill Franks, —Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytic, Wiley, 2012
2	Chuck Lam, —Hadoop in Actio, Dreamtech Press, 2011
E-Resources:	
1	https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified
2	https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
3	https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html
4	https://www.pdfdrive.com/data-science-and-big-data-analytics-e58447171.html

Internal Assessment:

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-3	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7015	Software Defined Radio	3

Prerequisite:
Computer Communication and Networks
Mobile Communication Systems

Course Objectives:

1	To introduce fundamental knowledge of Software Defined Radio (SDR) technology in next generation networks.
2	To introduce the hardware and software requirements and design aspects of SDR.
3	To introduce the architecture, functions and challenges in Cognitive Radio networks.
4	To introduce spectrum sensing techniques spectrum awareness in CR networks.
5	To understand spectrum allocation techniques and performance evaluation in CR networks.
6	To introduce the various standards available in CR technology and GNU platform for experimentation.

Course Outcomes:

1	To Learn the hardware and software architecture and various design principles of SDR.

2	To understand challenges of receiver design and select suitable hardware and software for SDR.
3	To understand the functions, components and challenges of CR technology for better spectrum exploitation.
4	To analyze various spectrum sensing techniques in the CR environment.
5	To understand and apply the techniques of dynamic spectrum allocation and scheduling in CR based networks.
6	To understand various standards of CR Technology and its role in next generation networks and GNU platforms.

Module		Content	Hrs
1		**Software Defined Radio**	**5**
	1.1	Basic components of Software Defined Radios, Software defined radio hardware architectures.	
	1.2	Distortion parameters - Sources and metrics of distortion in a transceiver, Nonlinear distortion and nonlinearity specifications, Power amplifiers, Nonlinear Distortion in Transmitted Signals.	
2		**SDR Architecture and Components**	**8**
	2.1	Power amplifier Line-up for linearity & power requirement calculations, Linearization Techniques for nonlinear distortion in SDR, Pre distortion Techniques for nonlinear distortion in SDR.	
	2.2	SDR Software architecture, Software Tunable Analog Radio Components, Antenna Systems, Reconfigurable Digital Radio Technologies, Basic Digital Radio Components.	
3		**Cognitive Radio**	**6**
	3.1	**Cognitive radio features and capabilities**: Cognitive radio architecture, Functions of cognitive radio, Dynamic spectrum access, Components of cognitive radio, Interference temperature, Spectrum sensing, Spectrum analysis and spectrum decision.	
	3.2	**Research challenges in Cognitive Radio:** Issues in spectrum sensing, Spectrum management issues Spectrum mobility issues, Network layer and transport layer issues, Cross-layer design for cognitive radio networks, Artificial intelligence approach for designing cognitive radio, Location-aware cognitive radio.	

4		**Spectrum Sensing for Cognitive Radio**	
	4.1	Challenges, Matched Filtering, Waveform-Based Sensing, Cyclostationarity - Based Sensing, Energy Detector-Based Sensing, Radio Identification, Cooperative Sensing, External Sensing, Statistical Approaches and Prediction.	**6**
	4.2	Sensing Frequency, Hardware Requirements and Approaches, Multi-dimensional Spectrum Awareness.	
5		**Dynamic spectrum access and management in Cognitive Radio**	
	5.1	Spectrum access models: Exclusive-use model, Shared-use model, Spectrum commons model, Dynamic spectrum access architecture: Infrastructure-based versus infrastructure less cognitive radio network, Centralized versus distributed dynamic spectrum access Inter- and intra-RAN dynamic spectrum allocation	**8**
	5.2	Medium access control for dynamic spectrum access: Optimal decision on spectrum sensing and spectrum access Multichannel and multiuser MAC Spectrum allocation and scheduling, Spectrum trading, Performance analysis of cognitive MAC protocols.	
6		**Advanced topics in Cognitive Radio**	**6**
	6.1	Cognitive radio architectures for Next Generation (XG) networks, Cognitive radio standardization: IEEE SCC 41, IEEE 802.22 for wireless regional area networks (WRANs).	
	6.2	GNU Radio for cognitive radio experimentation.	
		Total	**39**

Textbooks:	
1	Huseyin Arslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007
2	Ekram Hossain, Dusit Niyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press, 2009
3	Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition, 2009.
4	Alexandar M Wylingskey, Maziar Nikovee, Y Thomas Hou, “Cognitive Radio Communications and Networks Principles and Practice”, Elsevier, 2010
Reference Books:	
1	Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd., 2009.
2	Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer, 2009.
3	Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press, 2009.
E Resources:	
1	NPTEL: https://nptel.ac.in/courses/108/107/108107107/
2	GNU Radio: https://www.gnuradio.org/ https://wiki.gnuradio.org/index.php/Tutorials http://www.gcndevelopment.com/gnuradio/downloads.html

Internal Assessment:

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-4	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-4	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7021	Robotics	3

Prerequisite: Engineering Mathematics III and IV	
Course Objectives:	
1	To introduce the functional elements of Robotics
2	To impart knowledge on the direct and inverse kinematics
3	To introduce the manipulator differential motion and control
4	To educate on various path planning techniques
5	To introduce the dynamics and control of manipulators
6	To study about the localization, planning and navigation
Course Outcomes:	

1	Explain basic concept of robotics.
2	Describe the differential motion, add statics in robotics
3	Describe the various path planning techniques.
4	Describe the dynamics and control in robotics industries.
5	Write program to use a robot for a typical application
6	Use Robots in different applications

Module no.	**Unit no.**	**Topics**	**Hrs.**
1.0	**BASIC CONCEPTS**		**03**
	1.1	Brief History	
	1.2	Types of Robot–Technology-Robot classifications and specifications	
	1.3	Design and Control issues	
	1.4	Various manipulators	
	1.5	Sensors , work cell	
	1.6	Programming language	
2.0	**DIRECT AND INVERSE KINEMATICS**		**08**
	2.1	Mathematical representation of Robots - Position and orientation	
	2.2	Homogeneous transformation Various joints, Degrees of freedom	
	2.3	Representation using the Denavit Hattenberg parameters	
	2.4	Direct kinematics-Inverse kinematics	
	2.5	Solvability – Solution methods-Closed form solution	
	2.6	SCARA robots	
3.0	**PATH PLANNING**		06
	3.1	Joint space technique	
	3.2	Use of p-degree polynomial, Cubic polynomial, Cartesian space technique	
	3.3.	Parametric descriptions	
	3.4	Straight line and circular paths	
	3.5	Position and orientation planning	
4.0	**DYNAMICS AND CONTROL**		**07**
	4.1	Lagrangian mechanics	
	4.2	2DOF Manipulator	
	4.3	Lagrange Euler formulation	
	4.4	Dynamic model	
	4.5	Manipulator control problem-Linear control schemes-PID control schemeForce control of robotic manipulator	
5.0	**SERVICE ROBOTICS**		**07**
	5.1	Need for service robot	

	5.2	LOCALIZATION: Challenges of Localization- Map Representation Probabilistic Map based Localization Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization	
	5.3	PLANNING AND NAVIGATION: Path planning overview, Cell decomposition path planning Potential field path planning-Obstacle avoidance	
6.0	**APPLICATIONS**		**06**
	6.1	Ariel robots	
	6.2	Collision avoidance	
	6.3	Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications	
	6.4	Humanoids	
		TOTAL	**39**

Textbooks:	
1	R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2	JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3	M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.
4	Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004
Reference Books:	
1	Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2	K. K.Appu Kuttan, Robotics, I K International, 2007.
3	Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4	B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied publishers,Chennai, 1998
5	Riadh Siaer, „The future of Humanoid Robots- Research and applications, Intech Publications, 2012.

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-3	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course - 4	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7022	5 G Technology	3

Prerequisite:
Digital Communication
Mobile Communication Systems

Course Objectives:

1	To Learn the basics of 5G and their features beyond wireless communication.
2	To understand 5G network architecture, Heterogeneous Network and Small cell concept.
3	To understand mm Wave technology, and its significance in next generation wireless networks.
4	To learn Non orthogonal Multiple Access (NOMA) and its features in 5G.
5	To introduce the concept and application of Cognitive Radio in 5G.
6	To Provide understanding of the key technologies, use cases and enablers of 5G and beyond communication systems.

Course Outcomes:

1	Distinguish between the major cellular communication standards (1G/2G/3G/4G/5G systems) features, requirements and applications.
2	Understand architecture of 5G wireless, heterogeneous and small cell networks and their deployment.
3	Apply the 5G techniques e.g., mmWave, massive MIMO, beam forming etc. for the design of wireless communication systems.
4	Analyse various modulation and multiplexing and multiple access techniques e.g., OFDM, NOMA etc. in 5G
5	Describe applications of cognitive radio in 5G Wireless Communications.
6	Apply various 5G technology features like eMBB, URL LC and mMTC in advance services such as autonomous cars, remote surgery high-definition video streaming, immersive augmented reality (AR) and virtual reality (VR)etc.

Module		Content	Hrs
1		**Introduction**	**4**
	1.1	Introduction to 5G Technology, Features, Requirements, Applications, 5G Services, 5Gi.	
	1.2	5G Technology Modulation Techniques (OFDM) and performance metrics.	
2		**5G Architecture**	**8**
	2.1	5G Network Architecture, Cloud RAN(C-RAN), Definitions of Heterogeneous Networks, Radio Resource, Interference Management, mobility management, handover and Traffic offloading scenarios for heterogeneous networks.	
	2.2	Small cell deployments: Different types, Deployment scenarios, performance and analysis, Energy efficient mechanism with BS sleep mode in green small cell networks, Game theory and learning techniques for self-organization in small cell networks.	
3		**Mm Wave**	**8**
	3.1	mmWave: Millimetre bands, radio-wave propagation Physical layer design and algorithms, mmWave MIMO challenges, channel modelling, channel estimation and Beam-forming. Types of transceivers, Merits and Demerits, Applications.	
	3.2	Physical or Radio layer Technologies: Massive MIMO (Sub 6GHz) -mm wave MIMO (above 6 GHz)	
4		**Non orthogonal Multiple Access (NOMA)**	

	4.1	Non orthogonal Multiple Access (NOMA), Different Types: power domain NOMA and code domain NOMA, Difference between Orthogonal multiple access and NOMA,	**5**
	4.2	Filter Bank multi carrier -Full duplex Radio Techniques, Precoding	
5		**Cognitive Radio for 5G Wireless Networks**	
	5.1	Introduction, Overview of Cognitive Radio Technology in 5G Wireless, Spectrum Optimisation using Cognitive Radio, Cognitive Radio and Carrier Aggregation, Energy-Efficient Cognitive Radio Technology.	**8**
	5.2	Cognitive Radios to Mitigate Interference in Macro/femto Heterogeneous Networks, Cognitive Radio enabled Operations, Interference Coordination: Orthogonality in the Time/Frequency domain, Intra-tier Interference mitigation, Compressive sensing.	
6		**Trends in 5G**	**6**
	6.1	5G NR, Carrier Aggregation in 5G, Open RAN, Use cases of 5G: eMBB, URL LC and mMTC, introduction to Software Defined Networking, Network Function Virtualisation (NFV).	
	6.2	Advance applications: Robotic surgery, driverless car and Industrial IoT (IIoT), Tactile Internet, 5G-IoT applications, AR/VR in 5G	
		Total	**39**

Textbooks:

1	R. Vannithamby and S. Talwar, Towards 5G: Applications, Requirements and Candidate Technologies., John Willey & Sons, West Sussex, 2017.
2	Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.
3	Alagan Anpalagan, Mehdi Bennis, Rath Vannithamby, Design and deployment of small cell networks, Cambridge university press, 2015

Reference Books:

1	Rose Qingyang Hu, Yi Qian, Heterogeneous Cellular Networks, John Wiley & Sons, Ltd., Publication, 2013

2	T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimeter Wave Wireless Communication., Pearson Education, 2015.
3	M. Vaezi, Z. Ding, and H. V. Poor, Multiple Access techniques for 5G Wireless Networks and Beyond., Springer Nature, Switzerland, 2019
4	Manish, M., Devendra, G., Pattanayak, P., Ha, N., 5G and Beyond Wireless Systems PHY Layer Perspective, Series in Wireless Technology Springer, 2021

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no.	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**	
End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-4	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-4	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7023	Internet Communication Engineering	3

Prerequisite:
1. Analog communication
2. Digital Communication
3. Computer Communication and Networks

Course Objectives:

1	To overview TCP/IP protocol suite
2	To discuss the Internet security protocols at upper layers of TCP/IP protocol suite.
3	To study multimedia communication basics and protocols
4	To discuss quality of service and its types
5	To explore the latest network trends

Course Outcomes:

1	To understand the functions of all layers of TCP/IP
2	To understand the internet security aspects of protocols and security services wrt Application layer and Network layer

3	To compare Integrated and Differentiated quality of services
4	To understand software defined networks and Internet of Things

Module no.	Unit no.	Topics	Hrs.
1.0	**Introduction to Internet**		**03**
	1.1	Overview of TCP/IP, layer functions	
2.0	**Application Layer in the Internet**		**06**
	2.1	Application Layer- Host configuration, DHCP, Domain Name System (DNS), Multicast DNS	
	2.2	Remote Login, TELNET and SSH, HTTPS, Electronic mail	
3.0	**Internet Security**		**09**
	3.1	Network layer security (AH, ESP, IPsec)	
	3.2	Transport layer security (SSL), Application layer security (Secure E mail-PGP, S/MIME)	
	3.3	VPN Firewall, Intrusion Detection System.	
4.0	**Multimedia Communications**		**10**
	4.1	Information Representation, Compression and Coding formats for text, image, audio and video.	
	4.2	Multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, Signaling Protocols: Real-Time Streaming Protocol (RTSP)	
	4.3	VoIP, IPTV	
5.0	**Quality of Services (QoS)**		**07**
	5.1	Integrated services (intserv): Architecture and Service Model, Resource Reservation Protocol (RSVP), Packet Scheduling Disciplines in the Internet	
	5.2	Differentiated Services (diffserv): Framework and Concept, Assured and Expedited Services, Packet Classification, Routers Internals and Packet Dropping Techniques	
6.0	**Network Industry Trends**		**04**
	6.1	Introduction to software defined networking, OPENFLOW	
	6.2	Introduction to Internet of Things (IoT): Definition and characteristics of IoT, Physical design of IoT: Things in IoT, IoT Protocols.	
		TOTAL	**39**

Textbooks:	
1	B. Forouzan, “TCP/IP Protocol Suite”, 4th Edition, McGraw-Hill Publication, 2010.
2	K. R. Rao, Zaron S. Bojkovic, Dragorad A. Milocanovic, “Multimedia Communication Systems”, Prentice Hall India, 2002. ISBN: 81-203-2145-6
3	Jason Edelman, Scott S. Lowe & Matt Oswalt, “Network Programmability & Automation”, Oreilly Publication, 2018.
Reference Books:	
1	Steve Heath, ”Multimedia and Communication Technology”, Second Edition, Focal Press, 2003.
2	Ted Wallingford, “Switching to VoIP”, Oreilly Publication, 2005, ISBN: 81-8147-145-8.
3	Fred Halsall, ”Multimedia Communications”, Pearson education, 2001.
4	Raif steinmetz, Klara Nahrstedt, ”Multimedia: Computing, Communications and Applications”, 1st edition, Pearson education, 2002.
5	Tay Vaughan, “Multimedia: Making it Work”, 6th edition, Tata McGraw Hill, 2004
6	Pallapa Venkataram,”Multimedia information systems”, Pearson education (InPress),2005.
7	Arshdeep Bagha and Vijay Madisetti,”Internet of Things: A Hands-on Approach”, University Press (India) Pvt. Ltd. (2015) ISBN 10: 8173719543 ISBN 13: 9788173719547

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	**GATE Based Assignment test/Tutorials etc**	**10 marks**
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	**Multiple Choice Questions (Quiz) - 2 times**	**5 marks**

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO701X	Department Optional Course-4	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO701X	Department Optional Course-4	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 7024	Advanced Digital Signal Processing	3

Prerequisite: Discrete-Time Signal Processing

Course Objectives:	
1	To develop a thorough understanding of power spectrum estimation and different models for the same.
2	To apply optimum linear filters, linear prediction, and adaptive filtering techniques for signal processing applications.
3	To process multi-rate data.
4	To develop multi-resolution analysis using wavelets.
Course Outcomes:	
1	Illustrate parametric and non-parametric techniques of power spectrum estimation.
2	Explain optimum linear filters and their different forms.

3	Perform linear estimation and prediction of discrete time signals.
4	Implement various types of adaptive filters for the given applications.
5	Design interpolator, decimator and sampling rate convertors for multi-rate signal processing.
6	Apply concepts of wavelets and filter banks for signal processing applications.

Module no.	**Unit no.**	**Topics**	**Hrs.**
1.0	**Power Spectrum Estimation**		**09**
	1.1	Principle of Power Spectrum Estimation	
	1.2	Non-Parametric Method of Power Spectrum Estimation: Modified Periodogram, Bartlett's Method, Welch's Method, Blackman-Tukey Method	
	1.3	Parametric Methods for Power Spectrum Estimation: Relationships between the Autocorrelation and the Model Parameters, AR, MA & ARMA Models	
	1.4	Introduction to Least-Squares Method for the AR Model Parameters and Yule-Walker Method for the AR Model Parameters	
2.0	**Optimum Linear Filters**		**03**
	2.1	Wiener Filters	
	2.2	FIR Wiener Filter (Wiener-Hopf filter)	
	2.3	IIR Wiener filter (Non-Causal and Causal IIR Wiener Filter)	
	2.4	Orthogonality Principle in Linear Mean-Square Estimation	
3.0	**Linear Prediction**		**05**
	3.1	Forward and Backward Linear Prediction	
	3.2	Solution of Normal Equation (Levinson-Durbin and Schur Algorithm)	
	3.3.	AR Lattice and ARMA Lattice Ladder Filters	
	3.4	MMSE Estimation	
	3.5	Introduction to Kalman Filter, Matched Filter	
4.0	**Adaptive Filters**		**07**
	4.1	Adaptive Algorithms: LMS Algorithm, NLMS Algorithm, RLS Algorithm, Lattice Ladder Algorithm	
	4.2	Applications of Adaptive Filters: System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation	
		Self-Study: Suppression of Narrowband Interference in Wideband Signals, Adaptive Array	
5.0	**Multi-rate Signal Processing**		**08**
	5.1	Introduction to Multi-rate Signal Processing	
	5.2	Interpolation and Decimation, Sampling Rate Conversion by Non-integer Factor	
	5.3	Multistage Interpolation and Decimation	
	5.4	Polyphase Decomposition	
	5.5	Filter Banks: Quadrature Mirror Filter Banks	
		Self-Study: Subband Coding	
6.0	**Introduction to Wavelets**		**07**

	6.1	Limitations of Fourier Transform and Short Time Fourier Transform, Introduction to Time-Frequency Tiling	
	6.2	Multi-resolution analysis using Discrete Time Wavelet Transform: Haar MRA, Analysis of two band dyadic filter banks, Frequency response of the Haar Filter Bank	
	6.3	Introduction to Daubechies Wavelets	
	6.4	Application of Wavelet theory to Signal Denoising (Soft and Hard Thresholding)	
		Self-Study: Signal Compression, Image Compression	
		TOTAL	**39**
Note: No questions will be asked in the end semester exam from self-study topics. However, students are encouraged to explore these topics for better understanding of the subject.			

Textbooks:	
1	John G. Proakis, Dimitris K. Manolakis, “Digital Signal Processing Principles, Algorithms, and Applications”, Prentice-Hall, 4th Edition, 2012.
2	Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fourth Edition, 2002
3	Martin Vetterli, Jelena Kovacevic, “Wavelets and Subband Coding”, Prentice-Hall, 1995.
4	Burrus, C. Sidney, Ramesh A. Gopinath, and Haitao Guo, "Introduction to wavelets and wavelet transforms", Prentice Hall Inc. 1997"
Reference Books:	
1	Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education, 2008.
2	E. Chandrasekhar, V. P. Dimri, V. M. Gadre (Eds.), “Wavelets and Fractals in Earth System Sciences”, CRC Press, 2013.
3	Tarun Kumar Rawat, “Digital Signal Processing”, Oxford University Press, 2014.
4	K. Deergha Rao, M.N.S. Swamy, “Digital Signal Processing: Theory and Practice”, Springer, 2018.
5	K. P. Soman, K.I. Ramchandran and N. G. Reshmi, “Insight into Wavelets: From Theory to Practice", Third Edition PHI, 2010.
6	P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice-Hall, 1993.
7	Sanjit K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, McGraw Hill, 2011
NPTEL / Swayam Course:	

1	"Estimation of Signals and Systems" by Prof. S. Mukhopadhyay, IIT Kharagpur. https://nptel.ac.in/courses/108/105/108105059/
2	"Adv. Digital Signal Processing – Multi rate and wavelets" by Prof. V. M. Gadre, IIT Bombay. https://nptel.ac.in/courses/117/101/117101001

Internal Assessment:

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Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

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2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**	
End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO701X	Institute Level Optional Course-1	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO701X	Institute Level Optional Course-1	20	20	60	2	--	--	100

CourseCode:	Course Title	Credit
ILO7011	Product Life Cycle Management	3
Prerequisite:		
Course Objectives:		
1	To familiarize the Learner with the need, benefits, and components of PLM	
2	To acquaint Learner with Product Data Management & PLM strategies	
3	To give insights into new product development program and guidelinesfor designing and developing a product	
4	To familiarize the Learner with Virtual Product Development, Design forenvironments, Life cycle assessment.	
Course Outcomes:		
1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	
2	Illustrate various approaches and techniques for designing and developingproducts.	

3	Apply product engineering guidelines / thumb rules in designingproducts.
4	Acquire knowledge in applying virtual product development tools and design forthe environment.

Module		Content	Hrs
1		**Introduction to Product Lifecycle Management (PLM)**	8
	1.1	Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, spread of PLM, Focus and Application	
	1.2	PLM Strategies: Industrial strategies, Strategy elements,Developing PLM Vision and PLM Strategy , Change management for PLM	
2		**Product Design**	10
	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model,	
	2.2	Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life CycleApproach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management,	
	2.3	The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3		**Product Data Management (PDM)**	5
	3.1	Product and Product Data, PDM systems and importance, Components of PDM, Reason forimplementing a PDM system	
	3.2	Financial justification of PDM, barriers to PDM implementations	
4		**From sustainable Development to design for environment**	6
	4.1	Sustainable Development, Key factors in Sustainable Development, Design for Environment	

	4.2	The Environment driving PLM- External Drivers: scale, Complexity, cycle times, globalization, regulations, Internal Drivers- Productivity innovation, collaboration, quality. Boardroom Driver-IT Value Map: income, revenue, costs. Comparing lean manufacturing, ERP, CRMand PLM	
5		**Life Cycle Assessment and Life Cycle Cost Analysis**	6
	5.1	**Premises,** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment.	
	5.2	Cost Analysis and the Life Cycle Approach, GeneralFramework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	
6		**Virtual Product Development Tool**	4
	6.1	Introduction VPD, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies.	
		Total	**39**

Textbooks:

1	John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004. ISBN: 1852338105
2	Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3	Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4	Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Reference Books:

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2	Fabio Giudice, Guido La Rosa, Antonino Risitano, —Product Design for the environment- A life cycle approach‖, Taylor & Francis 2006, ISBN: 0849327229
3	Saaksvuori Antti, Immonen Anselmie, —Product Life CycleManagement‖, Springer, Dreamtech, ISBN: 3540257314

4	Michael Grieve, ―Product Lifecycle Management: Driving the next generation of lean thinking‖, Tata McGraw Hill, 2006, ISBN: 0070636265

Internal Assessment:

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Continuous Assessment:

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr. No	Assessment Tools	Marks
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6	GATE Based Assignment test/Tutorials etc.	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8	Multiple Choice Questions (Quiz)	5 marks
9	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 marks
10	Project based Learning and evaluation / Extra assignment / Question paper solution	10 marks
11	Multiple Choice Questions (Quiz)	5 marks
12	Literature review of papers/journals	5 marks

13	Library related work	5 marks
*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
End Semester Theory Examination:		
1	Question paper will be of 60 marks and the duration will be 2 hours.	
2	Question paper will have a total of five questions	
3	All questions have equal weightage and carry 20 marks each	
4	Any three questions out of five need to be solved.	

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO701X	Institute Level Optional Course-1	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO701X	Institute Level Optional Course-1	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ILO7013	Management Information System	03
Prerequisite:		
Course Objectives:		
1	To discuss the roles played by information technology in today's business.	
2	To understand the Intelligent Techniques for Data Analytics.	
3	To determine ethical and privacy issues in management systems.	
4	To understand the requirements for various Business Operations	
5	To define various technologies on which information systems are built	
6	To determine the types of systems used for enterprise-wide knowledgemanagement and the way they provide value for businesses.	
Course Outcomes:		
1	The impact of information systems on an organisation's growth.	
2	The principal tools and technologies for accessing information from databasesto improve business performance and decision making.	
3	The ethical frameworks and security concerns in information systems.	

4	The various business models used for social computing.
5	IT infrastructure and its components and its current trends
6	Various enterprise-wide knowledge management systems and its functionalities.

Module		**Content**	**Hrs**
1		**Introduction to Information Systems (IS):**	**4**
		Computer Based Information Systems, Impact of IT on organizations, Importance of IS toSociety. Organizational Strategy, Competitive Advantages and IS	
2		**Database and Business Intelligence:**	**8**
		Database Approach, BigData, Data warehouse and Data Marts, **Managing data resources: establishing an information policy, ensuring data quality** Business intelligence (BI): Decision Making Process, BI for Data analytics and Presenting Results	
3		**Ethical and Social Issues in Information Systems:**	
		Ethical issues and Privacy, Information Security. Threat to IS,and Security Controls	**6**
4		**Social Computing (SC):**	**7**
		SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	
5		**Emerging Technologies:**	**7**
		The Emerging Mobile Digital Platform: Consumerization of IT and BYOD (Bring Your Own Device), Grid Computing, Virtualization, Cloud Computing, Green Computing, High-Performance and Power-Saving Processors, Autonomic Computing Contemporary Software Platform Trends: Web Services andService-Oriented Architecture, Software Outsourcing and Cloud Services Management Issues: Dealing with Platform and Infrastructure Change Management and Governance	
6		**Information System within Organization:**	**7**
		Knowledge management System, Knowledge management value chain, Decision Support System, Transaction Processing Systems, ERP and ERP support of Business Process.	
		Total	**39**

Textbooks:	
1	Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2	K.C. Laudon and J.P. Laudon, Management Information Systems: Managing theDigital Firm, 13th Ed. © Pearson Education Limited 2014
Reference Books:	
1	MIS: Management Perspective, D.P. Goyal, Vikas Publishing House Pvt. Ltd, 4thEdition.
2	D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization,Prentice Hall, 2008.

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment:

Continuous Assessment is of 20 marks. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr. No	Assessment Tools	Marks
1	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8	Multiple Choice Questions (Quiz)	5 marks
9	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 marks
10	Project based Learning and evaluation / Extra assignment / Question paper solution	10 marks
11	Multiple Choice Questions (Quiz)	5 marks

12	Literature review of papers/journals	5 marks
13	Library related work	5 marks
*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
End Semester Theory Examination:		
1	Question paper will be of 60 marks and the duration will be 2 hours.	
2	Question paper will have a total of five questions	
3	All questions have equal weightage and carry 20 marks each	
4	Any three questions out of five need to be solved.	

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO701X	Institute Level Optional Course-1	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO701X	Institute Level Optional Course-1	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ILO7016	Cyber Security and Laws	03
Prerequisite:		
Course Objectives:		
1	To understand and identify different types cybercrime and cyber law	
2	To recognized Indian IT Act 2008 and its latest amendments	
3	To learn various types of security standards compliances	
Course Outcomes:		
1	To be able to understand the history of cyber crime and need for cyber law.	
2	To be able to recognize various types of cyber crimes and related security issues	
3	To be able to identify the tools and methods used in cyber crime	
4	To be able to discuss the need for cyber space for transactions and interactions	
5	To be able to appreciate the evolution of IT act.	
6	To be able to interpret the necessity of information security standards and compliances.	

Module		Content	Hrs
1		**Introduction to Cybercrime**	4
	1.1	Cybercrime definition, history and threats to security goals, Classifications of cybercrime, How criminal plan the attacks	
	1.2	The Need for an Indian Cyber Law, Introduction to Indian ITA2000	
2		**Cyber frauds and Security issues**	**4**
	2.1	Social Engg, Cyber stalking, Online Drug Trafficking , Botnets, Attack vector, Credit Card Frauds in Mobile andWireless Computing Era	
	2.2	Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, work from home cybersecurity Tips and Risks	
	2.3	Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
		Self Learning Topics: Types of Cyber Frauds and security issues	
3		**Tools and Methods Used in Cybercrime**	
	3.1	Phishing, Password Cracking, Keyloggers and Spywares, Virus andWorms, Steganography	**10**
	3.2	DoS and DDoS Attacks, SQL Injection, Buffer OverFlow,	
	3.3	Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
4		**The Concept of Cyberspace**	7
	4.1	E-Commerce , The Contract Aspects in Cyber Law ,The SecurityAspect of Cyber Law ,The Intellectual Property Aspect in CyberLaw	
	4.2	The Evidence Aspect in Cyber Law , The Criminal Aspect in CyberLaw, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking	
5		**Indian IT Act**	8
	5.1	Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	
		Self Learning Topics: Case Studies	
6		**Information Security Standard compliances**	6
	6.1	SOX, HIPAA, ISO	

		Self-Learning Topics: FISMA, NERC, PCI, GLBA	
		Total	**39**

Textbooks:	
1	Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2	Cyber Security and Lawas, Madhumita Chatterjee, Sangita Chaudhary, Gaurav Sharma, Staredu solutions
3	Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
Reference Books:	
1	The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
2	The Information technology Act, 2000; Bare Act- Professional Book Publishers, NewDelhi.
3	Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
4	Kennetch J. Knapp, *Cyber Security* & *Global Information Assurance* Information Science Publishing.
5	William Stallings, *Cryptography and Network Security,* Pearson Publication
Useful Links:	
1	The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
2	A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and ContinuousAssessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completedDuration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECL701	Microwave Engineering Laboratory	--	2	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC701	Microwave Engineering Laboratory	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECC701	Microwave Engineering Laboratory	1
Prerequisite:		
Lab Objectives:		
1	To become familiar working with rectangular waveguides and doing microwave bench set up.	
2	To determine the characteristics of various microwave components	
3	To be able to measure wave parameters like impedance, frequency, wavelength using microwave bench and VSWR/power meter	
4	To study characteristics and behaviour of various microwave semiconductor devices.	
Lab Outcomes:		
1	Able to handle microwave equipment	
2	Able to understand microwave measurements and test the characteristics of microwave components	
3	Able to understand Wave guide and transmission line measurements	
4	Demonstrate working of microwave semiconductor devices	
5	Demonstrate the microwave bench set up and conducting measurements of different parameters	

Suggested Experiments: Students are required to complete at least 8 to 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Measurement of microwave frequency using direct and indirect method.
2	Measurement of guide wavelength
3	Measurement of VSWR of unknown load
4	Measurement of impedance of unknown load.
5	Study of field patterns of various modes inside a rectangular waveguide cavity using Virtual lab
6	Study of field patterns of various modes inside a rectangular waveguide using Virtual lab
7	Find the change in characteristics impedance and reflection coefficients of the transmission line by changing the dielectric properties of materials Embedded between two conductors. using Virtual lab
8	Determination of VI characteristics of Gunn diode using microwave test bench.
9	Measurement of attenuation
10	Measurement of microwave power
11	Characterization of E plane TEE, H plane TEE and Magic TEE
12	Measurement of reflection coefficient using transmission line bench
Term Work:	
1	Term work should consist of 8 to 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECL702	Mobile Communication System Laboratory	--	2	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC702	Mobile Communication System Laboratory	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECC702	Mobile Communication System Lab	1

Prerequisite:

Lab Objectives:

1	To understand the inter-dependencies of design parameters of cellular system.
2	To examine orthogonality condition for CDMA systems.
3	To Classify different types of propagation models and analyze the link budget
4	To understand the working principles of OFDM, MIMO, and Cognitive radio

Lab Outcomes:

1	Demonstrate the effect of cellular system design parameters on system capacity and quality of service.
2	Compare and contrast trunking radio systems.
3	Examine the effect of small-scale fading parameters on the performance of radio channel characteristics.
4	Analyze link budget for various propagation path-loss models

5	Summarize the attributes of OFDM, MIMO, and Cognitive radio. 6. Evaluate the performance of different MIMO systems

Suggested Experiments: Students are required to complete at least 8 experiments.	
Sr. No.	**Name of the Experiment**
1	Prerequisite Study of Mobile Communication.
2	Write a program to divide a given area into equal hexagon and create a cluster
3	To observe the effect on cluster size N on S / I ratio and comment on voice quality
4	To study shift in frequency due to doppler effect
5	To study Two-ray ground reflection Model
6	To Analyze of diffraction loss in various scenarios
7	To study how call blocking probability varies as the load on a GSM network is continuously increased
8	To Simulate and analyze Global System for Mobile (GSM) handover
9	To Simulate and analyse Code Division Multiple Access (CDMA) handover
10	Experiment on SDR: a & b) To measure the BER and understand the impact of SNR and fading on BER performance with the help of Constellation Diagram and Eye Diagram in QAM and in PSK c & d) To measure the BER and understand the impact of Modulation Order on BER performance with the help of Constellation Diagram and Eye Diagram in QAM and in PSK
11	To design cellular system with respect to number of users, cell radius and number of cells in given area.
12	To plot channel capacity versus SNR for different MIMO systems.

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.

3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 10-marks, Mobile App Development: 15-marks)
Continuous assessment exam	
1	Based on the subject and related labs.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECP701	Major Project-I*	--	6$	--	3	--	3

*Should be conducted batch wise $ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration(in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECP701	Major Project -I	--	--	--	--	50	100	150

Course Code:	Course Title	Credit
ECP701	Major Project - I	3

Prerequisite:
Knowledge of subjects studied during semester I-VI

Course Objectives:

1	To enable the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a social real life problem or an issue, and mapped with 17 sustainable development goals (SDGs) to transform our world via a substantial piece of work which is to be carried out over an extended period.
2	To enable the students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Course Outcomes:

1	To undertake problem identification, formulation and design engineering solutions to solve social problems following a systematic approach.
2	To demonstrate a sound technical knowledge of selected problems/ issues.
3	To present design/ solution in a forum/ community involving poster presentations and demonstrations of operational hardware and software of selected problem/ issue.
4	To demonstrate the knowledge, skills and attitudes of a professional engineer.

Guidelines	
1	**Project Topic:** i. To proceed with the project work it is very important to select the right topic to solve a real-life problem in a given time frame. ii. Project can be undertaken on any topic addressing Electronics and Telecommunication programmes, solving real life problems and mapped with 17 sustainable development goals (SDGs) to transform our world. (List IN THE END). iii. Research and development projects on problems of practical and theoretical interest are also encouraged. iv. Project work must be carried out by the group of at least two students and maximum three/four. v. Students can certainly take ideas from anywhere (Society/ NGOs/ Company/ through Survey), but be sure that they should evolve them in the unique way to suit their project requirements. vi. The project work can be undertaken in collaboration with a research institute or organization/company/any business establishment in consultation with the internal guide, Head of department, Deputy Head and department project in charge and mutually acceptable terms and conditions. To review the progress of the project undertaken outside the institute, an internal guide must visit the industry once in a month. Also, the final working project should be demonstrated at the time of exam in the institute. Students must consult an internal guide along with an external guide (if any) in selection of topic. vii. Head of department and senior faculties in the department will take final decision regarding selection of projects. viii. Students have to submit a weekly progress report of the project to the internal guide whereas the internal guide has to keep track of the progress of the project and also has to maintain attendance reports. This progress report will be used for awarding term work marks. ix. There will be two reviews of progress of the project in the semester by the review panel assigned by Head of department, Deputy Head and department project in charge. The evaluation by review panel will be used for awarding term work marks.

2	**Project Report Format:** At the end of semester, a project report should be submitted by the group as per given format (In LATEX only). It should preferably contain at least following details, i. **Abstract** **ii. Introduction** **iii. Literature Survey** a) Survey of Existing system b) Limitations of Existing system or research gap c) Problem Statement and Objective d) Scope **iv. Proposed System** a) Analysis/Framework/ Algorithm b) Details of Hardware & Software c) Design details d) Methodology (your approach to solve the problem) **v. Implementation Plan for next semester** **vi. Conclusion** **vii. References in standard format** **Minimum number of pages should be 25.**

Term Work:

Distribution of marks for term work shall be as follows:

a) Weekly Attendance/discussion/Assessment

b) Project work contribution

c) Project Review I & II

d) Project Report (Hard Bound)

e) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project-I should be conducted by Internal and External examiners approved by Academic council/ Exam cell. Students have to give presentations and demonstrations on Project-1.

The 17 sustainable development goals (SDGs) to transform our world:

GOAL 1: No Poverty

GOAL 2: Zero Hunger

GOAL 3: Good Health and Well-being

GOAL 4: Quality Education

GOAL 5: Gender Equality

GOAL 6: Clean Water and Sanitation

GOAL 7: Affordable and Clean Energy

GOAL 8: Decent Work and Economic Growth

GOAL 9: Industry, Innovation and Infrastructure

GOAL 10: Reduced Inequality

GOAL 11: Sustainable Cities and Communities

GOAL 12: Responsible Consumption and Production

GOAL 13: Climate Action

GOAL 14: Life Below Water

GOAL 15: Life on Land

GOAL 16: Peace and Justice Strong Institutions

GOAL 17: Partnerships to achieve the Goal

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECC801	Optical Communication and Networks	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECC801	Optical Communication and Networks	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECC801	Optical Communication and Networks	3

Prerequisite:
FEC102 - Engineering Physics-I
FEC202 - Engineering Physics-II
ECC302 - Electronic Devices & Circuits
ECC405 - Principles of Communication Engineering
ECC501 - Digital Communication
ECC601 - Electromagnetics and Antenna

Course Objectives:

1	Introduction to optical fiber communication, it's need, elements and fundamentals.
2	To learn Parameters that limits the repeaterless transmission, its mitigation and Managing techniques.
3	To learn high speed optical network components such as sources, detectors, amplifiers, filters etc.
4	Study the multiplexing schemes SDH and SONET, WDM, OTDM and applications for next generation networks.
5	To learn high speed network management techniques and challenges in its counterpart Free Space Optics

Course Outcomes:

1	To Understand optical fiber communication system at large with propagation mechanism of fibers and working principles of the sources and detectors for deployment.

2	To understand the parameters that limit the repeaterless transmission, its mitigation and Managing techniques.
3	Design point to point optical fiber communication links using appropriate optical fibers, light sources, couplers, detectors, and multiplexers.
4	Understand SDH and SONET, WDM, OTDM techniques, applications and implementation.
5	Apply the knowledge acquired to design the next generation fiber and FSO networks for indoor and outdoor applications

Module		Content	Hrs
1		**Introduction and Basics of Optical fiber communication**	**07**
	1.1	History, need, advantages and disadvantages of optical fiber communication, Optical Bands and Windows, Fiber optic applications.	
	1.2	Light Propagation in optical Fiber, Types of optical fibers, Modes in optical fiber.	
	1.3	Fiber Fabrication techniques, Fiber Joints, Connectors and Splices.	
2		**Transmission Characteristic of Optical Fiber**	**07**
	2.1	**Transmission losses in the optical fiber:** Attenuation mechanisms (Absorption losses, Radiation losses and linear scattering losses), Measurement of attenuation, OTDR.	
	2.2	**Dispersion in Optical fiber:** Types of Dispersion and their compensation, Dispersion compensated, Dispersion shifted and dispersion flattened Fibers.	
3		**Optical Communication Systems**	**07**
	3.1	Working principle and characteristics of optical sources (LED, LASER, VCEL)	
	3.2	Working principle and characteristics of detectors (PIN, APD), Optical receivers and their performance, coherent and non-coherent detection	
	3.3	Point to point links system considerations, link power budget, and rise time budget	
4		**Optical Network System Components and standards**	

	4.1	Fiber Optic Devices: Couplers, isolators, circulators, multiplexers, Optical routers and filters, fiber gratings, Fabry parot filter and switches, wavelength converters, Add drop multiplexers, Optical Amplifiers.	**8**
	4.2	Need of SONET/SDH, SONET and SDH standards, protection schemes in SONET/SDH.	
5		**Optical Networks**	
	5.1	Operational principle of WDM, WDM network elements, Types of WDM Networks.	**6**
	5.2	OTDM, multiplexing and de-multiplexing.	
	5.3	FTTH networks	
6		**Network Design and advances in Optical Networks**	**4**
	6.1	Network management functions (configuration management, performance management, fault management) and optical safety	
	6.2	Introduction to free space optics and its challenges	
	6.3	Photonic Crystal Fiber and applications	
		Total	**39**

Textbooks:

1	John M. Senior, —Optical Fiber Communication, Prentice Hall of India Publication, Chicago, 3rd Edition, 2013
2	Gerd Keiser, —Optical Fiber Communication, Mc-Graw Hill Publication, Singapore, 4th Edition, 2012.
3	T.L. Singhal –Optical Fiber Communication Principles and Applications, Cambridge Press, Edition 2016.
4	Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, Optical Networks: A Practical Perspective, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
5	Ivan B. Djordjevin,__Advanced Optical and Wireless Communication Systems, Springer, Edition 2018

6	Debasish Datta, Optical Networks, Oxword Cambridge University Press,2021
7	Kaushal, H.Jain, V.K. Kar,S, Free Space Optical Communication ,Springer,2017
Reference Books:	
1	G Agarwal, Fiber optic communication System, John Wiley and Sons, 3rd Edition, New York 2014
2	Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perespectiv, Elsevier Publication Elsevier India Pvt.ltd, 3rd Edition, 2010
3	P.E.Green, Optical Network, Prentice Hall,1994.
4	Biswanath Mukherjee, —Optical Communication Network, McGraw-Hill, 1997.
5	Le Nguyen Binh, —Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink, CRC Press, 2010
6	Harry G. Parros, Communication Oriented Networks, Wiley
7	G. Agrwal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Edition, New York, 2014.

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no.	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:

1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8011	System On chip Design	3

Prerequisite: Digital VLSI , Digital System Design, Processing, Mini Project 2B: FPGA project Design

Course Objectives:

1	To introduce modern system design using SoC
2	To understand the concept of hardware software co-design
3	To learn software and hardware design integration

Course Outcomes:

1	Explain basics of SoC design
2	Design and verify SoC system
3	Explain physical design flow
4	Analyze routing issues in SoC Design
5	Interpret complex SoC design issues
6	Explain non-technical issues related to SoC

Module		Content	Hrs
1		**Introduction to SoC Design**	**8**
	1.1	The fundamental trends of SoC design, SoC design flow, The Semiconductor Economics, Challenges in SoC design.	
	1.2	Hardware system structure, Software structure, Accelerating Processors for traditional software task, System Design with multiple processor design	
2		**System Level Design**	**5**
	2.1	Complex SoC system architecture, Processor centric SoC organization, Communication Design –Hardware and Software interconnects	
	2.2	Balancing computation and Communication, SoC Design flow, non-processor building block in SoC design	
3		**RTL Synthesis**	8
	3.1	Review of Verilog - RTL Coding and RTL Synthesis RTL coding guidelines, Synthesizable coding style, FSM Coding style, Memory Modelling.	
4		**SoC Verification**	**6**
	4.1	Verification technology options, Verification methodology. System level verification, block-level verification. Timing verification.	
5		**Embedded SoC Design**	**8**
	5.1	Introduction to Embedded System Design using Zynq, Software Development Environment, create a SoC-Based System using Programmable Logic	
6		**Reconfigurable SoC Arithmetic: Case Study**	**4**
	6.1	16 bit Carry Skip Adder on FPGA using LUT, 16 bit Carry Select Adder on FPGA using LUT, Divide-and-conquer 4 × 4 multiplier design using LUT	
		Total	**39**

Textbooks:

1	Engineering the Complex SOC: Fast, Flexible Design with Configurable Processors-Chris Rowen, Pesrson, 2004.
2	System on a chip verification: Methodology and Verification-Second edition, Prakash Rashinkar, Peter Paterson, Leena Singh, Kluwer Academic Publishers

3	Digital Design with RTL Design, VHDL and VERILOG- Frank Vahid, John Wiley and Sons Publisher, 2010
Reference Books:	
1	System-on-a-Chip: Design and Test- Rochit Rajsuman-Artech house-2002
2	VLSI Physical design Automation: Theory and Practice, Sadiq Sait, Habib Youssef, World Scientific Publishing, 1999
3	Surviving the SoC revolution- Henry Chang, Larry Cooke, Grant Martin, Kluwer Academic Publishers-2002
NPTEL course	
	1. https://nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-2.pdf 2. https://www.xilinx.com/support/university/vivado/vivado-workshops/Vivado-embedded-design-flow-zynq.html 3. https://www.xilinx.com/support/university/vivado/vivado-workshops/Vivado-adv-embedded-design-zynq.html

Internal Assessment:
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Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
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4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8012	Natural Language Processing	3

Prerequisite:

Artificial Neural Networks and Fuzzy logic

Course Objectives:

1	To understand natural language processing and to learn how to apply basic algorithms in this field.
2	To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3	To design and implement applications based on natural language processing

Course Outcomes:

1	Have a broad understanding of the field of natural language processing.
2	Understand the mathematical and linguistic preliminaries necessary for various processes in NLP
3	Be able to Design, implement and test algorithms for NLP problems
4	Perform Word-Level, Syntax-Level and Semantic-Level Analysis

5	Develop basic understanding of Pragmatics in NLP
6	Be able to apply NLP techniques to design real world NLP applications

Module no.	**Unit no.**	**Topics**	**Hrs.**
1.0	**Introduction to Natural Language Processing**		**06**
	1.1	The need of NLP. Generic NLP system, Levels of NLP	
	1.2	Stages in building a Natural Language Processing System. Challenges and ambiguities in NLP Design	
2.0	**Mathematical and Linguistic Preliminaries**		**06**
	2.1	Probability Theory, Conditional Probability and Independence, Bayes Rule, Random Variables, Probability Distributions, Statistics, Counting, Frequency, Mean and Variance	
	2.2	English Grammar, Parts of Speech, Phrase Structures	
3.0	**Word Level Analysis**		**06**
	3.1	Tokenization, Segmentation, Lemmatization, Edit Distance, Collocations, Porter Stemmer, N-gram Language Model	
	3.2	Morphological Analysis, Derivational and Reflectional Morphology	
4.0	**Syntax-Analysis**		**08**
	4.1	Tag set for English, Penn Tree bank, Introduction to Parts of Speech Tagging (POST)	
	4.2	Markov Processes, Hidden Markov Models (HMM)	
	4.3	Parts of Speech Tagging using Hidden Markov Models, Viterbi Algorithm	
5.0	**Semantic Analysis**		**08**
	5.1	Lexical Semantics, ambiguous words, word senses, Relations between senses: synonym, antonym, reversives, hyponym, hypernym, meronym, structured polysemy, metonymy, zeugma	

	5.2	Introduction to WordNet, gloss, synset, sense relations in WordNet. Cosine distance between documents. Word sense disambiguation.	
6.0	**Pragmatics and applications of NLP**		**05**
	6.1	Reference resolution: Discourse model, Reference Phenomenon, Syntactic and Semantic Constraints on co reference	
	6.2	Applications of NLP: Categorization, Summarization, Sentiment Analysis, Named Entity Recognition, Machine Translation, Information Retrieval, Question Answer System	
		TOTAL	**39**

Textbooks:	
1	Daniel Jurafsky, James H. Martin, Speech and Language Processing,‖ Second Edition, Prentice Hall.
2	Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
Reference Books:	
1	Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly, first edition, 2011.
2	Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor), The Handbook of Computational Linguistics and Natural Language Processing, first Edition, 2010.
NPTEL / Swayam Courses:	
1	Course: Natural Language Processing By Prof. Pawan Goyal, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_cs102/preview
2	2. Course: Applied Natural Language Processing By Prof. Ramaseshan R, CMI https://onlinecourses.nptel.ac.in/noc20_cs87/preview

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4.	Creating Proof of concept	10 marks
5.	**Mini Project / Extra Experiments/ Virtual Lab**	**10 marks**
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/ competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	**Multiple Choice Questions (Quiz)**	**5 marks**

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ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8013	Wireless Networks	3

Prerequisite: Computer Communication and Networks, Mobile Communication System

Course Objectives:

1	To analyze the fundamental architecture, design issues and standards of wireless networks.
2	To compare Personal Area Network (PAN) technologies such as ZigBee, Bluetooth, UWB, NFC and 6LoWPAN.
3	To classify different LAN topologies and technologies and understand WMAN networks.
4	To classify network protocols for ad hoc networks.
5	To understand planning and design of GSM and CDMA system in Wireless WANs.
6	To apply Wireless sensor networks concepts to develop an IoT applications.

Course Outcomes: After successful completion of the course student will be able to:

1	Explain fundamental architecture, design issues and standards of wireless networks.
2	Compare different types of Personal Area Network (PAN) technologies such as ZigBee, Bluetooth, UWB, NFC and 6LoWPAN.
3	Analyse different LAN technologies and understand WMAN network architecture.
4	Compare various types of network protocols and understand Mobile ad hoc and vehicle ad hoc network
5	Evaluate the planning and design of performance of GSM and CDMA system in Wireless WANs.
6	Understand the basic network architecture of Wireless sensor networks to develop an IOT applications.

Module		**Content**	**Hrs**
1		**Overview of wireless networks**	**04**
	1.1	Wireless Networks: Architecture, Classifications, Communication Problems, Networking issues and Networking Standard.	
	1.2	Wireless Body Area Networks: Properties, Network Architecture, Network components and Applications	
2		**Wireless Personal Area Networks**	**10**
	2.1	WPAN: Bluetooth (802.15.1): Radio Specifications, Protocol Stack, Link Types, Security, Topologies, Applications.	
	2.2	ZigBee (802.15.4): Radio Specifications, Components, Topologies, Protocol Stack, Applications.	
	2.3	RFID: Radio Specifications, Architecture, Types and applications.	
	2.4	Near Field Communication & UWB (802.15.3 a): Introduction and working.	
	2.5	6LoWPAN: Features, Architecture, protocol stack and applications	
3		**Wireless Local Area and Wireless Metropolitan Network (WMAN)**	**06**
	3.1	Wireless Local Area Network: Equipment, Topologies, Technologies, Applications, Protocol Architecture of WLAN, Main features of	

		IEEE802.11a,b,e, i and n, Comparison between IEEE802.11a,b,e, i and n,	
	3.2	WMAN(IEEE802.16): Introduction, WMAN Network Architecture, Network Protocols, Broadband Wireless Networks, Applications	
4		**Wireless Adhoc Networks**	05
	4.1	Wireless Adhoc Networks: Features, advantages & Applications, Mobile Adhoc Networks: Network Architecture, MAC Protocol.	
	4.2	Vehicular Adhoc Networks (VANETs): Characteristics, Protocols & Applications	
5		**Wireless Wide Area Networks**	06
	5.1	Planning and design of Wireless Networks, Radio design for a cellular Network	
	5.2	Receiver sensitivity, Link budget for GSM and CDMA Systems, HSDPA	
6		**Advanced Technologies of Wireless Networks**	08
	6.1	Wireless Sensor Networks: Network Architecture, Design Considerations, Network Protocol Stack, and Applications	
	6.2	Wireless Mesh Network: Network architecture, Protocols, technologies & Applications	
	6.3	Internet of Things: IOT Conceptual Frame work, Architecture, Technology & Examples. M2M Communication	
		Total	**39**

Textbooks:

1	Vijay K.Garg "Wireless Communications and Networking", Morgan–Kaufmann series in Networking-Elsevier.
2	Dr SunilkumarS. Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocol"Wiley India Pvt Ltd
3	Raj Kamal, "Internet of Things Architecture & Design Principles" Mcgraw Hill

Reference Books:

1	Upena Dalal "Wireless and Mobile Communications", Oxford university Press

2	Andreas F. Molisch “wireless communications” WILEY INDIA PVT LTD, Second edition.
3	Kazem Sohraby, Daniel Minoli, and Taieb Znati, “Wireless Sensor Networks: Technology, Protocols, and Applications”, Wiley Student Edition

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		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8014	Web Design	3

Prerequisite: Skill development lab Java, Skill development lab Python

Course Objectives:

1	To design and create web pages using HTML5 and CSS3.
2	To implement client-side scripting to static web pages.
3	To create dynamic web pages using server-side scripting.
4	To use MVC framework for web application development.
5	To use web services in web application development

Course Outcomes:

1	Design web pages using HTML5 and CSS3.
2	Apply the concepts of client-side validation and scripts to static web pages using JavaScript and its framework.
3	Build responsive web pages using front-end framework Bootstrap.
4	Develop a web application using appropriate web development framework.
5	Apply the concepts of server-side validation and scripts using pHp.
6	Understand working of web services.

Module		**Content**	**Hrs**
1		**INTRODUCTION TO WWW**	**3**
	1.1	Understanding web system architecture, understanding 3 - tier web architecture. Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers	
2		**CLIENT-SIDE PROGRAMMING PART I**	**5**
	2.1	**HTML:** Basic structure of an HTML5 document, Creating an HTML5 document, Markup Tags, Heading-Paragraphs, line Breaks HTML5 Tags - Introduction to elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia, Forms and other HTML5 controls	
	2.2	**CSS:** Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling 4 (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties), CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector)	

3		**CLIENT-SIDE PROGRAMMING PART II**	
	3.1	**Bootstrap:** Introduction to Bootstrap, downloading and installing Bootstrap. The Grid System: Introducing the Grid, Offsetting and Nesting, Responsive Features, Utility Classes, and Supported Devices.	**3**
	3.2	**CSS Foundations**: Typography in Bootstrap, Styling Tables, Styling Forms, Styling Buttons, Images, icons, and Thumbnails. Navigation Systems: Tabs, Pills, and Lists, Breadcrumbs and Pagination, Navigation Bar, Making the Navigation Bar Responsive.	
4		**WEB DEVELOPMENT WITH JAVA**	12
	4.1	**Server-side programming Java Servlets**: Java Servlet Architecture, Servlet Life Cycle, Form GET and POST actions, Session Handling, Understanding Cookies	
	4.2	**Client-side programming: JavaScript** Introduction to JavaScript, Lexical Structure, Types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Handling Events.	
	4.3	**Client-side programming: JavaScript framework jQuery** jQuery: jQuery Basics, jQuery Getters and Setters, Altering Document Structure, Handling events with jQuery, Animated Effects, Utility functions, jQuery Selectors and Selection Methods	
5		**SERVER-SIDE PROGRAMMING**	12
	5.1	Introduction to PHP, PHP Tags, Adding Dynamic content, accessing form variables, identifiers, user-declared variables, Data types, Constants, Operators, Control structures, Conditionals, Iteration constructs, using arrays, string manipulation and regular expressions, reusing code and writing functions	
	5.2	Designing and creating your web database, Accessing MySQL database from the Web with PHP, Session Control in PHP	
	5.3	Introduction to AJAX: AJAX design basics, AJAX vs Traditional Approach, Rich User Interface using Ajax, MVC architecture	
6		**WEB SERVICES**	4

	6.1	Introduction to Web Services: The definition of web services, basic operational model of web services (SOAP and REST), tools and technologies enabling web services, benefits and challenges of using web services	
	6.2	Web Services Architecture: Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services	
		Total	**39**

Textbooks:

1	Kogent Learning Solutions Inc,."Web Technology Black Book", Dreamtech Press, First Edition, 978-7722- 97
2	Jeffrey C. Jackson, Duquesne University,"WEB TECHNOLOGIES: A Computer Science Perspective", Pearson Prentice Hall, 2007
3	R. Nagappan, R. Skoczylas, R.P. Sriganesh,"Developing Java Web Services",Wiley India, 2008
4	Aravind Shenoy Ulrich Sossou, "Learning Bootstrap", PACKT PUBLISHING, first edn, 2015

Reference Books:

1	Ralph Moseley, M.T. Savliya , "Developing Web Applications'', Willy India, Second edn
2	Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications. https://ebooks-it.org/0470082801-ebook.htm
3	Jennifer Kyrnin, "SAMS Teach Yourself Bootstrap in 24 hours", 1st edition, Pearson Education.
4	Martin Bean, "Laravel 5 Essentials", PACKT Publishing Ltd
5	Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011.

6	Achyut S Godbole and Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
7	Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.
8	David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
9	Steven Holzner, “The Complete Reference – PHP”, Tata McGraw Hill, 2008
10	Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012.
11	J. Millman and A. Grabel, “Head First HTML and CSS”, 2nd edition, O‟ Reilly
12	Ben Frain, “Responsive Web design with HTML5 and CSS3”, PACKT Publishing Ltd.
13	L. Welling and L. Thomson, “PHP and MySQL Web Development”, 4th edition, Adison Wesley Professional.
Useful Links:	
1	www.w3schools.com

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ECCDLO801X	Department Level Optional Course-5	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
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ECCDLO801X	Department Level Optional Course-5	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8015	**RF Design**	3

Prerequisite:

- Electromagnetics and Antenna
- Microwave Engineering

Course Objectives:

1	To provide state-of-art knowledge in RF circuits and microwave systems.
2	To explain various methodologies presently prevalent for design of active and passive RF circuits.
3	To enable students to make system level design decisions.
4	To expose students to state-of-art simulation systems.
5	To teach students Computer aided design tools for analysis and design of circuits

Course Outcomes:

1	Characterize devices at higher frequencies.
2	Design and analyze RF circuits and components.

3	Design and analyze amplifiers, oscillators and mixers at microwave frequencies.
4	Analyze EMI and EMC in RF Circuits

Module		Content	Hrs
1		**Introduction to RF, Impedance Matching and RF Filter**	**08**
	1.1	**Introduction** Characteristics of RF Waves and applications, RF Components and Circuits: Equivalent Circuits of Concentrated Passive Components like Resistors, Capacitors, Inductors.	
	1.2	**RF Filter Design and Implementation:** Butterworth Filter, Chebyshev Filter, Stepped Impedance Filter.	
	1.3	**Analysis and design:** Strip lines, Microstrip lines and coupled lines.	
	1.4	**Impedance Matching:** Causes and effects, Techniques using L-C and distributed Parameters.	
2		**Device Characterization**	**06**
	2.1	Multi-port Network representation, S-parameters: Properties and characterization.	
	2.2	Spectrum Analyzer and Vector Network Analyzer Basics	
	2.3	Non-linear Measurements: Load/Source pull, Vector Network Analysis, Pulsed measurements	
	2.4	Noise Characterization: Noise Figure, Noise temperature, Noise parameters, Noise Correlation matrix.	
3		**Amplifier Design**	**10**
	3.1	Two-port power gains, Stability Determination: Mathematical and Graphical	
	3.2	Single stage amplifier design: Design for Maximum Gain, Design for Specified Gain, Low Noise Amplifier design	
	3.3	Power amplifiers: Characteristics of power amplifier and classes of amplifiers, Design of Class A power amplifier	
4		**Frequency Generation**	
	4.1	One-port and two-port microwave oscillator design, Dielectric Resonator Oscillator (DRO), Analysis of phase noise in oscillators.	

	4.2	Mixers: Characteristics, Types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, and Image reject mixers.	**06**
5		**Electromagnetic Interference in RF circuits**	
	5.1	Natural and Nuclear Sources of EMI, EMI From Apparatus and Circuits.	**05**
	5.2	Elements Of Interference including Antennas, Transmitters, Receivers and Propagation.	
	5.3	**EMI Coupling**: **Common-Mode Coupling**: Common-Mode Coupling Mechanisms Including Field to Cable, Ground Impedance, Ground Loop and Coupling Reduction Techniques. Differential-Mode Coupling: Differential-Mode Coupling Mechanisms Including Field to Cable, Cable to Cable and Coupling Reduction Techniques.	
	5.4	**Other Coupling mechanisms:** Power Supplies and Victim Amplifiers.	
6		**Electromagnetic Compatibility**	**04**
	6.1	**Electromagnetic Compatibility** The Importance of Grounding for achieving EMC, Grounding Schemes (Single Point, Multi-Point and Hybrid), Shield Grounding and Bonding. Shielding Effectiveness, Shielding Considerations (Reflective and Absorptive), Shielding Compromises (I.E., Apertures, Gaskets, Waveguide Beyond Cut-Off).	
	6.2	**EMI Diagnostics and Fixes:** Techniques Used in EMI Diagnostics and Fixes.	
	6.3	**EMC Specifications, Standards and Measurements.** A Review Of MIL-Standards, FCC And CISPR Requirements.	
		Total	**39**

Textbooks & References:

1	David Pozar, "*Microwave Engineering*", Fourth Edition, Wiley Publication, 2011.
2	Matthew M. Radmanesh, "*Radio Frequency and Microwave Electronics*", PearsonEducation, 2015.
3	F. Giannini, G. Leuzzi, "*Non-linear Microwave Circuit Design*", 1st Edition, Wiley Publication, 2004.
4	Harvey Lahpamer, "Microwave Transmission Networks Planning, Design andDeployment", Second Edition, Tata McGraw Hill, 2010.

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ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8021	Autonomous Vehicles	3

Prerequisite:

Sensor Technology

IPMV

ANNFL

Deep Learning

Course Objectives:

1	Introduction to Autonomous vehicles/SDC (Self Driving Cars), advantages and challenges in SDC's.
2	Gain Knowledge about the Sensors in SDC's.
3	Understand the in- vehicle communication aspects in SDC's
4	Understand perception and localization in SDC.
5	Get to grips with planning and control in SDC.
6	To know the various applications of SDC's.

Course Outcomes:	
1	Understand fundamentals of SDC (Self Driving Cars).
2	Compare different types of Sensors in SDC's.
3	Illustrate different protocols of In - vehicle communication for SDC's.
4	Identify perception and localization in SDC's.
5	Analyze planning and control in SDC.
6	Evaluate different applications and algorithms in SDC's

Module no.	**Unit no.**	**Topics**	**Hrs.**
1.0	**Introduction**		**04**
	1.1	Introduction to Autonomous Vehicles /Self Driving cars (SDC), Benefits of SDCs, Challenges in Current Deployment.	
	1.2	Levels of Autonomy	
2.0	**Sensors in Autonomous Vehicles**		**06**
	2.1	Camera (3D and stereo), LiDAR, Sensor Fusion	
	2.2	Passive Perception with Sonar and Millimeter Wave Radar	
	2.3	Vehicle-to-Everything Infrastructure	
3.0	**In-Vehicle Communication Systems**		**08**
	3.1	CAN: Introduction and architecture	
	3.2	CANopen: Introduction and architecture	
	3.3.	FlexRay protocol: Introduction and architecture	
	3.4	Introduction to Operating System for SDC's	
4.0	**Perception and Localization in SDC**		**09**

	4.1	Introduction to Computer vision in SDC. Artificial eyes VS human eyes. Four pillars of autonomous driving: Perception, Localization, Planning and Control.	
	4.2	Perception: Object Detection and Line Lane detection Object/ obstacle Detection: Comparison of 2D and 3D object detection. Overview of ML algorithms for obstacle detection-Histogram of Oriented Gradients (HOG), Support Vector Machine (SVM). Object detection using deep learning algorithm: Architecture of YOLO	
	4.4	Line Lane Detection: Introduction to Semantic Segmentation, architecture, overview of different semantic segmentation architecture.	
	4.4	Localization: Introduction to GNSS, GNSS error analysis, Visual Odometry, SLAM Self-Learning: Implementation of YOLO for object Detection, Implementation of semantic segmentation for images.	
5.0	**Planning and Control in SDC**		**06**
	5.1	Planning and Control: Architecture of planning and control, Traffic Prediction and routing	
	5.2	Behavioral decision, Motion Planning and feedback control.	
6.0	**Applications of SDC**		**06**
	6.1	DragonFly Model: Sensor Configuration and Software Architecture	
	6.2	Enabling Commercial Autonomous Space Robotic Explorers: Sensor configuration and its working	
	6.3	Algorithm for YOLO object detection: Detecting objects in images and Detecting objects in videos	
		TOTAL	**39**

Textbooks:	
1	Sumit Ranjan, Dr. S. Senthamilarasu - Applied Deep Learning and Computer Vision for Self Driving Cars , Packt Publishing Ltd. 2020.
2	Shaoshan Liu, Liyun Li , Jie Tang, Shuang Wu, Jean-Luc Gaudiot - Creating Autonomous Vehicle System , Second Edition , Morgan & Claypool Publishers , 2018.
3	William Ribbens - Understanding- Automotive-Electronics , Butterworth-Heinemann Publisher , Fifth Edition, 1998.
Reference Books:	
1	Markus Maurer ,J. Christian Gerdes, Barbara Lenz , Hermann Winner - Autonomous Driving Technical, Legal, Social Aspects , Springer Open, 2015.
2	Shaoshan Liu - Engineering Autonomous Vehicles and Robots, Wiley, 2020
E-Resources:	
1	Open Innovation in EVs: A case study of Tesla Motors https://www.diva-portal.org/smash/get/diva2:635929/FULLTEXT01.pdf
2	Autonomous vehicles Research report by MRCagney https://drive.google.com/drive/folders/1nxROagqwDKUpVMDLFPPgG7_DKakuyItf
3	Reinventing Safety: A Joint Approach to Automated Driving Systems Mercedes-Benz and Bosch
Online Courses	
1	https://digitaldefynd.com/best-self-driving-cars-courses/
2	https://www.classcentral.com/course/intro-self-driving-cars-13140

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

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4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

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End Semester Theory Examination:

1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
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4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8022	Satellite and Nano Satellite Communication	3

Prerequisite:

- Analog Communication
- Digital Communication

Course Objectives:

1	To understand the basics of satellite communications and different satellite orbits
2	Provide an in-depth understanding of satellite communication system operation, launching techniques, andearth station technology
3	To Analyze and evaluate satellite link design
4	To review structure design, payload and space segment related to Nano satellite

Course Outcomes:

1	Understand the basic concepts of satellite communication system and orbital parameters.
2	Explain various satellite sub-systems, earth station technologies and launching mechanisms.
3	Analyze and evaluate link budget and various performance parameters of satellite signal for proper communication.

4	Understand Nano satellite's structure design, payloads, Thermal control system and space segment

Module		Contents	Hrs.
1.0		**Overview of Satellite Systems, Orbits and Launching**	**08**
	1.1	An overview of space and classification of satellite, orbital elements: apogee and perigee heights, semi-major axis, eccentricity, and mean anomaly, argument of perigee, inclination and right ascension of the ascending node, polar orbiting satellites, Kepler's first, second and third law, Orbital perturbations, effects of a non-spherical earth, atmospheric drag.	
	1.2	Sub-satellite point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage.	
	1.3	Selection of launching site, launch window, zero and non-zero-degree latitude launching, sea launch, Launchers: Polar Satellite Launch Vehicle (PSLV), Geostationary Satellite Launch Vehicle (GSLV), Reusable launch vehicles (RLV), Sounding rockets, Fuels used for launch Vehicles.	
2.0		**Space Segment**	**04**
	2.1	Satellite configuration, transponder sub-system, antenna sub- system, AOC sub- system, TT&C sub-system, power sub-system, thermal sub-system.	
	2.2	Reliability and quality assurance	
3.0		**Earth Station**	**03**
	3.1	Design consideration	
	3.2	General configuration: block diagram, receive only type earth, transmit-receive type earth station, antenna system, feed system, tracking system, LNA and HPA	
4.0		**Satellite Losses and Links**	**10**
	4.1	Atmospheric losses, ionospheric losses, transmission losses, feeder losses, antenna misalignment losses, rain attenuation, other impairments, antenna polarization, polarization of satellite signals, cross polarization discrimination, ionospheric depolarization, rain depolarization and ice depolarization, Isotropic radiated power and link budget	
	4.2	System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature and carrier to noise ratio	
	4.3	Saturation flux density, input back off, earth station HPA, output back off and satellite TWTA output	
	4.4	Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio and intermodulation noise	
5.		**Overview of nano satellite**	**06**
	5.1	Introduction: Important transformation, Review of nano satellite, Global economics related to it, Evolution of nano satellite, ISRO's small satellite program and future scenario	

	5.2	Payloads for nano satellite: Types of payloads: Earth observation payload, communication payload and scientific payload. Design considerations for payloads	
	5.3	Nanosatellite structures: Function of satellite structure, Types of structure designs: Skin frame structure, Truss structure, Monocoque cylinders and Skin stringer structure, Overview for building of structure and materials for structures	
6.		**Space segment for nano satellite**	**08**
	6.1	Thermal control system (TCS) implementation in nano satellite and it's testing for verification of TCS. Power system design for nano satellite	
	6.2	Function and design consideration of Deployment mechanisms, Critical elements in deployment mechanisms, Overview of types of deployment mechanisms	
	6.3	On board Computer and digital electronics (OBC): Block diagram of typical OBC, Overview of OBC Software and hardware, Telemetry and telecommand, Attitude control electronics	
	6.4	Quality, Quality assurance, product assurance and reliability analysis for Nano satellite	
		Total	**39**

Textbooks & Reference Books:

1	Dennis Roddy, -Satellite Communications, 4th Ed., Mc. Graw-Hill International Ed. 2009.
2	M. Richharia, -Satellite Communication Systems Design Principles, Macmillan Press Ltd. Second Edition 2003.
3	R. N. Mutangi, — Satellite Communication, Oxford university press, 2016.
4	Gerard Maral and Michel Bousquet,-Satellite Communication Systems, 4th Edition, Wiley Publication
5	Gerard Maral, —VSAT Networks, John Willy & Sons
6	Space technology Veterans, Quintessence of Nano satellite technology (small is big), Planet aerospace India, 2020
7	Timothy Pratt, Charles Bostian, and Jeremy Allmuti, —Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd. 2004
8	Wilbur L. Pritchard, Henri G. Suyderehoud and Robert A. Nelson, -Satellite Communication systems Engineering, Pearson Publication

Internal Assessment:

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		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLOC 8023	Network Management in Telecommunication	3

Prerequisite: Computer Communication Networks

Course Objectives:

1	To understand the concepts of network management in Telecommunication (NMT), architectures and protocols.
2	To familiarize the student with the design, analysis, operation and management of modern data communications networks.
3	To provide the student with a working knowledge of the types of communication network management systems and their strengths and limitations in solving various information network management problems.

Course Outcomes:

1	Explain the need for interoperable network management and analyze the trends and development of the Telecommunications Network Management.
2	Demonstrate broad knowledge of fundamental principles and technical standards underlying NMT.
3	Describe the concepts and architecture behind standards-based network management associated with SNMP and CMIP.
4	Apply basics of telecommunication, networking and information technologies and architect and implement networked informative systems.

5	Continuously improve their knowledge of technology and communication skills.		
Module		**Content**	**Hrs**
1		**Introduction of Network Management**	**4**
	1.1	Introducing Network Design Concepts: Case histories on network, system and service management, Challenges of IT managers	
	1.2	Network Management: Goals, organization and functions	
	1.3	Network management architecture, organization network and management perspectives	
2		**OSI Network Management**	**7**
	2.1	Network Management standards	
	2.2	OSI Network Management model	
	2.3	Network Management layers	
	2.4	ISO Network Management functions	
	2.5	Communication model and functional model	
	2.6	Abstract Syntax Notation One (ASN.1): Terminology, symbols, and conventions. TLV encoding structure	
3		**Internet Management**	
	3.1	SNMP model: SNMP Organizational model, System overview, Information model, Management of Information Base	
	3.2	SNMP v1: SNMP Communication model- SNMP architecture, administrative model, SNMP Protocol specifications, SNMP operations, SNMP Functional model	**10**

	3.3	SNMPv2: Major changes in SNMPv2, SNMPv2 architecture, SNMPv2 Management Information Base, SNMPv2 protocol, Compatibility with SNMPv1	
	3.4	SNMPv3:Key features, SNMPv3 architecture, SNMPv3 applications, Security, security model, message format, SNMPv3 User- based Security Model, Access control (VACM)	
4		**Telecommunication Management Networks (TMN) and Broadband Network Management**	**5**
	4.1	Definition of TMN , TMN framework, TMN functional model	
	4.2	TMN Conceptual model, OSI functionality in TMN	
	4.3	Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service	
	4.4	ATM Network Management – ATM network reference model, ATM Management Information Base, M1, M2, M3, M4 interfaces	
5		**Network Management Tools and Applications**	**9**
	5.1	System Utilities for Network Management: Basic tools, SNMP tools and Protocol analyzer	
	5.2	Network Statistics and Measurements: Traffic load, Protocol statistics, Data and Error statistics	
	5.3	Network Management Applications: Fault, Configuration, Accounting, Performance and Security (FCAPS)	
	5.4	Event Correlation Techniques: Rule-based reasoning, Model-based reasoning, Case-based reasoning, Codebook, State Transition Graph model and Finite State Machine model	
	5.5	Policy-based Management and Service Level Management	
6		**Software Defined Network**	**4**

	6.1	Introduction to SDN, Traditional Network vs SDN network, SDN Architecture	
	6.2	Plane separation, Simple device and centralized control, Network automation and Virtualization, Openness, SDN Operation, Applications	
		Total	**39**

Textbooks:	
1	Mani Subramaniam, Network Management Principles and Practice, New Delhi: Pearson, 2010.
2	Alexander Clemm, Network Management Fundamentals, Cisco Press, December 2006, ISBN-13: 978-158720137.
3	Benoit Claise and Ralf Wolter, Network Management: Accounting and Performance Strategies, CISCO Press, 2007.
4	J. Richard Burke, Network Management: Concepts and Practice, A Hands-On Approach, Pearson Education India, 2008, ISBN-13: 978-8131718490
5	Salh Aiidarons, Thomas Plevoyak, Telecommunications Network Technologies and Implementations, Eastern Economy Edition, New Delhi:IEEE Press, 1998.
6	Henry Haojin Wang, Telecommunication Network Management, McGraw Hill, 1999.
7	Paul Goransson, Chuck B., Timothy C. "Software Defined Network-A Comprehensive Approach", Morgan Kaufman
8	Thomas Nadeau & Ken Gray, "Software Defined Networks", O'Reilly publications
9	Sanjeev Sondur, "Software Defined Networking for Beginners", ResearchGate

Useful Links:	
1	https://www.youtube.com/watch?v=liBB_Q7Go5k
2	https://www.youtube.com/watch?v=xdUjwlyyi9U
3	https://www.youtube.com/watch?v=aQGeSDauRso
4	https://nptel.ac.in/courses/117/101/117101050/

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
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ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO8024	Microstrip Antenna	3

Prerequisite:

- **Electromagnetics and Antenna**
- **Microwave Engineering**

Course Objectives:

1	Fundamental parameters and characteristics of Microstrip Antennas (MSA)
2	Design and analysis of Rectangular and Circular MSA.
3	Different compact and broadband techniques of MSA.
4	Circularly Polarized MSA's and various applications in wireless communication systems.

Course Outcomes:

1	Apply the fundamental parameters of MSA.
2	Analyze Rectangular and Circular MSA.
3	Identify various compact and broadband methods of MSA.
4	Examine the methods of circular polarization.

5	Compare various applications of MSA.

Module		Content	Hrs
1		**Introduction to Microstrip Antennas**	**05**
	1.1	Types of MSA's, Characteristics of MSA's, Advantages and Disadvantages, Applications of MSA's.	
	1.2	Reflection coefficient, VSWR, Return loss, Impedance mismatch, VSWR Bandwidth, Gain, Directivity, E-Plane and H-Plane radiation pattern, Co and Cross polarisation, Specific absorption rate (SAR), Axial ratio.	
	1.3	Feeding Techniques, brief introduction to Methods of Analysis, Surface waves.	
2		**Design of Rectangular Microstrip Antenna (RMSA)**	**08**
	2.1	Design considerations of RMSA: Resonant frequency, Voltage and Current variation, Radiation Pattern, Calculation of effective dielectric constant, actual and effective length, width, feed point location.	
	2.2	Parametric Study of RMSAs : Effect of - feed point location, width of RMSA(W), height of substrate(h), dielectric constant(Ɛr), probe diameter, finite ground plane, loss tangent.	
	2.3	Analysis of Higher order modes of RMSA	
3		**Design of Circular Microstrip Antenna (CMSA)**	**08**
	3.1	Design considerations of CMSA: Resonant frequency, Input Impedance and Voltage Distribution, Radiation Pattern, Calculation of effective dielectric constant, actual and effective radius, feed point location.	
	3.2	Parametric Study of CMSAs : Effect of loss tangent	
	3.3	Analysis of Higher order modes of CMSA	
4		**Compact and Broadband Techniques**	

	4.1	Compact Techniques for RMSA and CMSA: Introduction, Compact Shorted RMSA, Partially Shorted RMSA, Effect of Dimensions of RMSA with a Single Shorting Post, Effect of the Position of the Single Shorting Post.	**08**
	4.2	Broadband Techniques for RMSA and CMSA: Planar Multiresonator configurations (Radiating and Non-radiating Gap coupled concept), Electromagnetically coupled MSA's, Stacked Multiresonator Rectangular Patches on Thick Substrates, U slot technique.	
5		**Circularly Polarized MSAs**	**05**
	5.1	Methods to achieve Circular Polarization in MSA : single feed and dual feed.	
	5.2	Design procedure for single feed circularly polarized MSA (RMSA & CMSA).	
6		**Applications of MSA**	**05**
	6.1	Introduction: Wearable and Fractal Antennas for wireless communication systems, MIMO Patch Antenna, Reconfigurable Antenna, Implanted Antennas in the medical field.	
		Total	**39**

Textbooks:

1	Girish Kumar, K. P. Ray, "Broadband Microstrip Antennas", Artech House, 2003.
2	Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley Publication, 2016.
3	Sabban, Albert," Wearable Communication Systems and Antennas for Commercial, Sport and Medical Applications", IOP Publishing, 2018. https://dx.doi.org/10.1088/2053-2563/aade55
4	Abed, M. J. Abu-AlShaer, and A. M. Jawad, "Fractal Antennas for Wireless Communications", in Modern Printed-Circuit Antennas. London, United Kingdom: IntechOpen, 2020 [Online]. Available: https://www.intechopen.com/chapters/71491 doi: 10.5772/intechopen.90332
5	Sharawi Mohammad S., "Printed MIMO antenna engineering", Artech House Publishers, 2014.
6	J. T. Bernhard, "Reconfigurable Antennas", Morgan and Claypool Publishers, 2007.
7	Rahmat-Samii, Yahya, Kim, Jaehoon, "Implanted Antennas in Medical Wireless Communications", Morgan & Claypool Publishers, 2006. https://doi.org/10.2200/S00024ED1V01Y200605ANT001

Reference Books:	
1	Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon, "Microstrip Antenna Design Handbook", Artech House, 2001.
2	Kin-Lu Wong, "Compact and Broadband Microstrip Antennas", John Wiley & Sons Inc, United States, 2002.
3	Kai Fong Lee, Kwai Man Luk, Hau Wah Lai, "Microstrip Patch Antennas", 2nd edition, World Scientific, 2018.

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECCDLO802X	Department Level Optional Course-6	3	--	3	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECCDLO802X	Department Level Optional Course-6	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ECCDLO 8025	Augmented and Virtual Reality	3

Prerequisite: Programming Language, Computer Graphics.

Course Objectives:

1	To learn the underlying concepts of Augmented and Virtual Reality and primitives of computer graphics.
2	To understand the use of hardware devices in AR-VR systems.
3	To understand the tracking system in AR.
4	To apply the concept of calibration and registration of different components in AR system.
5	To design AR-VR applications.
6	To understand the use of AR-VR in interdisciplinary immersive applications

Course Outcomes:

1	Identify and compare different Virtual and Augmented Reality Technologies and apply modelling techniques.
2	Identify and use AR-VR hardware components.
3	Apply concepts of Computer Vision for tracking in AR Systems.

4	Apply calibration techniques and registration for components in AR.
5	Design AR-VR application.
6	Apply insights of AR-VR in different applications.

Module		Content	Hrs
1		**Introduction to Augmented and Virtual Reality**	**05**
		Definition and Scope, A Brief History of Augmented and Virtual Reality, AR-VR Architecture, Challenges with AR-VR, AR-VR systems and functionality, Types of Augmented Reality Application (Location Based AR Apps Marker-Based AR Applications). Understanding Virtual Space and Geometry: coordinate systems, Geometric Modelling, 2D transformations, 3D rotation and 6 degree of freedom, View Transformation, projective transformation, Related fields: MR, XR and ubiquitous computing and their comparison.	
2		**Visual Physiology, perception and Interaction**	**05**
		Mechanics of Sight: the visual pathway, spatial vision and depth cues. Display fundamentals, optical architecture. Augmenting displays. Multimodal Displays; Visual Perception; Spatial Display Model; Visual Displays. Mechanics of hearing, audio displays. Augmented and Virtual reality Hardware	
3		**Tracking and Computer Vision for AR**	
		Characteristics of Tracking Technology; Stationary Tracking Systems; Mobile Sensors; Optical Tracking; Sensor Fusion; Marker Tracking, infrared tracking, Natural feature tracking by detection.	**10**
4		**Calibrations and Registration**	**06**
		Camera projection and setup for AR. Camera calibration techniques. Registration	
5		**AR-VR Application Development**	**07**
		AR-VR Application Requirements, Software engineering requirements, AR-VR Design Principles, Data Flow, Scene Graphs; Developer Support: Parameter Configuration, Tools used in AR-VR development.	
6		**Applications of AR-VR and Human Factors, Legal and Social Considerations**	**06**
		Applications of AR-VR in: Edutainment, Medical, Military, Production and Manufacturing, Navigation, Astronomical Observation, E-commerce; What are	

		Human Factors, Physical Side Effects, Visual Side Effects, Legal Considerations, Moral and Ethical Considerations.	
		Total	**39**

Textbooks:	
1	John Vince, "Virtual Reality Systems", Pearson publication
2	Tony Parisi, "Learning Virtual Reality", O'REILLY'
3	Dieter Schmalsteig and Tobias Hollerer, "Augmented Reality- Principles and Practice", Pearson Education, Inc. 2016 Edition.
4	Chetankumar G Shetty, "Augmented Reality- Theory, Design and Development", Mc Graw Hill, 2020 Edition
5	Alan B. Craig, "Understanding Augmented Reality – Concepts and Applications", Morgan Kaufmann, Elsevier, 2013 Edition.
Reference Books:	
1	Borko Furht, "Handbook of Augmented Reality", Springer.
2	Erin Pangilinan, Steve Lukas, and Vasanth Mohan, "Creating Augmented and Virtual Realities"Theory and Practice for Next-Generation Spatial Computing", O'Reilly Media, Inc., 2019 Edition.
3	Jens Grubert, Dr. Raphael Grasset, "Augmented Reality for Android Application Development", PACKT Publishing.
Online References:	
1	www.nptel.ac.in
2	www.coursera.org

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment **is of 20 marks.** The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following: -

Sr.no.	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

***For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.**

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO801X	Institute Level Optional Course-2	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO801X	Institute Level Optional Course-2	20	20	60	2	--	--	100

CourseCode:	Course Title	Credit
ILO8021	Project Management	3
Prerequisite: Software Engineering and its concepts.		
Course Objectives:		
1	To familiarize the students with the use of a structured methodology/approachfor each and every unique project	
2	Awareness about the utilizing project management concepts, tools and techniques in managing the Project	
3	To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure	
4	Focus on Planning and Risk management techniques in the development ofa Project	
5	Effective Techniques for Monitoring and Control of the Projects.	
6	Awareness about the ethics to be followed in a project and quality ofleadership.	
Course Outcomes:		

1	To understand the Necessity of Project management and Project Management Knowledge Areas.
2	Apply selection criteria and select an appropriate project from different options.
3	Perform SWOT Analysis and Prepare a Work Breakdown Structure for a projectand develop a schedule based on it.
4	Identify the Risk and solution to it
5	To understand Project Monitoring and Control using various Techniques
6	Project Management towards Effective Leadership and Quality of theproject.

Module		**Content**	**Hrs**
1		**Project Management Foundation:**	6
		Definition of a project, Project v/s Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and Role of project manager. Different Forms of Project Management, Project Environment, **Project Management for Industry, Service Sector and Public Sector.** Negotiations and resolving conflicts. PM knowledge areasas per Project Management Institute (PMI).	
2		**Initiating Projects:**	6
		How to get a project started, selecting projects strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	
3		**Software Project Planning & Software CostEstimation:**	**8**
		Business Case, Project selection and Approval, Project charter, Project Scope management, Creating the WorkBreakdown Structures (WBS). Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS). Software Estimation: Size Estimation: Function Point(Numerical). Cost Estimation: COCOMO (Numerical), COCOMO-II (numerical) till Early design model.	
4		**Planning Projects:**	7

		Crashing project time, Resource loading and leveling,Goldratt's critical chain, Project Stakeholders and Communication plan. Software Risk Management: Identify IT Project Risk, Risk Analysis and Assessment,Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation.	
5		**Monitoring and Controlling Projects:**	6
		Project Organization, Agile Project Management and Team Building, Earned Value Management techniques for measuring value of work completed; Change Management. Project Contracting: Project procurement management, contracting and outsourcing	
6		**Project Leadership and Ethics:**	6
		Introduction to project leadership, ethics in projects.Multicultural and virtual projects. Project Quality Management: Concept of Quality, Process of Quality Management, Quality Assurance Techniques Closing the Project: Process of project termination, completing a final report, doing a lesson learned analysis; acknowledging successes and failures	
		Total	**39**

Textbooks:

1	Jack Meredith & Samuel Mantel, Project Management: A managerial approach, WileyIndia, 7thEd
2	Gido Clements, Project Management, Cengage Learning.
3	Gopalan, Project Management, , WileyIndia
4	John M Nicholas, Herman Steyn , Project Management for Engineering, Business andTechnology, Routledge, Taylor Francis Group.

Reference Books:

1	Dennis Lock, Project Management, Gower Publishing England, 9 thEd.
2	Managing Information Technology Project, 6th Edition, by Kathy Schwalbe, CengageLearning publication

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO801X	Institute Level Optional Course-2	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO801X	Institute Level Optional Course-2	20	20	60	2	--	--	100

Course Code	Course Name	Credit
ILO 8022	Finance Management	3

Prerequisite:

Course Objectives:

1	To know about the Indian financial system, instruments and market.
2	To understand the relationship between risk, return and time value of Money.
3	To understand the financial statements and ratio analysis.
4	To understand capital budgeting and working capital management.
5	To know about Capital structure and its approaches.
6	To understand different dividend policy theories.

Course Outcomes: Student will be able

1	To explain Indian financial system , instrument and market
2	To determine risk , return and time value of Money with respect to financial decisions.
3	To decide investment decisions for projects with the help of financial ratios.
4	To explain capital budgeting structure and working capital management.
5	To discuss the concept of capital structure and its approaches.
6	To apply dividend policies with respect to various scenarios.

Module	Unit No.	Content	Hrs
1		**Indian Financial System**	08
	1.1	Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, Treasury Bills, Trade credit.	
	1.2	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	
	1.3	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2		**Financial Risk and Returns**	06
	2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio	
	2.2	Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	

	2.3	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3		**Corporate Finance**	09
	3.1	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	
	3.2	Overview of Financial Statements, Balance Sheet, Profit and Loss Account, and Cash Flow Statement.	
	3.3	Financial Ratio Analysis: Purpose of Financial Ratio Analysis. Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4		**Capital Budgeting**	10
	4.1	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions	
	4.2	Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	
	4.3	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity‘s Working Capital Needs; Estimation of Working Capital Requirements, Management of Inventories; Management of Receivables, and Management of Cash and Marketable Securities	
5		**Capital Structure**	03
	5.1	Factors Affecting an Entity‘s Capital Structure, Overview of Capital Structure Theories	
	5.2	Capital Structure Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach.	

		Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
6		**Dividend Policy**	03
	6.1	Meaning and Importance of Dividend Policy; Factors Affecting an Entity‘s Dividend Decision; Overview of Dividend Policy Theories and approaches—Gordon‘s Approach, Walter‘s Approach and Modigliani Miller Approach	
		Total	39

Reference Books:

1	Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2	Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3	Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4	Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO801X	Institute Level Optional Course-2	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO801X	Institute Level Optional Course-2	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ILO8023	Entrepreneurship Development and Management	3
Prerequisite: Basic Communication Skills		
Course Objectives:		
1	To acquaint with entrepreneurship and management of business	
2	Understand Indian environment for entrepreneurship	
3	Idea of EDP, MSME	
Course Outcome		
1	Understand the concept of business plan and ownerships	
2	Interpret key regulations and legal aspects of entrepreneurship in India	
3	Understand government policies for entrepreneurs	
4	Interpret key regulations and legal aspects of entrepreneurship in India	

5	Understand government policies for entrepreneurs
6	Concept of success in small business

Module		**Content**	**Hrs**
1		**Overview Of Entrepreneurship:**	4
	1.1	Definitions, Businesman v/s entrepreneur, competencies, Rolesand Functions of Entrepreneurship,	
	1.2	History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of anEntrepreneur	
	1.3	Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development:	
	1.4	Contribution of Government Agencies in Sourcing informationfor Entrepreneurship	
2		**Business Plans and Importance of Capital To Entrepreneurship: Entrepreneurship and Business Development**	9
	2.1	Preliminary and Marketing Plans, Management and Personnel,Start-up Costs and Financing as well as Projected Financial Statements,	
	2.2	Legal Section, Insurance, Suppliers and Risks, Assumptionsand Conclusion, Capital and its Importance to the Entrepreneur	
	2.3	Starting a New Business, Buying an Existing Business,New Product Development	
	2.4	Business Growth and the Entrepreneur Law and its Relevance to Business Operations	
3		**Women 's Entrepreneurship Development**	5
	3.1	Social entrepreneurship-role and need	
	3.2	EDP cell, role of sustainability	
	3.3	sustainable development for SMEs, case studies, exercises	

4		**Indian Environment for Entrepreneurship:**	8
	4.1	key regulations and legal aspects, MSMED Act 2006 and its	
		implications, schemes and policies of the Ministry of MSME,role and responsibilities of various government organizations,departments, banks etc.,	
	4.2	Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund,PMEGP, discussions, group exercises etc	
5		**Effective Management of Business:**	**8**
	5.1	Issues and problems faced by micro and small enterprises and effective management of M and S enterprises	
	5.2	BCG matrix, risk management, credit availability, technology innovation,	
	5.3	supply chain management, linkage with large industries, exercises, e-Marketing	
6		**Achieving Success In The Small Business**	5
	6.1	Stages of the small business life cycle, four types offirm-evel growth strategies, Options	
	6.2	harvesting or closing small business Critical Success factorsof small business	
		Total	**39**

Textbooks:	
1	Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
2	Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship,latest edition, The McGrawHill Company
Reference Books:	

1	T N Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
2	C N Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
3	Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
4	Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
5	Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
6	Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
7	Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
8	Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
9	Laghu Udyog Samachar
10	www.msme.gov.in www.dcmesme.gov.in www.msmetraining.gov.in

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:

Sr. No	Assessment Tools	Marks
1	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8	Multiple Choice Questions (Quiz)	5 marks
9	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 marks
10	Project based Learning and evaluation / Extra assignment / Question paper solution	10 marks
11	Multiple Choice Questions (Quiz)	5 marks
12	Literature review of papers/journals	5 marks
13	Library related work	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.	
Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
End Semester Theory Examination:	
1	Question paper will be of 60 marks and the duration will be 2 hours.
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ILO801X	Institute Level Optional Course-2	3	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem. Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ILO801X	Institute Level Optional Course-2	20	20	60	2	--	--	100

Course Code:	Course Title	Credit
ILO8029	Environmental Management	3

Prerequisite: Knowledge of Environmental Sciences

Course Objectives:

1	Understand and identify environmental issues relevant to India and global concerns.
2	Learn concepts of ecology.
3	Familiarise environment related legislation.

Course Outcomes:

1	Understand the concept of environmental management
2	Understand ecosystem and interdependence, food chain etc.
3	Understand and interpret environment related legislations

Module No.	Unit No.	Topic	Hrs.
1		**Introduction and Definition of Environment**	**10**
	1.1 **1.2**	Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, the Energy scenario.	
2		**Global Environmental concerns**	**06**
	2.1 **2.2**	**Global Environmental concerns:** Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes. Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3		**Concepts of Ecology**	**05**
	3.1	Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity.	
4		**Scope of Environment Management**	**10**
	4.1 **4.2**	Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	**10**
5		**Total Quality Environmental Management**	**05**
	5.1	ISO-14000, EMS certification.	
6		**General overview of major legislations**	**03**
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc	
		Total	**39**

Reference Books:	
1	C J Barrow, Environmental Management: Principles and Practice, Routledge Publishers London, 1999
2	Jon C. Lovett and David G. Ockwell, A Handbook of Environmental Management, Edward Elgar Publishing
3	T V Ramachandra and Vijay Kulkarni, Environmental Management, TERI Press
4	Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5	S N Chary and Vinod Vyasulu, Environmental Management: An Indian Perspective, Maclillan India, 2000
6	Mary K Theodore and Louise Theodore, Introduction to Environmental Management, CRC Press Environment and Ecology, Majid Hussain, 3 rd Ed. Access Publishing 2015

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of **20 marks**. The assessment tools for the continuous assessment will be considered on approval by the subject teachers. The assessment tools can be any 2 or max 4 of the following:

Sr.no	Assessment Tools	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk/competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*For sr.no.1, the date of certification exam should be within the term and in case a student isunable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECL801	Optical Communication and Networks Laboratory	--	2*	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECL801	Optical Communication and Networks Laboratory	--	--	--	--	25	25	50

Lab Code	Lab Name	Credit
ECC801	Optical Communication and Networks Laboratory	1

Prerequisite:

Lab Objectives:

1	To make students understand and familiarize with different types of optical fibers.
2	To enable the students to measure the fundamental parameters such as numerical aperture, losses, dispersion for single mode and multimode fibers.
3	Expose the students to characterize various sources and detectors.
4	To enable the students to analyze point-to-point optical fiber link.
5	To understand the basic concepts of multiplexing in optical systems.

Lab Outcomes:

1	To identify the different types of fibers and understand their properties.
2	To measure the losses, dispersion and compensation techniques in all optical networks.
3	To design all optical network with amplifiers and modern lasers for error free transmission.
4	To implement a point-to-point optical fiber network, WDM or DWDM Network.
5	To develop power budget and rise time budget for a given optical fiber link.

Suggested Experiments: Students are required to complete at least 8 experiments and present one case study.	
Sr. No.	**Name of the Experiment**
1	Measurement of Numerical Aperture of optical Fiber.
2	Measurement of attenuation characteristics of Fiber for different lengths.
3	Measurement of coupling losses in optical fibers.
4	Measurement of bending losses in optical fibers.
5	Simulation and study of DWDM without Dispersion Compensated Fiber using Optisystem.
6	Simulation and study of DWDM with Dispersion Compensated Fiber using Optisystem.
7	Simulation and Investigation of the L-I curves and spectrum of a FP Laser using Optisystem.
8	Simulation and Investigation of the characteristics of PIN Photodiode using Optisystem.
9	Determination of power budget (link loss) for a given optical link.
10	Determination of rise time budget (data rate) for a given optical link.
11	Case studies on recent trends in optical communication.
Term Work:	
1	Term work should be graded based on at least 8 experiments and one case study.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	TW marks: 25 Experiments: 20 marks Case study: 05-marks
Continuous assessment exam	
1	Based on the subject and related lab.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Pract.	Theory	Pract.	Tut.	Total
ECP801	Major Project-II	--	12$	--	6	--	6
Total		**12**	**14**	**12**	**7**	**--**	**19**

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract & Oral	Total
		Mid Test (MT)	Continuous Assessment (CA)					
ECP801	Major Project -II	--	--	--	--	50	100	150

Course Code:	Course Title	Credit
ECP801	Major Project - II	3

Prerequisite:
Knowledge of subjects studied during semester I-VI

Course Objectives:

1	To enable the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a social real life problem or an issue, and mapped with 17 sustainable development goals (SDGs) to transform our world via a substantial piece of work which is to be carried out over an extended period.
2	To enable the students to demonstrate to proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Course Outcomes:

1	To undertake problem identification, formulation and design engineering solutions to social problems following a systematic approach.
2	To demonstrate a sound technical knowledge of selected problems/ issues.
3	To present design/ solution in a forum/ community involving poster presentations and demonstrations of operational hardware and software of selected problem/ issue.
4	To demonstrate the knowledge, skills and attitudes of a professional engineer.

Guidelines	
1	**Project Topic:** i. To proceed with the project work it is very important to implement the idea presented in Sem VII. ii. The completed project is to be demonstrated with results, conclusion and future work. iii. Students have to submit a weekly progress report of the project to the internal guide whereas the internal guide has to keep track of the progress of the project and also has to maintain attendance reports. This progress report can be used for awarding term work marks. This progress report will be used for awarding term work marks. iv. There will be two reviews of progress of the project in the semester by the review panel assigned by Head of department, Deputy Head and department project in charge. The evaluation by review panel will be used for awarding term work marks. v. Students are to be encouraged to participate in various project competitions, national and international conferences and present their work in reputed journals. Innovative/ unique work/idea is to be encouraged to file patents to protect the innovations.
2	**Project Report Format:** At the end of semester, a project report should be submitted by the group as per given format (In LATEX only). It should preferably contain at least following details, **i. Abstract** **ii. Introduction** **iii. Literature Survey** a) Survey of Existing system b) Limitations of Existing system or research gap c) Problem Statement and Objective d) Scope **iv. Proposed System** a) Analysis/Framework/ Algorithm b) Details of Hardware & Software c) Design details d) Methodology (your approach to solve the problem) **v. Implementation steps** **vi. Conclusion** **vii. References in standard format** **Minimum number of pages should be 50.** Along with the project report a CD/ pen drive consisting of folders of project documentation, all literature survey papers, implemented code, required software, utilities, used component details, user manual etc, is to be submitted. Number of copies of the project report to be submitted: 2+ No. of students in the group

Term Work:

Distribution of marks for term work shall be as follows:

a) Weekly Attendance/discussion/Assessment

b) Project work contribution

c) Project Review I & II

d) Project Report (Hard Bound)

e) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project-II should be conducted by Internal and External examiners approved by Academic council/ Exam cell. Students have to give presentations and demonstrations on Project-II.