Electronics and Communication Engineering Department

National Institute of Technology Delhi

Teaching Scheme and Curriculum

Bachelor of Technology

(2015 Onwards)

Choice Based Flexible Credit Requirement

Sl. No.	Category of Courses	Credits offered	Minimum Credits to be Earned
1.	Basic Sciences	24	24
2.	Departmental Core	68	68
3.	Other Engineering	33	33
4.	Humanities and Social Sciences	12	12
5.	Elective	21	15
6.	Open Elective	06	03
7.	Project	14	14
8.	Mandatory Courses	09	09

Minimum Credits Required for Award of Degree = 175

Teaching Scheme

Semester I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	PHL 100	Electromagnetics and Quantum Physics	3	1	0	4
2.	CSB 101	Problem Solving and Computer Programming	3	0	2	4
3.	MAL 101	Advanced Calculus	3	1	0	4
4.	EEB 100	Introduction to Electrical and Electronics Engineering	3	0	2	4
5.	HMB 100	Professional Communication	3	0	2	4
6.	MEL 101	Environmental Studies	3	0	0	3
7.	PHP 100	Physics Laboratory	0	0	3	2
8.	MEP 103	Product Design and Realization Laboratory I	0	0	2	1
9.	EAP 101	Extra-Academic Activity	0	0	2	1
	Total Credits		18	2	13	27

Semester II

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CYL 100	Chemical Structures & Reactivity	3	1	0	4
2.	CSB 102	Data Structures	3	0	2	4
3.	MAL 151	Linear Algebra and Complex Analysis	3	1	0	4
4.	MEB 100	Engineering Visualization	3	0	2	4
5.	HMB 101	Human Values and Ethics	3	0	2	4
6.	MEL 102	Engineering Mechanics	3	0	0	3
7.	CYP 100	Chemistry Laboratory	0	0	3	2
8.	MEP 104	Product Design and Realization Laboratory II	0	0	2	1
9.	EAP 102	Extra-Academic Activity	0	0	2	1
	Total Credits		18	2	13	27

Semester III

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECB 201	Solid State Devices	3	0	2	4
2.	EEL 201	Network Analysis and Synthesis	3	1	0	4
3.	ECB 202	Digital Electronics	3	0	2	4
4.	ECL 203	Electromagnetic Theory	3	1	0	4
5.	ECB 204	Signals and Systems	3	0	2	4
6.	ECL 205	Probability Theory and Stochastic Processes	3	1	0	4
7.	ECP 201	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
	Total Credits		18	3	8	25

Semester IV

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 251	Control Theory	3	0	0	3
2.	ECB 252	Analog Electronics	3	0	2	4
3.	ECB 253	Analog Communication	3	0	2	4
4.	ECB 254	Electronic Measurement and Instrumentation	3	0	2	4
5.	CSB 253	Software Engineering	3	0	2	4
6.	ECL xxx	Elective- I (From Bouquet I)	3	0	0	3
7.	MAL 251	Partial Differential Equations and Numerical Analysis	3	1	0	4
8.	ECP 351	Summer Internship / Summer Project - I	-	-	-	-
	Total Credits		21	1	8	26

*Summer Internship I credit will be awarded in the consecutive semester i.e. in semester V

Semester V

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 301	Antenna and Wave Propagation	3	0	0	3
2.	ECB 302	Microprocessor and Microcontroller	3	0	2	4
3.	ECB 303	Digital Communication	3	0	2	4
4.	ECB 304	IC Applications	3	0	2	4
5.	ECB 305	Optical Fibre Communication	3	0	2	4
6.	ECL xxx	Elective – II (From Bouquet I)	3	0	0	3
7.	ECP 301	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
8.	ECP 351	Summer Internship I/ Summer Project	-	-	-	1
	Total Credits		18	0	10	24

List of Electives: Bouquet I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 241	Semiconductor Laser Theory	3	0	0	3
2.	ECL 242	Semiconductor Device Modeling	3	0	0	3
3.	ECL 351	Architectural Design of ICs	3	0	0	3
4.	ECL 352	Fibre Optic Sensors and Devices	3	0	0	3
5.	ECL 353	Integrated Optics	3	0	0	3
6.	ECL 243	Analytical and Computational Techniques in Electromagnetics	3	0	0	3
7.	ECL 244	Optical Networks	3	0	0	3
8.	ECL 245	Detection and Estimation Theory	3	0	0	3
9.	ECL 354	Information Theory and Coding	3	0	0	3
10.	ECL 355	Communication Networks	3	0	0	3
11.	ECL 246	RF Components and Circuit Design	3	0	0	3
12.	ECL 247	EMI and EMC Techniques	3	0	0	3
13.	ECL 356	Antenna Theory and Design	3	0	0	3
14.	ECL 357	Radar Engineering	3	0	0	3
15.	ECL 358	Satellite Communication	3	0	0	3

Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CSB 342	Computer Networks	3	0	2	4
2.	ECB 351	Basics of VLSI	3	0	2	4
3.	ECB 352	Digital Signal Processing	3	0	2	4
4.	ECL xxx	Elective – III (From Bouquet II)	3	0	0	3
5.		Open Elective – I	3	0	0	3
6.	EEB 351	Power Electronics	3	0	2	4
7.	ECP 451	Summer Internship II/ Summer Project	-	-	-	-
8.	HMP 352	Technical Communication	0	0	2	1
	Total Credits		18	0	10	23

*Summer Internship II credit will be awarded in the consecutive semester i.e. in semester VII

List of Electives for (Bouquet II):

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 361	Analog VLSI Circuits	3	0	0	3
2.	ECL 362	Digital VLSI Circuits	3	0	0	3
3.	ECL 363	Introduction to MEMS	3	0	0	3
4.	ECL 364	Wireless and Adhoc Networks	3	0	0	3
5.	ECL 365	Optical Signal Processing	3	0	0	3
6.	ECL 366	Error Control Coding	3	0	0	3
7.	ECL 367	Telecommunication Switching and Networks	3	0	0	3
8.	ECL 368	DSP Processors and Architecture	3	0	0	3
9.	ECL 369	Antenna for Wireless Communication	3	0	0	3
10.	ECL 370	Radio and Microwave Wireless Systems	3	0	0	3
11.	ECL 371	Microcontrollers for Embedded System Design	3	0	0	3
12.	ECL 372	Microprocessors and Applications	3	0	0	3

Semester VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECB 401	RF and Microwave Engineering	3	0	2	4
2.	ECL xxx	Elective – IV (From Bouquet III)	3	0	0	3
3.	ECL xxx	Elective – V (From Bouquet III)	3	0	0	3
4.		Open Elective – II	3	0	0	3
5.	ECP 402	Project Work	0	0	6	4
6.	ECP 451	Summer Internship II/ Summer Project	-	-	-	1
	Total Credits		12	0	8	18

List of Electives: (Bouquet III)

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 451	Nano-electronics and Nano-photonics	3	0	0	3
2.	ECL 452	Low Power Devices and Systems	3	0	0	3
3.	ECL 453	FPGA based Physical Design	3	0	0	3
4.	ECL 454	Micro Fabrication Technology	3	0	0	3
5.	ECL 455	Digital Image Processing	3	0	0	3
6.	ECL 456	Next Generation Networks	3	0	0	3
7.	ECL 457	Statistical Signal Processing	3	0	0	3
8.	ECL 458	Multimedia Communication and Systems	3	0	0	3
9.	ECL 459	Microwave Devices and Circuits	3	0	0	3
10.	ECL 460	RF Integrated Circuits	3	0	0	3
11.	ECL 461	Radar Signal Processing	3	0	0	3
12.	ECL 462	Millimeter Wave Technology	3	0	0	3
13.	ECL 463	Embedded System Design	3	0	0	3
14.	ECL 464	CPLD and FPGA Architectures and Applications	3	0	0	3

Semester VIII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL xxx	Elective – VI (from Bouquet IV)	3	0	0	3
2.	ECL xxx	Elective – VII (from Bouquet IV)	3	0	0	3
3.	HML 451	Industrial Management	3	0	0	3
4.	ECP 452	Project Work	0	0	15	10
	Total Credits		9	0	15	19

List of Electives: (Bouquet IV)

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 471	Analog and Mixed Signal IC Design	3	0	0	3
2.	ECL 472	Non- Linear Fibre Optics	3	0	0	3
3.	ECL 473	VLSI Interconnects	3	0	0	3
4.	ECL 474	Fault Diagnostics in Electronic Circuits	3	0	0	3
5.	ECL 475	Wavelet Transforms	3	0	0	3
6.	ECL 476	Advanced Optical Communication Systems	3	0	0	3
7.	ECL 477	Pattern Recognition and Machine Learning	3	0	0	3
8.	ECL 478	Digital Communication Techniques	3	0	0	3
9.	ECL 479	Modern Radar and Avionics Systems	3	0	0	3
10.	ECL 480	Signature Analysis and Radar Imaging	3	0	0	3
11.	ECL 481	RF and Microwave Networks	3	0	0	3
12.	ECL 482	Mixed Signal and RF Design	3	0	0	3
13.	ECL 483	Embedded Real Time Operating Systems	3	0	0	3
14.	ECL 484	Neural Networks	3	0	0	3

Credit Distribution for Branch Specific Courses

Basic Science Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	PHL 100	Electromagnetics and Quantum Physics	3	1	0	4
2.	MAL 101	Advanced Calculus	3	1	0	4
3.	PHP 100	Physics Laboratory	0	0	3	2
4.	CYL 100	Chemical Structures and Reactivity	3	1	0	4
5.	MAL 151	Linear Algebra and Complex Analysis	3	1	0	4
6.	CYP 100	Chemistry Laboratory	0	0	3	2
7.	MAL 251	Partial Differential Equations and Numerical Analysis	3	1	0	4
			15	5	6	24

Other Engineering Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CSB 101	Problem Solving and Computer Programming	3	0	2	4
2.	MEP 103	Product Design and Realization Laboratory –I	0	0	2	1
3.	MEP 104	Product Design and Realization Laboratory –II	0	0	2	1
4.	CSB 102	Data Structures	3	0	2	4
5.	MEB 100	Engineering Visualization	3	0	2	4
6.	MEL 102	Engineering Mechanics	3	0	0	3
7.	EEL 201	Network Analysis and Synthesis	3	1	0	4
8.	EEB 351	Power Electronics	3	0	2	4
9.	CSB 342	Computer Networks	3	0	2	4
10.	CSB 253	Software Engineering	3	0	2	4
			24	2	14	33

Humanities Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HMB 100	Professional Communication	3	0	2	4
2.	HMB 101	Human Values and Ethics	3	0	2	4

3.	HML 451	Industrial Management	3	0	0	3
4.	HMP 352	Technical Communication	0	0	2	1
			9	0	6	12

Departmental Elective Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL xxx	Departmental Elective – I	3	0	0	3
2.	ECL xxx	Departmental Elective – II	3	0	0	3
3.	ECL xxx	Departmental Elective – III	3	0	0	3
4.	ECL xxx	Departmental Elective – IV	3	0	0	3
5.	ECL xxx	Departmental Elective – V	3	0	0	3
6.	ECL xxx	Departmental Elective – VI	3	0	0	3
7.	ECL xxx	Departmental Elective – VII	3	0	0	3
			21	0	0	21

Open Elective Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.		Open Elective – I	3	0	0	3
2.		Open Elective – II	3	0	0	3
			6	0	0	6

Major Project Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECP 402	Project Work	0	0	6	4
2.	ECP 451	Project Work	0	0	15	10
			0	0	19	14

Other Mandatory Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MEL 101	Environmental Studies	3	0	0	3
2.	ECP 251	Summer Internship/ Summer Project – I	-	-	-	1
3.	ECP 351	Summer Internship/ Summer Project – II	-	-	-	1
4.	ECP 201	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
5.	ECP 301	Colloquium/ Industrial Lecture/ Seminar	0	0	2	1
6.	EAP 101	Extra Academic Activity I	0	0	2	1
7.	EAP 102	Extra Academic Activity II	0	0	2	1
			3	0	12	9

Core Engineering Courses:

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	EEB 100	Introduction to Electrical and Electronics Engineering	3	0	0	3
2.	ECB 201	Solid State Devices and Applications	3	0	2	4
3.	ECB 202	Digital Electronics	3	0	2	4
4.	ECL 203	Electromagnetic Theory	3	1	0	3
5.	ECB 204	Signals and Systems	3	0	2	4
6.	ECL 251	Control Theory	3	0	0	3
7.	ECB 252	Analog Electronics	3	0	2	4
8.	ECB 253	Analog Communication	3	0	2	4
9.	ECL 205	Probability Theory and Stochastic Process	3	1	0	4
10.	ECB 254	Electronic Measurement and Instrumentation	3	0	2	4
11.	ECB 302	Microprocessor and Microcontroller	3	0	2	4
12.	ECB 303	Digital Communication	3	0	2	4
13.	ECB 304	IC Applications	3	0	2	4
14.	ECB 352	Digital Signal Processing	3	0	2	4
15.	ECB 305	Optical Fibre Communication	3	0	2	4
16.	ECB 351	VLSI Design and Technology	3	0	2	4
17.	ECL 301	Antennas Wave and Propagation	3	0	0	3
18.	ECB 401	RF and Microwave Engineering	3	0	2	4
			54	2	26	68

List of Open Electives to be offered to Other Departments

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECL 700	Introduction to Nano science and Nano technology	3	0	0	3
2.	ECL 702	Growth, Fabrication and Manufacturing of Electronic Devices	3	0	0	3
3.	ECL 703	Neural Networks and Fuzzy Logic	3	0	0	3
4.	ECL 705	Electronic Materials and their Applications	3	0	0	3
5.	ECL 706	Optimization Techniques	3	0	0	3
6.	ECL 707	Green Technologies	3	0	0	3
7.	ECL 708	Machine Learning and Pattern recognition	3	0	0	3
8.	ECL 709	Wireless Communication and Sensor Networks	3	0	0	3
9.	ECL 711	Data Communication and Networking	3	0	0	3

10.	ECL 713	Micro-electronics and VLSI Technology	3	0	0	3

CURRICULUM

Course no: PHL 100	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Theory			
Course Title	**ELECTROMAGNETICS AND QUANTUM MECHANICS**			
Course Coordinator				
Course objectives:	To understand the basic concepts of electromagnetic theory through vector analysis. To understand the fundamentals of optics (interference, diffraction, and polarization), lasers, and fiber optics. To understand the origin, evolution of quantum physics (mainly particle properties of light and wave properties of particles) and solid state physics In the end, the course will briefly convey some important topics of nanotechnology and instrumentation.			
POs				
Semester	**Autumn: Yes**		**Spring: Yes**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Introduction to Electrodynamics
	Author	D. J. Griffiths
	Publisher	Addison Wesley
	Edition	3rd ed. (1999)
2.	Title	Optics
	Author	A. K. Ghatak
	Publisher	Tata McGraw-Hill Education
Reference Books:		
1.	Title	An introduction to fiber optics
	Author	A. Ghatak and K. Thyagarajan
	Publisher	Cambridge University Press
	Edition	1998

2.	Title	Concepts of Modern Physics
	Author	A. Beiser
	Publisher	Tata McGraw-Hill Education
	Edition	6th ed. (2008)
Content	**UNIT I:** **08** Vector analysis and Electromagnetic Theory: Brief review of vector algebra, Electrostatics and magnetostatics, Maxwell's equations in differential and integral forms and their interpretation, EM wave equation, transverse nature and speed of EM waves, EM energy density, Poynting vector. **UNIT II:** **12** Interference, Diffraction, and Polarization**:** Interference of EM waves**;** Division of amplitude: Uniform and wedge-shaped films; interferometers; Fresnel and Fraunhofer diffractions of EM waves; Diffraction grating; Polarization by transmission; Polarization by reflection; Double refraction. **UNIT III:** **08** Lasers and Fiber Optics: Lasers: Basic principle, Types and applications. Fiber optics: Optical wave guiding, types of optical fibers, transmission losses, fiber optic communication. **UNIT IV:** **14** Quantum Physics: Dual nature of light; Compton Effect; De-Broglie waves; Davisson-Germer Experiment; Phase and group velocities; Uncertainty principle; Wave-function; Schrodinger wave equation; Particle in a finite and infinite potential well; Tunnel effect. Superposition Principle, Continuity Equation for probability density; Stationary states, Bound states, Free-particle solution, 1-D infinite potential well, Expectation values and uncertainty relations; 1-D finite potential well, Quantum mechanical tunneling and alpha-decay, Kronig-Penny model and emergence of bands. **UNIT V:** **06** Nanotechnology and Instrumentation**:** Introduction to Nanotechnology; carbon nanotubes, Optical Microscope, Biomedical Instrumentation, Holography.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: CSB 101	**Open course (YES/NO)**		**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO		NO	NO	NO
Type of course	Theory				
Course Title	**PROBLEM SOLVING AND COMPUTER PROGRAMMING**				
Course Coordinator					
Course objectives:	This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering.				
POs					

Semester	**Autumn: Yes**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1	Title	Programming in ANSI C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	6th edition, 2012
Reference Book:		
1	Title	Let Us C
	Author	Yashavant Kanetkar
	Publisher	Infinity Science Press
	Edition	13th edition, 2012
2	Title	The C Programming Language
	Author	Brian Kernighan & Dennis Ritchie

	Publisher	Prentice Hall
	Edition	2nd Edition, 1988
3	Title	Schaum's Outline of Programming with C
	Author	Byron S Gottfried
	Publisher	TATA McGraw Hill
	Edition	2nd edition, 1996

Content	**UNIT I:** **05** Introduction to Computers: Hardware and Software. Basic Model of Computation, Notion of Algorithms, Flowcharts, Top down design, bottom up approaches of problem solving, Number system. **UNIT II:** **09** Introduction to programming language, Basics of C, Basic Data types – integer, float, double, char, Boolean, Void. Arithmetic and logical operators: precedence and associativity. Flow of Control- Conditional statements- If-else, Switch-case constructs, Loops- While, do-while, for. **UNIT III:** **07** Function – User defined functions, library functions, Parameter passing – call by value, call by reference, recursion. **UNIT IV:** **07** Arrays- Advantages and drawbacks, one-dimensional, Multi-Dimensional Arrays and strings: Declaration, Initialization, Accessing, Passing arrays and strings as parameters to functions. Pointers, Dynamic memory allocation, Dynamic arrays – One dimensional, Multidimensional dynamic array. **UNIT V:** **08** Structure: Declaration, Initialization, passing structure to function, Use of pointers in structure. Preprocessors, Macros, File management in C I/O – Opening, closing and editing files. Correctness & Efficiency Issues in Programming, Time & Space measures.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **MAL 101**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**N**
Type of Course	Theory			
Course Title	**ADVANCED CALCULUS**			
Course Coordinator				
Course objectives:	This course is aimed to cover differential, integral and vector calculus for functions of one and more than one variable. These mathematical tools and methods are used extensively in physical sciences, engineering, and computer graphics.			
POs				
Semester	**Autumn: Yes**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Thomas' Calculus
	Author	G. Thomas, M. Weir, J. Hass
	Publisher	Pearson Pub.
	Edition	2010
2.	Title	Introduction to Real Analysis
	Author	R.G. Bartle, D.R. Sherbert

	Publisher	John Wiley and Sons
	Edition	2011
Reference Books:		
1.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig
	Publisher	John Wiley and Sons
	Edition	2008
Content	**UNIT I:** **18** Differential Calculus: Limit and Continuity of functions; differentiability; Jacobian, Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Convergence of sequences and series of real numbers; Power series; Functions of several variables, limit and continuity, Partial Derivatives and Differentiability, Maxima & Minima of two variables, Lagrange method of multiplier. **UNIT II:** **14** Integral Calculus: Fundamentals theorem of integral calculus, Riemann Integration, Improper Integrals, Double and Triple integrals-computation of surface area and volumes-change of variables in double and triple integrals. **UNIT III:** **16** Vector Calculus: Scalar and vector field; Vector differentiation; Level surfaces, Directional Derivatives, Gradient of Scalar field; Divergence and Curl of a vector field; Laplacian, Line and Surface integrals; Green's theorem in plane Gauss Divergence's theorem and Stoke's theorem.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **EEB 100**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory			
Course Title	**INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING**			
Course Coordinator				
Course objectives:	To introduce the fundamentals of Electrical and electronics Engineering including circuit analysis, transformers, machines, analog and digital electronics.			
POs				
Semester	**Autumn: Yes**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Electrical and Electronic Technology
	Author	E Hughes
	Publisher	Pearson
	Edition	
2.	Title	Fundamentals of Electrical and Electronics Engineering
	Author	Smarajit Ghosh
	Publisher	PHI

	Edition	Second
3.	Title	Text book of Basic Electrical and Electronics Engineering
	Author	J.B. Gupta
	Publisher	S.K. Kataria
	Edition	
Reference Books:		
1.	Title	Electrical Engineering Fundamentals
	Author	V. D. Toro
	Publisher	Prentice Hall
	Edition	
2.	Title	Electrical Machinery
	Author	P.S. Bimbhara
	Publisher	Khanna
	Edition	
3.	Title	Integrated Electronics
	Author	Millmann & Halkias
	Publisher	TMH
	Edition	
4.	Title	Digital Logic & Computer Design
	Author	M. Morris Mano
	Publisher	Pearson
	Edition	
Content	**UNIT I:** **08** Electrical Circuit Analysis: Voltage & Current sources: dependent & independent source, source conversion. Analysis of D.C. circuits: Mesh & Loop analysis, Nodal analysis. Network Theorems: Thevenin's, Norton's, superposition theorem etc. Star- Delta circuits. 1-Φ ac Circuits: Review of 1-Φ phase ac circuits under sinusoidal steady state conditions, Resonance, Active, Reactive and Apparent power, Power factor. 3-Φ ac circuits: Balanced and Unbalanced supply, Star and Delta connections, power measurement. **UNIT II:** **06** Transformers: Magnetic Circuits: Review of laws of electromagnetism, Flux, MMF and their relation, analysis of magnetic and electric circuit. Single phase transformer: Basic concepts, constructional features, EMF equation, voltage, current and impedance transformation, Equivalent circuits. **UNIT III:** **08** Electrical Machines: DC Machines: Constructional features, working principle, emf equation, types of dc machines and their characteristics.	

	Induction Machines: Constructional features, working principle, emf equation, concept of slip and torque–slip characteristics. Synchronous Machines: Constructional features, working principle and emf equation. **UNIT IV: 08** Digital electronics: Number systems: decimal, binary, octal, hexadecimal, their complements, operation and conversion, floating point and signed numbers. Demorgan's theorem, Logic Gates: Basic and Universal Gates, their representation, truth table and realization, Half and Full adder circuits, Flip-Flops etc. **UNIT V: 06** Electronic Devices and Circuits: Introduction to semiconductors, Diodes: types of diodes and their characteristic. Bipolar Junction Transistors: working, configurations (CC, CB & CE) and mode of operation.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% Lab: Continuous Evaluation 50% End Semester 50% 60% weightage to theory and 40 % weightage to laboratory for overall grading

Course no: HMB 100	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**Yes**	**No**	**No**
Type of Course	Theory			
Course Title	**PROFESSIONAL COMMUNICATION**			
Course Coordinator				
Course objectives:	To inculcate linguistic skills in students.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Technical Communication: Principles and Practice
	Author	Raman, Meenakshi and Sharma, Sangeeta,
	Publisher	Delhi: Oxford University Press
	Edition	2004
2.	Title	Technical Writing and Professional Communication,
	Author	Thomas N Huckin and Leslie & Oslen
	Publisher	McGrow Hills
	Edition	2004
Content	**UNIT I:** **15** Theory of communication, Cycle of communication, Types of communication, Verbal and Non-verbal Communication, Oral communication, Written Communication, Body language, Paralanguage, Proxemics, Chronemics, Haptics, Flow of communication, 7Cs of communication, Barriers to communication. **UNIT II:** **15** Reading Skills: Practice in reading a wide range of texts with a view to	

	improving their reading comprehension, and also grammar and vocabulary. Reading Comprehension, reading a Novel, Note Making, Interpretation of Non Verbal Data. **UNIT III: 15** Writing Skills: Practice in Written Communication with a view to enabling independent, original and creative writing. Construction of Sentences and Paragraphs Writing for Correspondence (letters, memos, emails, and fax) Professional Writing (Process Writing, Technical Description and Report Writing), Tips for making presentation, Curriculum Vitae etc. **UNIT IV: 15** Speaking and Listening Skills (Laboratory Work) Practice in Speaking and Listening Activities with a view to improving their oral and listening skills. Individual speech sounds, Stress and Intonation patterns, Personality Development Questionnaires, Role Play, Extempore, Group Discussions, Facing Interviews, Presentation Skills.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: MEL 101	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory			
Course Title	**ENVIORNMENTAL STUDIES**			
Course Coordinator				
Course objectives:	Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. Develop analytical skills, critical thinking, and demonstrate problem-solving skills using scientific techniques.			
POs				
Semester	**Autumn: NO**		**Spring: YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course	MEL 101				
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Environmental Science and Engineering
	Author	J.G. Henry and G.W. Heinke
	Publisher	Pearson Education
	Edition	2004
Reference Books:		

1.	Title	Introduction to Environmental Engineering and Science
	Author	G.B. Masters
	Publisher	Pearson Education
	Edition	2004
Content	**UNIT I:** **06** Multidisciplinary nature of environmental studies**:** Definition, scope and importance, need for public awareness **UNIT II:** **06** Ecosystems - Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems, Biogeochemical cycles **UNIT III:** **06** Natural Resources: Concept of Renewable and non-renewable resources, Natural resources and associated problems. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Bioenergy and biofuels **UNIT IV:** **06** Bio diversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity **UNIT V:** **06** Environmental pollution: Definition, Cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards, Causes, effects and control measures of urban and industrial wastes. Pollution case studies. Solid waste Management **UNIT VI:** **06** Social Issues and Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Climate change, global	

	warming, acid rain, ozone layer depletion and Eutrophication, Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **PHP 100**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Practical			
Course Title	**PHYSICS LABORATORY**			
Course Coordinator				
Course objectives:	The course is aimed at providing the practical knowledge of: i. Basic optics experiments (Interference, diffraction, and polarization) ii. Basic semiconductor devices experiments (diode, LED etc.) Modern physics experiments (Hall effect, Planck's constant, bandgap measurement, Thompson experiment)			
POs				
Semester	**Autumn: NO**		**Spring: YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	0	0	3	2	**24**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	
	Author	
	Publisher	

	Edition	
Content	1. To study the Hall Effect and determination of hall coefficient, and charge carrier concentration. 2. To study interference and diffraction of light by slits (single, double, and/or multiple). 3. To find out wavelength of light by using plane transmission diffraction grating. 4. To study the interference of light by Fresnel's biprism. 5. To determine the wavelength of light by Newton's rings method. 6. To determine specific rotation of sugar using half shade polarimeter. 7. To study the polarization of light and verify Malus' law. 8. To determine the energy bandgap of a semiconductor by resistivity measurement. 9. To determine the e/m ratio by Thomson's method. 10. To study photoelectric effect and to determine the Planck's constant. 11. To determine Planck's constant with LED. 12. To determine the refractive index and Cauchy's constants using prism and spectrometer. 13. To find out the Resolving power of diffraction grating using spectrometer. 14. To determine the fill factor and efficiency of solar cell (in series and parallel). 15. To study LCR circuit and to find out the resonance frequency. 16. To study the V-I characteristics of silicon, germanium, and Zener diodes in forward and reverse bias. (**Note:** Any 8-10 experiments may be performed)	
Course Assessment	Continuous Evaluation 50% End Semester 50%	

Course no: **MEP 103**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Laboratory			
Course Title	**PRODUCT DESIGN & REALIZATION LABORATORY- I**			
Course Coordinator				
Course objectives:	This course is to introduce the basic principles 3D modeling of products. At the end of this course, the students could develop 3D models and their engineering drawings using software such as Solidworks etc.			
POs				
Semester	**Autumn: YES**		**Spring: NO**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	0	0	2	1	**12**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course	MEP 103				
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Solidworks 2015 For Engineers and Designers
	Author	Sham Tickoo
	Publisher	Dreamtech Press
	Edition	2016
Reference Books:		
1.	Title	Exploring Solidworks 2011: A Project Based Approach
	Author	Prof. Sham Tickoo and Sandeep Prem

	Publisher	Dreamtech Press
	Edition	2011
Content	**UNIT I:** **02** SolidWorks Basics and the User Interface: Design Intent, File References, Opening Files, The Solid Works User Interface **UNIT II:** **02** Introduction to Sketching**:** 2D Sketching, Stages in the Process, Saving Files, what are We Going to Sketch, Sketching, Sketch Entities, Basic Sketching, Rules That Govern Sketches, Design Intent, Sketch Relations, Dimensions, Extrude, Sketching Guidelines **UNIT III:** **03** Basic Part Modelling: Basic Modelling, Terminology, Choosing the Best Profile Choosing the Sketch Plane, Details of the Part, Boss Feature Sketching on a Planar Face, Cut Feature, Using the Hole Wizard, View Options, Filleting, Detailing Basics, Drawing Views, Center Marks, Dimensioning, Changing Parameters **UNIT IV:** **02** Modelling a Casting or Forging: Case Study: Ratchet, Design Intent, Boss Feature with Draft, Symmetry in the Sketch Sketching Inside the Model, View Options, Using Model Edges in a Sketch, Creating Trimmed Sketch Geometry, Using Copy and Paste **UNIT V:** **02** Patterning: Why Use Patterns?, Reference Geometry, Linear Pattern, Circular Patterns, Mirror Patterns, Using Pattern Seed Only, Sketch Driven Patterns **UNIT VI:** **02** Revolved Features**:** Case Study: Handwheel, Design Intent, Revolved Features, Building the Rim, Building the Spoke, Edit Material, Mass Properties, File Properties Using SolidWorks SimulationXpress. **UNIT VII:** **02** Shelling and Ribs: Shelling and Ribs, Analysing and Adding Draft, Other Options for Draft, Shelling, Ribs, Full Round Fillets, Thin Features **UNIT VIII:** **02** Editing: repairs: Part Editing, Editing Topics, Sketch Issues, FilletXpert, DraftXpert **UNIT IX:** **02** Editing: Design Changes: Part Editing, Design Changes, Information from a Model, Rebuilding Tools, Sketch Contours, Editing with Instant 3D **UNIT X:** **02** Configurations: Configurations, Using Configurations, Creating Configurations, Link Values Equations, Configure Dimension / Feature, Modelling Strategies for Configurations, Editing Parts that Have Configurations, Design Library. **UNIT XI:** **02** Design Drawings: More About Making Drawings, Section View, Model Views, Broken View, Detail Views, Drawing Sheets and Sheet Formats,

	Projected Views, Annotations **UNIT XII: 02** Bottom up assemble modelling: Case Study: Universal Joint, Bottom-Up Assembly, Creating a New Assembly, Position of the First Component, Feature Manager Design Tree and Symbols, Adding Components, Using Part Configurations in Assemblies, Sub-assemblies, Smart Mates Using Assemblies, Analysing the Assembly, Checking for Clearances, Changing the Values of Dimensions, Exploded Assemblies, Explode Line Sketch, Bill of Materials, Assembly Drawings Inserting Sub-assemblies, Pack and Go.
Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: CYL 100	**Open Course (YES/NO) YES**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Theory			
Course Title	**CHEMICAL STRUCTURE AND REACTIVITY**			
Course Coordinator				
Course objectives:	By learning this subject, students will be able to understand: i. The basic concept of atomic structure bonding and reactivity. ii. Also this course will also introduce students to basics of electrochemistry, reactions kinetics. iii. This course is design to impart the knowledge of structures of various molecules, their interactions, synthesis route and structural relationship. iv. At the end of this session students will able to understand about the applied chemistry especially about commercial polymer, petroleum products and engineering of materials.			
POs				

Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Inorganic Chemistry: Principles of Structure and Reactivity
	Author	J. E. Huheey
	Publisher	Pearson India
	Edition	4th Edition
2	Title	Concise Inorganic Chemistry
	Author	J. D. Lee
	Publisher	Wiley
	Edition	5th Edition
3	Title	Elements of Physical Chemistry
	Author	P. W. Atkins
	Publisher	Oxford Univ Press
	Edition	2nd Edition
4	Title	Organic Chemistry

	Author	R. T. Morrison
	Publisher	Pearson
	Edition	6th Edition
Content	**UNIT I:** **12** Fundamentals of Inorganic Chemistry: Periodic table, atomic and ionic radii, ionization energy, electron affinity, electronegativity and periodicity. Properties and chemical behavior of s, p, d and f block elements. Chemical Bonding: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O. Crystal Field Theory (CFT), comparison of the stability of octahedral and tetrahedral complexes on the basis of crystal field stabilization energy (CFSE), factor affecting the magnitude of CFSE, application of crystal field theory. Jahan-Teller effect definition and example from d^9 and high spin d^4 systems. **UNIT II:** **08** Fundamentals of Organic Chemistry: Nomenclature of organic molecules. Aromaticity: Benzenoid and non-benzenoid compounds generation and reactions. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Important name reactions and rearrangements. **UNIT III:** **08** Electrochemistry: Introduction, Types of Conductors, Conductance in Electrolytic Solutions, Factor Affecting Conductance, Kohlrausch' law of Independent Migration of Ion. Conductometric titration, Electro Chemical Cell, Electrode Potential and EMF of a Galvanic Cell, Electrochemical Series., Types of Electrode, Batteries. Chemical Kinetics: Introduction, Rate of Reaction, Average Rate and Instantaneous Rate, Rate Law Expression, Rate Constant, Factor Influencing Rate of the Reaction. Order and Molecularity of the Reaction, Zero order, First Order Chemical Kinetics, Half-life of a reaction. **UNIT IV:** **08** Types of Analysis. Separation Techniques, Potentiometry, pH metry, Spectroscopic techniques: UV-Visible spectroscopy, Lambert Beer's Law, principles and applications of UV-Visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy. **UNIT V:** Applied Chemistry **12** **Petroleum Products and Technologies:** Petroleum and petrochemicals, Petroleum cracking, reforming, synthetic petrol, knocking in petrol and diesel engines. **Industrial Polymers:** Classification of Polymers, Polymer reaction and mechanism of polymerization. Polymerization Techniques, molecular weight of polymers. Commercially important polymers: fibbers, elastomers, adhesives, plastics, vinylic and phenolics, polyesters, polyamide. **Engineering Materials:** Cement, Gypsum ($CaSO_4.2H_2O$), Plaster of Paris ($2CaSO_4.H_2O$ or $CaSO_4.1/2H_2O$), Lime, Glass, Refractories, Insulating Material.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: CSB 102	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of course	**Theory**			
Course Title	**DATA STRUCTURES**			
Course Coordinator				
Course objectives:	This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering.			
POs				

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Fundamentals of Data Structures
	Author	E. Horowitz, S. Sahni
	Publisher	Computer Science Press
	Edition	2nd Edition, 2008
Reference Book:		
1.	Title	Data Structures Using C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	2013
2.	Title	Data Structure and Program Design
	Author	R.L. Kruse
	Publisher	Prentice Hall
	Edition	2nd Edition, 1996
3.	Title	Data Structures Using C
	Author	A. M. Tanenbaum, Y. Langsam, M. J. Augenstein

	Publisher	Pearson Education
	Edition	1990
Content	**UNIT I:** **05** Introduction: Dynamic aspects of operations on data, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures, Types of data structures – linear and nonlinear. Introduction to algorithm: Asymptotic notations, Analysis of algorithms: Time and Space complexity. **UNIT II:** **07** Arrays: Dynamic memory allocation, one-dimensional arrays, multidimensional arrays, operations on arrays, storage – Row major order, Column major order. Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists. **UNIT III:** **08** Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations – infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue. **UNIT IV:** **08** Trees: Binary tree, Binary search tree, threaded binary tree, Height balanced trees, Tries, Heaps, Hash tables. Graph traversals: Breadth First Search, Depth First Search, Shortest path: Depth first search in directed and undirected graphs. Union-find data structure and applications. Directed acyclic graphs; topological sort. **UNIT V:** **08** Searching: Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort, Radix sort, Bucket sort. Algorithm design techniques: Divide and conquer, Greedy approach, dynamic programming.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: MAL 151	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**No**	**No**
Type of Course	Theory			
Course Title	**LINEAR ALGEBRA AND COMPLEX ANALYSIS**			
Course Coordinator				
Course objectives:	This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Also, this course covers basic concepts of complex analysis, such as limit, continuity, differentiability and integration, and also related theorems.			
POs				
Semester	**Autumn:**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Linear Algebra and its Applications
	Author	David C. Lay
	Publisher	Pearson Pub.
	Edition	2011
2.	Title	Complex variables and its applications
	Author	R. V. Churchill
	Publisher	McGraw Hill
	Edition	1960
Reference Books:		
1.	Title	Introduction to Linear Algebra
	Author	Gilbert Strang
	Publisher	Cambridge Press

	Edition	2009
2.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig
	Publisher	John Wiley and Sons
	Edition	2008
Content	**UNIT I:** **24** Linear Algebra: Elementary of row and column operations on a matrix, Rank of a matrix, Normal form, Inverse of matrix, Systems of linear equation and their solutions, Vector space and its subspaces, Spanning sets and linear independence, Determinant properties, Linear transformation, Range space and Rank, Null space and nullity, Eigenvalues and eigenvector, Diagonalization of matrices, Similarity of matrices, Inner product, Gram Schmidt process, Least square approximations. **UNIT II:** **24** Complex Analysis: Complex number and elementary properties, Complex Functions-Limit, continuity and differentiability, Polar form of Complex number, Cauchy Riemann Equations, Analytic and Harmonic functions, Cauchy's Theorem, Cauchy's Integral formula, Taylor and Laurent's series expansion, Zeros and singularities, Residues, Residue theorem and its applications.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: MEB 100	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**No**
Type of Course	THOERY			
Course Title	**ENGINEERING VISUALIZATION**			
Course Coordinator				
Course objectives:	1. To impart and inculcate proper understanding of the theory of projection. 2. To improve the visualization skills. 3.To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient. 4. To impart the knowledge on understanding and drawing of simple residential/office buildings.			
POs	1. Students will be able to understand the theory of projection. 2. Students will be able to know and understand the conventions and the methods of engineering drawing. 3. Students will be able to improve their visualization skills so that they can apply these skills in developing new products. 4. Students will be able to prepare simple layout of factory buildings.			
Semester	**Autumn:**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	NIL				
Text Books:					

1.	Title	Engineering Drawing
	Author	N. D. Bhatt
	Publisher	Charotar Publishing House Pvt. Ltd.
	Edition	Fifty Third 2014
Reference Books:		
1.	Title	AutoCAD 2007 Bible
	Author	E. Finkelstein
	Publisher	Wiley Publishing Inc.
	Edition	2007
Content	**OVERVIEW:** Sketching concepts. Orthographic Projections and views: Principles of Axonometric projections and Development of Isometric, Dimensioning of Orthographic Views, Sectioning in Orthographic views and assembly drawings. Introduction: Overview of the course, Examination and Evaluation patterns. **UNIT I**: **09** Lines Lettering and Dimensioning: Types of lines, Lettering, Dimensioning, Geometrical Constructions, Polygons. Scales: Plain scales, Diagonal scales, Scale of chords. **UNIT II**: **09** Curves used in Engineering Practice: Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Spiral, Helix on cone and cylinder. **UNIT III**: **09** Orthographic projection of points: Principles of Orthographic projection, Projections of points. Projections of Lines: Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes, Traces **UNIT IV**: **09** Projections of Planes: Projections of a plane perpendicular to one of the reference planes and inclined to the other, Oblique planes. **UNIT V**: **08** Projections of Solids: Projections of solids whose axis is parallel to one of the reference planes and inclined to the other, axis inclined to both the planes. **UNIT VI:** **08** Section of Solids: Sectional planes, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section. **UNIT VII:** **08** Isometric views: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Isometric views – simple objects. Assembly drawings of the machine parts. **NOTE:** Interpretation of drawings: Introduction of CAD package to construct a simple solid model, using a CAD package to construct solid models and generating orthographic, isometric, sectional views with dimensioning, Assembly of components and generation of corresponding drawings. Animation of single of machines in CAD.	
Course Assessment	Theory (60%): Continuous Evaluation 25%, Mid Semester 25% End Semester 50% Laboratory (40%): Continuous Evaluation 50%	

Course no: HMB 101	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of Course	Practical			
Course Title	**HUMAN VALUES AND ETHICS**			
Course Coordinator				
Course objectives:	To inculcate ethical understanding in students.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	Tutorial	Practical	Credits	Total Teaching Hours
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Organizational Behaviour: Text and Cases
	Author	Chitale, et.al.
	Publisher	PHI Learning Private Limited.
	Edition	
Reference Books:		
1.	Title	Ethics in Engineering
	Author	Mike W. Martin & Roland Schinzinger

	Publisher	McGraw Hills
	Edition	
Content	**UNIT I:** **15** Introduction: Organizational Systems and Resources Personality, Types of Personality, Determinants of Personality. Biographical and Personal factors. Environmental Factors. Psychological Factors. Big Five Personality traits. **UNIT II:** **15** Feelings, Classification of Feelings. Dimensions of Emotions. Emotions and External Constraints. Emotional Intelligence. Spiritual Intelligence. Authority, Responsibility and Accountability: Meaning of Authority, Responsibility and Accountability. Balance between Authority, Responsibility and Accountability. **UNIT III:** **15** Human Resource Policies& Procedures. Introduction, Importance of Policies, Policy formation, Human resources planning. Decision-making &Ethics. **UNIT IV:** **15** Concept of moral Relativism and Moral Imperialism. Cognitive Moral Development. Encouragement to Ethical Behaviour. Approaches to Fostering Ethical Behaviour.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **MEL 102**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of Course	Theory			
Course Title	**ENGINEERING MECHANICS**			
Course Coordinator				
Course objectives:	This course is to introduce the basic principles of engineering mechanics with emphasis on their analysis and application to practical engineering problems.			
POs				
Semester	**Autumn: YES**		**Spring YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course	MEL 102				
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Engineering Mechanics
	Author	Timoshenko, Young, Rao & Pati
	Publisher	McGraw Hill Education India
	Edition	5 (2013)
Reference Books:		
1.	Title	Engineering Mechanics
	Author	J.L. Meriam& L.G. Kraige

	Publisher	Wiley
	Edition	7 (2011)
Content	**UNIT I:** **03** System of Coplanar forces: Introduction to coplanar & non-coplanar force system. Forces and their components. Moment of the force about a point, couple. Resultant of coplanar force system - concurrent forces, parallel forces, non-concurrent non-parallel system of forces. **UNIT II:** **03** Equilibrium of coplanar force system: Meaning of equilibrium, free body diagrams, equilibrium of concurrent, parallel and non-concurrent non-parallel (general) system of forces. Types of supports, determination of reactions at supports for various types of determinate beams. **UNIT III:** **03** Forces in Space: Rectangular components of forces in space, Resultant of concurrent forces, moment of a force about a point, moment of a force about a given axis, resultant of general force system, Equilibrium of a particle in space. **UNIT IV:** **03** Analysis of pin jointed frame/ truss: Perfect truss, Imperfect truss, Analysis of truss by method of joints and method of section. **UNIT V:** **03** Friction: Laws of friction, angle of friction, angle of repose, cone of friction, Equilibrium of bodies on rough horizontal and inclined plane, application to problems involving wedges, ladder. Belt friction, flat belts on the flat pulleys. **UNIT VI:** **03** Centroid of Plane Areas: Concept of Centroid of plane areas. Centroid of areas by integration. Centroid of composite areas. **UNIT VII:** **03** Moment of Inertia: Moment of inertia of plane areas, parallel axis theorem. Introduction to polar moment of inertia, product of inertia and mass moment of inertia. **UNIT VIII:** **03** Kinematics of Particle: Velocity and acceleration in terms of rectangular coordinate system, rectilinear motion, motion along plane curved path, tangential and normal component of acceleration, acceleration - time, velocity- time, graphs and their use, relative velocity, projectile motion, simple harmonic motion. **UNIT IX:** **03** Kinematics of rigid bodies: Translation, pure rotation and plane motion of rigid bodies, instantaneous, centre of rotation for velocity for bodies in plane motion, link mechanisms (upto two links) **UNIT X:** **03** Kinetics of Particles: Newton's laws of motion, D'Alembert's principle, equation of dynamic equilibrium, linear motion, curvilinear motion. **UNIT XI:** **03** Energy and Momentum Principles: Work done by a force, potential and kinetic energy, power, work energy equation, principle of conservation of energy, momentum, impulse and momentum principle, principle of conservation of momentum, impact of solid bodies, elastic impact, semi-elastic impact and plastic impact.	

	UNIT XII: 03 Kinetics of rigid bodies: D'Alembert's principle for bodies under translational motion, rotational motion about a fixed axis and plane motion. Application to motion of bars, cylinders, spheres.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CYP 100	Open Course (YES/NO) YES	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of course	Practical			
Course Title	**CHEMISTRY LABORATORY**			
Course Coordinator				
Course objectives:	This course will provide the practical knowledge to the students on: i) Various types of Titrations ii) Synthesis and characterization of various organic and inorganic compounds. iii) Identification of unknown compounds iv) Hand on experience on various analytical equipments.			
POs				

Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Laboratory hours**
Contact Hours	0	0	3	2	**24**
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Essentials of Experimental Engineering Chemistry,
	Author	Shashi Chawla
	Publisher	Dhanpat Rai and Co Pvt Ltd
	Edition	4th Edition
2.	Title	Vogel's Quantitative Inorganic Analysis
	Author	G. Svehla
	Publisher	Prentice Hall
	Edition	7th Edition

Content	**1.** To find the strength in grams per liter of the given solution of sodium hydroxide with the help of stander oxalic acid solution. **2.** Estimation of water hardness by EDTA method. a. To determine the strength of calcium ion in given $CaCO_3$ solution by complexometric titrations. b. To determine the strength of magnesium ion in given $MgSO_4$ solution by complexometric titrations. c. To determine the total hardness of given water sample by

	complexometric titrations. **3.** To determination the strength of ferrous ammonium sulphate with the help of $K_2Cr_2O_7$ solution. **4.** To Preparation of a nickel complex $[Ni(NH_3)_6]Cl_2$ and estimation of nickel by complexometric titration. **5.** Preparation of benzimidazole. **6.** Identification of functional group present in an organic compound-unknown sample **7.** Measurement of physical properties: Surface tension and viscosity. **8.** Chemical kinetics- Acid hydrolysis of ethyl acetate. **9.** Acid-base titration using pH meter. **10.** Acid-base titration by conductometry.
Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: MEP 104	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Laboratory			
Course Title	**PRODUCT DESIGN & REALIZATION LABORATORY - II**			
Course Coordinator				
Course objectives:	The student will be able to identify the manufacturing processes required to manufacture an engineering product. The student will have a brief exposure of basic manufacturing machineries and processes, which are widely utilized in industries to manufacture products.			
POs				
Semester	**Autumn: NO**		**Spring: YES**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	0	0	2	1	**12**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course	MEP 104				
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Introduction to Basic Manufacturing Processes and Workshop Technology
	Author	Rajendra Singh
	Publisher	New Age International Publishers, India
	Edition	2006
Reference Books:		
1.	Title	A Textbook of Workshop Technology: Manufacturing Processes
	Author	R. S. Khurmi& J K Gupta
	Publisher	S. Chand Publications
	Edition	16/e
Content	**UNIT I:** **04** Fitting trade: Preparation of T-Shape Work piece as per the given specifications. Preparation of U-Shape Work piece that contains: Filing, Sawing, Drilling, Grinding. Practice marking operations **UNIT II:** **04**	

	Machine Shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools). Demonstration of different operations on Lathe machine. Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting. Study of Quick return mechanism of Shaper. **UNIT III: 04** Carpentry: Study of Carpentry Tools, Equipment and different joints. Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint **UNIT IV: 04** Foundry trade: Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes. Demo of mould preparation. Practice – Preparation of mould by using split pattern. **UNIT V: 04** Welding: Introduction: Study of Tools and welding Equipment (Gas and Arc welding), Selection of welding electrode and current, Bead practice, Practice of Butt Joint, Lap Joint. **UNIT VI: 04** Forging: Introduction, upsetting, drawing down, punching, bending, swaging and fullering.
Course Assessment	Continuous Evaluation 50% End Semester 50%

Course no: ECB 201	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**SOLID STATE DEVICES**			
Course Coordinator				
Course objectives:	Introduce students to the physics of semiconductors and the inner working of semiconductor devices. To Provide students the insight useful for understanding new semiconductor devices and technologies.			
POs	A student who successfully fulfills the course requirements will have demonstrated: An ability to utilize semiconductor models to analyze carrier densities and carrier transport. An ability to understand and utilize the basic governing equations to analyze semiconductor devices.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	PHL 100 EEB 100				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old course	None				
Overlap course codes as per proposed course numbers	None				

Text Books:		
1.	Title	Solid State Electronic Devices
	Author	Ben G Streetman and S. K. Banerjee
	Publisher	Pearson
	Edition	7th Edition
2.	Title	Electronic Devices and Circuits
	Author	Christos C. Halkias, Jacob Millman, Satyabrata Jit
	Publisher	Tata McGraw Hill Eucation Pvt Ltd.
	Edition	Third Edition (2010)
3.	Title	Semiconductor Devices - Basic principles
	Author	Jasprit Singh
	Publisher	Wiely Publications
	Edition	Semiconductor Devices - Basic principles
Content	**UNIT I:** **06** Introduction to Quantum Theory of Solids: Basic principles of quantum	

	mechanics, Schrodinger equation and its applications, Atoms and formation of energy bands, electrical conduction in solids, density of states functions, bonding forces and energy bands in solids. **UNIT II: 06** Semiconductor in Equilibrium: charge carriers in semiconductors, carrier concentrations, dopant atoms and energy levels, intrinsic and extrinsic semiconductors; charge neutrality, Fermi energy level. **UNIT III: 06** Carrier Transport Phenomena: Carrier drift, diffusion, graded impurity distribution, Hall Effect, scattering in semiconductors, velocity- electric field relations, high field transport charge injection and quasi Fermi levels. Non-Equilibrium Excess Carriers in Semiconductors: Carrier generation and recombination, characteristics of excess carriers, excess carrier lifetime, introduction to surface effects. **UNIT IV: 06** PN junction and hetero-structures: basic structure and principle of operation, pn junction under bias, junction capacitance, steady state conditions, transient and ac conditions, reverse bias breakdown, metal-semiconductor junctions. **UNIT V: 06** Bipolar Junction Transistors: Fundamental operation, amplification with BJTs, generalized biasing and equivalent circuit models, non-ideal effects, switching. **UNIT VI: 06** Field – Effect Transistors: Transistor operations. JFET, Metal-Semiconductor FET, MISFET, MOSFET and their operations, device characteristics, non-ideal effects, CV characteristics, equivalent circuits, HEMTS. Introduction to advanced processes and semiconductor Devices: Light emitting diodes, semiconductor lasers, photo detectors, solar cells, power devices etc. **Tentative List of Experiments:** 1. To study Cathode Ray Oscilloscope. 2. To study time constant of a RC circuit. 3. To study PN diode characteristics. 4. To study Zener diode characteristics. 5. To study half wave and full wave rectifier circuits. 6. To study Bridge wave rectifier circuit. 7. To study zener diode as a voltage regulator. 8. To study clipper and clamper circuits. 9. To study voltage multiplier circuits. 10. To study the characteristics of various transistor configurations. 11. To study the performance of CE amplifier. 12. To study the performance of CC amplifier. 13. To study the performance of CB amplifier.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: EEL 201	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Thoery			
Course Title	**NETWORK ANALYSIS AND SYNTHESIS**			
Course Coordinator				
Course objectives:	To introduce the fundamentals of network analysis using matrices, two-port, and network synthesis.			
POs				

Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Teaching Hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers	EEB 100				
Prerequisite credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	---				

Text Books:

1.	Title	Network Analysis
	Author	M.E. Van Valkenburg
	Publisher	Prentice Hall
	Edition	3rd Ed.
2.	Title	Network Analysis and Synthesis
	Author	Franklin F. Kuo
	Publisher	Wiley
	Edition	2nd Ed.
3.	Title	Engineering Circuit Analysis
	Author	W. H. Hayt and J E Kemmerly
	Publisher	TMH
	Edition	8th Ed.

Content	**UNIT I: 06** Introduction: KCL, KVL, Network theorems and its application in the analysis of networks. **UNIT II: 08** Network Functions and Response Analysis: Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function, Impulse response and complete response, Time domain behavior form pole-zero plot. **UNIT III: 07** Poly-Phase Circuits: Introduction to polyphase system, Generation of three-phase voltages, Interconnection of 3 phase sources and loads, Star-to-Delta and Delta-to-Star transformation, Voltage, current and power in a star and delta connected system, three phase balanced and unbalanced circuits. **UNIT IV: 07** Two Port networks: Two port parameters, relationships among different network parameters, inter connections of networks. **UNITV: 08** Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, properties of one port immittance functions and their synthesis, Foster and Cauer forms, RLC synthesis, Introduction to two-port network synthesis.
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECB 202**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**DIGITAL ELECTRONICS**			
Course Coordinator				
Course objectives:	To introduce number systems and basic postulates of Boolean algebra and shows the correlation between Boolean expressions. To introduce the methods for simplifying Boolean expressions. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits. To introduce the concept of memories, programmable logic devices and digital ICs.			
POs	On completion of this course, the students can design combinational and sequential digital logic circuits. Also they will have knowledge on Programmable Logic devices and its usage.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	EEB 100				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Digital Design
	Author	M. Morris Mano
	Publisher	Prentice Hall of India Pvt. Ltd./ Pearson Education (Singapore) Pvt. Ltd., New Delhi 2003
	Edition	3rd Edition, 2003

2.	Title	Fundamentals of Logic Design
	Author	Charles H. Roth
	Publisher	Thomson Learning
	Edition	2003
3.	Title	Digital Principles and Applications
	Author	Donald P. Leach and Albert Paul Malvino
	Publisher	Tata Mcgraw-Hill
	Edition	6th edition 2003

Content

UNIT I: 06

Minimization Techniques and logic gates: Boolean postulates and laws – De-Morgan's Theorem -Principle of Duality – Boolean expression – Minimization of Boolean expressions ––Minterm – Maxterm – Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions – Quine- McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – Multilevel gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates.

UNIT II: 06

Combinational circuits: Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/ Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III: 08

Sequential circuits: Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation–Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter –Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram-State table –State minimization – State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers– Shift register counters – Ring counter – Shift counters - Sequence generators.

UNIT IV: 08

Memory devices: Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – Static RAM Cell- Bipolar RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.

UNIT V: 08

Synchronous and asynchronous sequential circuit: Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits

	Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits. **Tentative List of Experiments:** 1. To study and verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, EX-OR, & EX-NOR). 2. To design and verify a half adder. 3. To design and verify a full adder. 4. To design and verify a half subtractor using logic gates. 5. To design and verify a full subtractor using IC 7483. 5. Design a 4bit magnitude comparator using combinational circuits. 6. Design a BCD to Excess 3 code converter using combinational circuits. 7. Design a BCD to decimal converter using combinational circuits. 8. Design of octal to binary converter using combinational circuits. 9. Design a 3 bit binary to gray code converter using combinational circuits. 10. Design a combinational circuit whose output is the 2's complement of the input number. 11. To design and implement multiplexer. 12. To design and implement a demultiplexer. 13. To design and verify a decoder. 14. To design and implement an encoder. 15. To design and verify the operation of RS, T and D flip-flops using logic gates. 16. To design and verify the operation of RS, T and D flip-flops using ICs. 17. To verify the operation of asynchronous and synchronous counters. 18. To verify the operation of a shift register using IC 7495, D- flipflops.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 203	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**ELECTROMAGNETIC THEORY**			
Course Coordinator				
Course objectives:	Understand The Electrostatics, Magneto statics, Maxwell's Equations EM Wave Characteristics & Transmission Lines. By the end of the semester student will demonstrate the ability to: 1. Apply vector calculus to understand the behavior of static electric fields in standard configurations. 2. Apply vector calculus to understand the behavior of static magnetic fields in standard configurations. 3. Describe and analyze electromagnetic wave propagation in free-space. 4. Describe and analyze transmission lines. 5. Work in a small team using a cooperative learning rules. 6. Communicate electromagnetic concepts both orally and in writing.			
POs	Ability to apply knowledge of mathematics, science, and engineering. Students use concepts from physics and calculus in the analysis of electromagnetic problems. Ability to identify, formulate and solve engineering problems. Students solve problems and perform simulations of field distributions and radiation patterns Ability to function in multidisciplinary teams. Students are assigned to study in base teams from the start of the semester and are required to follow cooperative learning rules of engagement. Ability to communicate effectively. Students solve problems, give oral individual presentations of solved problems, and write reports of individual and team projects.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers	PHL 100				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old					

course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Engineering Electromagnetics
	Author	William H. Hayt and John A. Buck
	Publisher	McGraw Hill Education
	Edition	8th Edition, 2012
2.	Title	Theory and Computation of Electromagnetic Fields
	Author	Jian-Ming Jin
	Publisher	John Wiley & Sons
	Edition	Second revised edition, 2015.

Content	**UNIT I: 12** Introduction to Vector Calculus: Spherical and cylindrical coordinates gradient, divergence and curl, Laplacian operator. Volume and line integrals, surface integrals, Divergence and Stoke's theorem. Dirac delta function. **UNIT II: 12** Magnetostatics: Coulomb's Law and Electric Field Intensity: The Experimental Law of Coulomb Electric Field Intensity Field Arising from a Continuous Volume Charge Distribution Field of a Line Charge Field of a Sheet of Charge Streamlines and Sketches of Fields. **UNIT III: 10** Electric Flux Density, Gauss's Law, and Divergence: Electric Flux Density, Gauss's Law, Application of Gauss's Law: Some Symmetrical Charge Distributions, Application of Gauss's Law: Differential Volume Element Divergence and Maxwell's First Equation, The Vector Operator ∇ and the Divergence Theorem. **UNIT IV: 08** Energy and Potential: Energy Expended in Moving a Point Charge in an Electric Field, The Line Integral, Definition of Potential Difference and Potential, The Potential Field of a System of Charges, Property Potential Gradient, The Electric Dipole Energy Density in the Electrostatic Field Conductors and Dielectrics **UNIT V: 06** The Steady Magnetic Field: Biot-Savart Law, Ampere's Circuital Law, Curl, Stokes' Theorem, Magnetic Flux and Magnetic Flux Density, The Scalar and Vector Magnetic Potentials, Derivation of the Steady-Magnetic-Field Laws.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECB 204**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**SIGNALS AND SYSTEMS**			
Course Coordinator				
Course objectives:	Coverage of continuous and discrete-time signals and systems, their properties and representations and methods those are necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc. Knowledge of frequency-domain representation and analysis concepts using Fourier Analysis tools, Z-transform. Mathematical and computational skills needed in application areas like communication, signal processing and control, which will be taught in other courses			
POs	Characterize and analyze the properties of CT and DT signals and systems. Analyze CT and DT systems in Time domain using convolution. Represent CT and DT systems in the Frequency domain using Fourier Analysis tools like CTFS, CTFT, DTFS and DTFT. Conceptualize the effects of sampling a CT signal Analyze CT and DT systems using Laplace transforms and Z Transforms.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Signals and Systems
	Author	Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab
	Publisher	PHI Publications
	Edition	
2.	Title	Principles of Linear Systems and Signals
	Author	B.P. Lathi
	Publisher	Oxford University Press Publications
	Edition	
3.	Title	Signals and Systems
	Author	Simon Haykin
	Publisher	John Wiley and Sons Publications
	Edition	

Content

UNIT I: 06

What is Signal and System Theory? The black-box approach. Formal definition of 'signal' and 'system'. The domain and range variables, continuous and discrete signals and cont. and discrete systems. Signal operations: folding, Shifting, scaling for Continuous and Discrete Time Signal. Characterization of systems: memory, linearity, causality, time-invariance, stability and Invertibilty. Condition on Impulse response of a system for an LTI system for memory, linearity, causality, time-invariance, stability, Invertibilty.

UNIT II: 08

Periodic signals: definition, periodicity of the sum of two signals, Orthogonal functions, Sinusoidal Fourier Series, Derivation of Fourier coefficient of sinusoidal series, continuous-time complex exponential Fourier Series. Relationship between Fourier coefficient of Sinusoidal and Exponential Fourier Series, Signal approximation using truncated Fourier series. Brief discussion of convergence issues and conditions for existence of the CTFS. Aperiodic signals and their representation: the transition from the CTFS to the Continuous Time Fourier Transform (CTFT). Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the FT. Extension of the FT for finite power signals: frequency domain Dirac impulses. Properties of the FS and FT: particular emphasis on convolution.

UNIT III: 08

A discussion of the discrete-time complex exponential. Discrete time systems and complex exponentials. Periodic discrete signals: sampling periodic continuous time signals. Periodic signal as a sum of complex exponentials. The discrete-time Fourier series: analysis and synthesis equations. The DFT: N-point DFT of an M-point signal. Aperiodic signals and their representation: the transition from the DTFS to the discrete-time Fourier Transform. Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the DTFT. Extension of the DTFT for finite power signals: frequency domain Dirac impulses. Properties of the DTFS and DTFT: particular emphasis on convolution.

UNIT IV: 08

	The principle of cont. signal sampling. The primary objective: perfect reconstruction. Ideal sampling and the sampling theorem: over- and under-sampling. Reconstruction theory: finite order interpolators and reconstruction distortion; ideal reconstruction. Non-ideal sampling and reconstruction. Sampling of discrete-time signals. **UNIT V: 06** Laplace Transform as a generalization of the FT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the LT. Inference of the FT from the LT. System characterization from the pole-zero plots. One-sided LT. The z-Transform as a generalization of the DTFT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the ZT. Inference of the DTFT from the LT. System characterization from the pole-zero plot. Cont. to discrete system transformations. One-sided ZT. **Tentative List of Experiments:** 1. Matlab Basics, Independent and dependent variable and function generation 2. Signal Generation: Such as unit impulse, unit step, Sinusoidal, exponential and others. 3. To create user function for performing signal operations: folding, Shifting, scaling, addition for continuous and discrete time signal. 4. Convolution and its properties for continuous and discrete time signal. 5.Implementation of Continuous Time Fourier Series (CTFS) of continuous periodic time signals. 6. Properties of CTFS and implementation of Discrete Time Fourier Series (DTFS) of Discrete periodic time signals. 7.Properties of DTFS. 8. Implementation of Discrete Time Fourier Transform (DTFT) of discrete time aperiodic signals. 9. Properties of DTFT. 10. Implementation of Discrete Fourier Transform (DFT) of discrete time signals.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECB 205	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**PROBABILITY THEORY AND STOCHASTIC PROCESSES**			
Course Coordinator				
Course objectives:	The objective of this course is to provide the fundamentals and advanced concepts of probability theory and random process to support graduate coursework and research in electrical, electronic and computer engineering. The required mathematical foundations will be studied at a fairly rigorous level and the applications of the probability theory and random processes to engineering problems will be emphasized. The simulation techniques will also be studied and MATLAB will be used as a software tool for bridging the probability theory and engineering applications.			
POs	On successful completion of the course, students should be able to explain fundamentals of probability theory, random variables and random processes, understand the mathematical concepts related to probability theory and random processes, understand the characterization of random processes and their properties, formulate and solve the engineering problems involving random processes, analyze the given probabilistic model of the problem, make precise statements about random processes and use computational techniques to generate simulation results.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					

Overlap course codes as per proposed course numbers	NIL				

Text Books:

1.	Title	Probability, Random Variables and Stochastic Processes
	Author	Athanasios Papoulis and S. Unnikrishna Pillai
	Publisher	Tata McGraw-Hill
	Edition	4th
2.	Title	A First Course in Probability
	Author	Sheldon M. Ross
	Publisher	Pearson
	Edition	9th
3.	Title	A Course in Probability Theory
	Author	Kai Lai Chung
	Publisher	Academic Press
	Edition	2nd

Content

UNIT I: 06

Introductory Probability: Defining Random Variables (RVs) Events, Measurability, Independence Sample Spaces, Events, Measures, Probability Independence and Conditional Probability, Bayes' Theorem.

UNIT II: 06

Random Variables Definition of Random Variables Discrete & Continuous RVs: Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Normal Expectations, Moments and Moment Generating Functions Notes: Random Vectors More to be inserted

UNIT III: 08

Intermediate Probability: Manipulating RVs Notes: Limits of Events, RVs, Distributions More to be inserted Conditioning RVs Conditional Distribution of a RV Computing Probabilities and Expectations by Conditioning IT Applications: List Model for Memory Management and Mean Time to a Pattern for Password Security Notes: Ordering and Classifying RVs.

UNIT IV: 08

Stochastic Processes: Indexing RVs Markov Chains Definition and Transition Probabilities Properties: Irreducibility, Steady-State Results and Time Reversibility Generic Applications: Hidden Markov Chains Exponential Distribution and Poisson Process Construction of Poisson Process from Exponential Distribution Conditional Arrival Times, Nonhomogeneous and Compound Poisson Processes Service Applications.

UNIT V: 08

Queues Normal Distribution and Brownian Process Construction of Brownian Process from Normal Distribution Hitting Times and Maximum Values Finance Applications: Arbitrage Theorem and Option Pricing.

Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 251	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**CONTROL THEORY**			
Course Coordinator				
Course objectives:	To understand time domain and frequency domain analysis of control systems required for stability analysis. To understand the compensation technique that can be used to stabilize control systems. To understand the open loop and closed loop (feedback) systems			
POs	Students who are successful in this class will demonstrate at least the abilities to: • Demonstrate an understanding of the fundamentals of (feedback) control systems. • Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems. Express and solve system equations in state-variable form (state variable models). • Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs. • Determine the (absolute) stability of a closed-loop control system. Apply root-locus technique to analyze and design control systems.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers	EEL-201				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course					

numbers					

Text Books:		
1.	Title	Control System Engineering
	Author	J. Nagrath and M. Gopal
	Publisher	New Age International Publishers
	Edition	5th Edition, 2007
2.	Title	Control System – Principles and Design
	Author	M. Gopal
	Publisher	Tata McGraw Hill
	Edition	2nd Edition, 2002
3.	Title	Automatic control systems
	Author	Benjamin. C. Kuo
	Publisher	Prentice Hall of India
	Edition	7th Edition, 1995
Reference Books:		
1.	Title	Digital Control and State Variable Methods
	Author	M. Gopal
	Publisher	TMH
	Edition	2nd Edition, TMH, 2007
2.	Title	Feedback and Control Systems
	Author	Schaum's Outline Series
	Publisher	Tata McGraw- Hill
	Edition	2007

Content

UNIT I: **08**

Control system modelling: Basic Elements of Control System – Open loop and Closed loop systems – Differential equation – Transfer function, Modelling of Electric systems, Translational and rotational mechanical systems – Block diagram reduction Techniques – Signal flow graph.

UNIT II: **06**

Time response analysis – First Order Systems – Impulse and Step Response analysis of second order systems – Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB.

UNIT III: **08**

Frequency Response analysis– Bode Plot, Polar Plot, Nyquist Plot – Frequency Domain specifications from the plots – Constant M and N Circles – Nichol's Chart – Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators – Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB.

UNIT IV: **06**

Stability analysis: stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram – Nyquist Stability Criterion – Relative Stability, Analysis using MATLAB.

UNIT V: **08**

State variable analysis and digital control systems: State space representation of Continuous Time systems – State equations – Transfer

	function from State Variable Representation – Solutions of the state equations – Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem – Sample & Hold – Open loop & Closed loop sampled data systems. **Tentative List of Experiments:** 1. To study D.C. speed control system on open loop and close loop. 2. To study of potentiometer displacement constant on D.C. motor position control. 3. To study of A.C. motor position control through continuous command. 4. To study Input / Output characteristic of a magnetic amplifier in mode (i) Saturable Reactor, (ii) Self Saturable Reactor. 5. To study of Synchro Transmitter in term of Position v/s Phase and voltage magnitude with respect to Rotor Voltage Magnitude/Phase. 6. To observe open loop performance of building block and calibration of PID Controls. 7. To study the open loop response on compensator. 8. Introduction to MATLAB (Control System Toolbox) and performance of different experiments.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECB 252	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**ANALOG ELECTRONICS**			
Course Coordinator				
Course objectives:	The subject aims to provide the student with: 1) An understanding of basic EE abstractions on which analysis and design of electrical and electronic circuits and systems are based, including lumped circuit, digital and operational amplifier abstractions. 2) The capability to use abstractions to analyze and design simple electronic circuits. 3) The ability to formulate and solve the differential equations describing time behaviour of circuits containing energy storage elements. 4) An understanding of how complex devices such as semiconductor diodes and field-effect transistors are modelled and how the models are used in the design and analysis of useful circuits. 5) The capability to design and construct circuits, take measurements of circuit behaviour and performance, compare with predicted circuit models and explain discrepancies.			
POs	Students will Learn how to develop and employ circuit models for elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors; Become adept at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, voltage and current dividers, and the node method; Appreciate the consequences of linearity, in particular the principle of superposition and Thevenin Norton equivalent circuits; Gain an intuitive understanding of the role of power flow and energy storage in electronic circuits; Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	ECB 201				
Prerequisite Credits	4				

Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Electronics Principles
	Author	Malvino
	Publisher	Tata McGraw Hills, New Delhi
	Edition	3rd
2.	Title	Electronic Devices and Circuits
	Author	Millman and Halkias
	Publisher	McGraw Hills, New Delhi
	Edition	2nd
3.	Title	Electronic Circuit Theory
	Author	Boylestead and Nashelski
	Publisher	Tata McGraw Hills, New Delhi
	Edition	3rd

Content

UNIT I: **06**

Transistor biasing and basic characteristics: Operating point, Bias stability, Different biasing arrangements, stabilization, Thermal runway and thermal stability, Small signal low frequency amplifiers, analysis of generalized amplifier models, Transistor hybrid models, Determination and measurement of h-parameters, analysis of transistor amplifier circuits using h- parameters.

UNIT II: **06**

Low frequency response of amplifiers: Cascading transistor amplifiers, calculations for different amplifier configurations, Emitter follower, Miller's theorem, Cascode transistor configurations, few configurations of high frequency response, Basic overview on difference and power amplifiers.

UNIT III: **06**

Large Signal Amplifier a) Difference between voltage and power amplifiers b) Importance of impedance matching in amplifiers c) Class A, Class B, Class AB, and Class C amplifiers d) Single ended power amplifiers, push-pull amplifier, and complementary symmetry push-pull amplifier.

UNIT IV: **06**

Feedback and operational amplifiers: Feedback concept, positive and negative feedback, different feedback configurations, Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Effects of real operational amplifier parameters on circuit performance. Linear applications of

	operational amplifiers: Instrumentation and Isolation amplifiers; Current and voltage sources; Active filters. Nonlinear applications of operational amplifiers: Comparators, Linearization amplifiers; Logarithmic amplifiers, multifunction modules & circuits, true rms convertors, Analog and Digital interface circuits: A/D, D/A Converters. **UNIT V: 06** Sinusoidal Oscillators a) Use of positive feedback b) Barkhausen criterion for oscillations c) Different oscillator circuits-tuned collector, Hartley Colpitts, phase shift, Wien's bridge, and crystal oscillator. Their working principles and simple numerical problems d) Series and parallel resonant circuits and bandwidth of resonant circuits e) Single and double tuned voltage amplifiers and their frequency response characteristics. **UNIT VI: 06** Multistage Amplifiers a) Need for multistage amplifier b) Gain of multistage amplifier c) Different types of multistage amplifier like RC coupled, transformer coupled, direct coupled, and their frequency response and bandwidth, Output stage and large signal amplifiers, Power amplifiers, Tuned amplifiers. Wave Shaping Circuits a) General idea about different wave shapers b) RC and RL integrating and differentiating circuits with their applications c) Diode clipping and clamping circuits and simple numerical problem on the circuits, Multivibration Circuits a) working principle of transistor as switch b) Concept of multi-vibrator: astable, monostable, and bistable and their applications c) Block diagram of IC555 and its working d) IC555 as monostable and astable multi-vibrator. Regulated DC Power Supplies a) Concept of DC power supply. Line and load regulation, Concept of fixed voltage, IC regulators (like 7805, 7905), and variable voltage regulator like (IC 723) c) Idea of SMPS. **List of Experiments:** 1. Study of Diode as clipper & clamper 2. Study of Zener diode as a voltage regulator 3. Study of ripple and regulation characteristics of full wave rectifier without and with capacitor filter 4. Study of characteristics curves of B.J.T. & F.E.T. 5. Construction of a two-stage R-C coupled amplifier & study of its gain & Bandwidth. 6. Study of class A & class B power amplifiers. 7. Study of class C & Push-Pull amplifiers. 8. Realization of current mirror & level shifter circuit using Operational Amplifiers. 9. Study of timer circuit using NE555 & configuration for monostable, bistable & astable multivibrator. 10. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip. 11. Construction of a simple function generator using IC.

	12. Realization of a V-to-I & I-to-V converter using Op-Amps. 13. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO). 15. Study of D.A.C & A.D.C 14. RC-Coupled Amplifier 15. Emitter Follower (Common Collector Amplifier) Common emitter amplifier and Differential Amplifier
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECB 253	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**ANALOG COMMUNICATION**			
Course Coordinator				
Course objectives:	To understand the basic concepts of Amplitude Modulation, Frequency modulation, Phase modulation techniques.			
POs	Describe different types of noise and predict its effect on various analog communication systems. Analyze energy and power spectral density of the signal. Express the basic concepts of analog modulation schemes Evaluate analog modulated waveform in time /frequency domain and also find modulation index. Develop understanding about performance of analog communication systems Calculate bandwidth and power requirements for analog systems. Analyze different characteristics of receiver.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	ECB-203				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Electronic Communication Systems
	Author	Kennedy, Davis
	Publisher	McGraw Hill
	Edition	4/e, 1999
2.	Title	Communication Systems
	Author	S. Haykins
	Publisher	Wiley
	Edition	4/e, 2001
3.	Title	Modern Digital and Analog Communication Systems
	Author	B.P. Lathi
	Publisher	Oxford University Press
	Edition	3/e, 1998

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Introduction to Communication Systems</td></tr>
<tr><td>Author</td><td>B. Carlson</td></tr>
<tr><td>Publisher</td><td>McGraw-Hill</td></tr>
<tr><td>Edition</td><td>4/e, 2009</td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>Modern Communication Circuits</td></tr>
<tr><td>Author</td><td>J. Smith</td></tr>
<tr><td>Publisher</td><td>McGraw Hill</td></tr>
<tr><td>Edition</td><td>2/e, 1997</td></tr>
<tr><td rowspan="4">3.</td><td>Title</td><td>Modern Electronic Communication</td></tr>
<tr><td>Author</td><td>J. S. Beasley & G. M. Miler</td></tr>
<tr><td>Publisher</td><td>Prentice Hall</td></tr>
<tr><td>Edition</td><td>9/e, 2008</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 08
Introduction: Introduction to communication systems, guided and unguided transmission media, Concept of bandwidth, electromagnetic spectrum and its usage, Review of Signal representation using Fourier Series & Fourier Transform. Introduction to Noise: Atmospheric, Thermal, Shot and Partition noise, Noise figure and experimental determination of noise figure, Shot noise in temperature limited diode and space charge limited diodes, Pulse response and Digital noise.
UNIT II: 12
Analog Modulation Techniques: Introduction and need of modulation, Theory of Amplitude Modulation; Amplitude modulation, DSB, SSB, (with and without carrier), VSB, Power Calculations, Generation of AM. Theory of Frequency Modulation (FM); FM and PM, Transmission FM spectra, Carson‘s rule, Bandwidth of FM, reactance FET modulator Armstrong method, Foster-Seely discriminator, PLL detector, Stereophonic FM, Narrow band and wide band FM. Comparison of FM and PM.
UNIT III: 08
Radio receivers: Tuned radio frequency receiver, Super heterodyne receiver, Sensitivity and selectivity, selection of IF. Block diagram and features of Communication Receiver and its spectral features.
UNIT IV: 08
Pulse Modulation Transmission and Reception: Sampling Theorem–low pass and band pass, Pulse Amplitude Modulation (PAM), Pulse Time Modulation (PTM); Pulse Width Modulation (PWM).
Tentative List of Experiments:
1. Study of AM Modulation/Demodulation.
2. Study of FM Modulation/Demodulation.
3. Study of Diode detector and AGC.
4. To study Sampling theorem.
5. Sensitivity of a superhet Receiver.
6. Selectivity of a superhet Receiver.
7. Fidelity of a superhet Receiver.
8. Study of Pulse Amplitude Modulation/Demodulation.
9. Study of Pulse Width Modulation/Demodulation.
10. Study of Pulse Position Modulation/Demodulation.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%</td></tr>
</table>

Course no: **ECB 254**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**ELECTRONIC MEASUREMENT AND INSTRUMENTATION**			
Course Coordinator				
Course objectives:	Understand the internal structure of all instruments that are used in measuring parameters related to electronics and also difference between analog meters and digital meters and their performance characteristics.			
POs	Students can understand about different instruments that are used for measurement purpose. They can analyze the Performance characteristics of each instrument. Understanding about different types of signal generators and recorders. Students can calculate all the parameters related to measurements. They can understand how waveforms can be analyzed using wave analyzers. Understanding the basic features of oscilloscope and its internal structures and different types Understanding of how different bridge networks are constructed and balanced for finding out values of resistance, capacitance and inductance. Understanding about different transducers and their working principles. Students can understand how different physical parameters can be measured.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	EEB 100 EEL 201				
Prerequisite Credits	04 + 04				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Electronic Instrumentation
	Author	H S Kalsi
	Publisher	Tata McGraw Hill
	Edition	3rd
2.	Title	Modern Electronic Instrumentation and Measurement techniques
	Author	W D Cooper
	Publisher	Prentice Hall of India
	Edition	2nd
3.	Title	Principles of Measurement & Instrumentation
	Author	Morris
	Publisher	Prentice Hall of India
	Edition	2nd
Reference Books:		
1.	Title	Transducers & Instrumentation
	Author	D.U. S Murthy
	Publisher	Prentice Hall of India
	Edition	3rd
Content	**UNIT I:** **09** Introduction, Theory of Performance: Performance characteristics of Instruments-Static, Performance characteristics of instruments-Dynamic, Types of Error- Problem, Types of Errors: Systematic & random errors Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors, Measuring Basic parameters: Electronic Multimeters, Electronic Voltmeter, Component Measuring Instruments, Q meter, Vector Impedance meter, RF Power & Voltage Measurements. **UNIT II:** **09** Oscilloscopes: CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes. Curve tracers. Signal Generation: Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators, Measurement Technique, Wave Analyzers, Frequency - selective wave analyser, heterodyne wave analyzer, Harmonic distortion analyser, Spectrum analyser. **UNIT III:** **09** Transducers: Classification, Selection Criteria, Characteristics, Construction, Working Principles, Application of following Transducers- RTD, Thermocouples, Thermistors. Characteristics, Construction, Working Principles of LVDT, RVDT, Strain Gauges, Bourdon Tubes, Bellows. Diaphragms, Seismic Accelerometers Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters. **UNIT IV:** **09** Medical Instrumentation: General introduction of medical instrumentation, its problems and specialty. Sensing devices for biomedical instruments: general requirements and special considerations. Diagnostic equipment: vector cardiograph, echocardiograph, comparison	

	of ECG, VCG and ECHO. **Tentative List of Experiments:** 1. To study block wise construction of analog oscilloscope & function generator. 2. To study block wise construction of multimeter & frequency counter. 3. To study measurement of different components and parameters like q of a coil using LCR Q –meter. 4. To study distortion factor meter and determination of the % distortion of the given oscillator. 5. To determine output characteristics of LVDT and measure displacement using LVDT. 6. To study characteristics of temperature transducer like thermocouple, thermistor and RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier. 7. Measurement of strain using strain gauge. 8. To study differential pressure transducer & signal conditioning of output signal. 9. Measurement of level using capacitive transducer. Study of distance measurement using ultrasonic transducer.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSB 253	Open course (YES/NO)		HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No		No	No	No
Type of course	**Core**				
Course Title	**SOFTWARE ENGINEERING**				
Course Coordinator					
Course objectives:	The course will cover topics regarding the software development other than programming, including testing, bug finding, verification, and validation for constructing robust code. The emphasis is on modern technology for developing reliable software at reasonable cost.				
POs					
Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1	Title	Software Engineering: A Practitioner's Approach
	Author	R. S. Pressman
	Publisher	McGraw Hill
	Edition	Seventh Edition, 2010
Reference Book:		
1	Title	Zero Defect Software
	Author	G. G. Schulmeyer
	Publisher	McGraw-Hill
	Edition	1992
2	Title	Object Oriented Modeling and Design
	Author	J. Rumbaugh
	Publisher	Prentice Hall
	Edition	1991
3	Title	Software Engineering
	Author	K.K. Aggarwal, Yogesh Singh

	Publisher	New Age International Publishers
	Edition	Third Edition, 2007
4	Title	Software Engineering
	Author	Ian Sommerville
	Publisher	Addison Wesley
	Edition	Ninth Edition
Content	**UNIT I:** **08** Introduction: What is Software Engineering and its history, software crisis, Evolution of a Programming System Product, Characteristics of Software, Brooks' No Silver Bullet, and Software Myths, Software Development Life Cycles: Software Development Process, The Code-and-Fix model, The Waterfall model, The Evolutionary Model, The Incremental Implementation, Prototyping, The Spiral Model, Software Reuse, Critical Comparisons of SDLC models, An Introduction to Non-Traditional Software Development Process: Rational Unified Process, Rapid Application Development, Agile Development Process. **UNIT II:** **08** Requirements: Importance of Requirement Analysis, User Needs, Software Features and Software Requirements, Classes of User Requirements: Enduring and Volatile, Sub phases of Requirement Analysis, Functional and Nonfunctional requirements, Barriers to Eliciting User requirements, The software requirements document and SRS standards, Requirements Engineering, Case Study of SRS for a Real Time System. Tools for Requirements Gathering: Document Flow Chart, Decision Table, Decision Tree, Introduction to nontraditional Requirements. **UNIT III:** **08** Software Design: Goals of good software design, Design strategies and methodologies, Data oriented software design, Structured Design: Structure chart, Coupling, Cohesion, Modular structure, Packaging, Object oriented design, Top-down and bottom-up approach, Design patterns, Structured Analysis: DFD, Data Dictionary, Software Measurement and Metrics: Various Size Oriented Measures: Halstead's software science, Function Point (FP) based measures, Cyclomatic Complexity Measures: Control flow graphs. Development: Selecting a language, Coding guidelines, Writing code, Code documentation. **UNIT IV:** **06** Software Testing: Testing process, Design of test cases, Functional Testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Path testing, Data flow and mutation testing, **Unit** testing, Integration and system testing, Debugging, Alpha & beta testing, testing tools & standards. **UNIT V**: **06** Software Maintenance: Management of maintenance, Maintenance process, Maintenance models, Regression testing, Reverse engineering, Software reengineering, Configuration management, documentation.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **MAL 251**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**No**	**Yes**	**No**
Type of Course	Theory			
Course Title	**PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS**			
Course Coordinator				
Course objectives:	This course provides an introduction to topics involving partial differential equations and numerical methods. Firstly, emphasis is placed on the development of abstract concepts and applications of linear and nonlinear first order partial differential equations, solution of wave, heat and Laplace's equations. Secondly, this course focuses on computational methods since mathematical models describing physical phenomena are rarely analytically solvable.			
POs				
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	1	0	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Numerical Analysis: Mathematics of Scientific

		computing
	Author	D. Kincaid and W Cheney,
	Publisher	AMS
	Edition	3rd edition 2002
2.	Title	Advanced Engineering Mathematics
	Author	E. Kreyszig,
	Publisher	John Wiley and Sons
	Edition	8th Edition, 2008.
Reference Books:		
1.	Title	An Introduction to Numerical Analysis
	Author	K. E. Atkinson
	Publisher	John Wiley and Sons
	Edition	2nd Edition 1989
Content	**UNIT I:** **24** Partial Differential Equations: Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant co-efficient, Non-homogeneous linear equations. Solutions of Wave equation, Heat equation and Laplace's equation by the method of separation of variables. **UNIT II:** **24** Numerical Analysis: Principles of floating point computations and rounding errors. Solutions of nonlinear equations: Bisection method, Newton's method and its variants, fixed point iterations, convergence analysis; Newton's method for non-linear systems. Interpolation: Polynomial interpolation, Hermite interpolation, spline interpolation, error estimates. Numerical differentiation: Based on interpolation, the method of undetermined coefficients, Richardson extrapolation, Error estimates. Numerical integration: Based on interpolation, quadrature methods, Gaussian quadrature, Error estimates. Initial value problems: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, multistep methods, stability and convergence analysis.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 241	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**SEMICONDUCTOR LASER THEORY**			
Course Coordinator				
Course objectives:	The course is designed to provide an understanding of the basic principles of operation of the modern diode semiconductor lasers. The course provides the opportunity for students to extend their background in semiconductor physics and theory and undertake advanced study and research in the variety of different branches of semiconductor optoelectronics.			
POs	When a student completes this course, s/he will understand the basic physics of optical processes in semiconductors: electronic structure, selection rules for interband and intersubband transitions, recombination, spontaneous and stimulated emission; they will be able to calculate the electrical and optical confinement in laser structures; they will understand the physics behind the semiconductor laser operation, basic parameters of laser performance and their limiting factors.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Fundamentals of Photonics
	Author	B. E. A. Saleh and M. C. Teich
	Publisher	John Wiley &Sons
	Edition	2nd Ed. (2007)
2.	Title	Semiconductor Optoelectronic Devices
	Author	P. Bhattacharya
	Publisher	Prentice Hall ofIndia (1997)

	Edition	
3.	Title	Semiconductor Optoelectronics: Physics and Technology
	Author	J. Singh
	Publisher	McGraw-Hill Inc. (1995)
	Edition	
4.	Title	Optical Fiber Communications
	Author	G. Keiser
	Publisher	McGraw-Hill Inc
	Edition	3rd Ed. (2000)
5.	Title	Photonics: Optical Electronics in Modern Communications
	Author	A. Yariv and P. Yeh
	Publisher	Oxford University Press, New York (2007)
	Edition	6th Ed.
Content	**UNIT I: 08** Gaussian Beams, TEM Modes, Higher Order Modes, Ray Tracing, Ray Matrices, Rays Analysis of Cavities Cavity Stability. Resonant Optical Cavities, General Cavity Concepts, Gaussian Beams in Cavities Cavity Q and Finesse Photon Lifetime, Atomic Radiation, Blackbody Radiation, Einstein's A and B Coefficients, **UNIT II: 08** Line Shape Amplification Line Broadening Laser Oscillation and Amplification, Threshold Conditions, Gain Saturation, Amplified Spontaneous Emission, General Characteristics of Lasers, CW Lasers, Dynamics Laser, Mode Locking, Saturable Absorbers, **UNIT III: 08** Laser Excitation: Three and Four Level Lasers, Rare Earth Lasers, Tunable Lasers, Semiconductor Lasers Semiconductor Theory, Review Diode Lasers, Quantum Effects. **UNIT IV: 05** Semiconductor Photon Sources: Electroluminescence. **UNIT V: 07** The LED: Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory and device characteristics; direct current modulation. Quantum-Well lasers; DFB, DBR and vertical-cavity surface emitting lasers (VCSEL); Laser diode arrays. Device packages and handling.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 242	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**SEMICONDUCTOR DEVICE MODELING**			
Course Coordinator				
Course objectives:	Introduce students to the physics of semiconductors and the inner working of semiconductor devices. Provide students the insight useful for understanding new semiconductor devices and technologies.			
POs	A student who successfully fulfills the course requirements will have demonstrated: An ability to utilize semiconductor models to analyze carrier densities and carrier transport. An ability to understand and utilize the basic governing equations to analyze semiconductor devices. An ability to understand and analyze the inner working of semiconductor p-n diodes, Schottky barrier diodes and new semiconductor devices.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Introduction to Semiconductor Device Modeling
	Author	C. Snowden
	Publisher	World Scientific
	Edition	1986
2.	Title	Fundamentals of Carrier Transport"
	Author	M. Lundstrom
	Publisher	Cambridge University Press
	Edition	2000

Content	**UNIT I: 05** Review of semiconductor physics: Quantum foundation, Carrier scattering, high field effects;

	UNIT II: **05** P- N junction diode modeling: Static model, Large signal model and SPICE models; **UNIT III:** **05** BJT modeling: Ebers Moll, Static, large-signal, small- signal models. Gummel - Poon model. Temperature and area effects. Power BJT model, SPICE models, Limitations of GP model; **UNIT IV:** **03** Advanced Bipolar models: VBIC, HICUM and MEXTARM; **UNIT V:** **10** MOS Transistors: LEVEL 1, LEVEL 2, LEVEL 3, BSIM, HISIMVEKV Models, Threshold voltage modeling. Punch through. Carrier velocity modeling. Short channel effects. Channel length modulation. Barrier lowering, Hot carrier effects. Mobility modeling, Model parameters; **UNIT VI:** **08** Analytical and Numerical modeling of BJT and MOS transistors: Introduction to various simulation techniques, Noise modeling; Modeling of heterostructure devices. Semi-classical Bulk Transport – Qualitative Model. Semi-classical Bulk Transport – EM field and Transport Equations. Drift-Diffusion Transport Model – Equations, Boundary Conditions, Mobility and Generation / Recombination. Characteristic times and lengths, details of Energy band diagrams, Types of Device Models – MOSFET models.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 351	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**ARCHITECTURAL DESIGN OF ICs**			
Course Coordinator				
Course objectives:	This course covers algorithm, architecture and circuit design trade-offs to optimize for power, performance and area.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Digital Integrated Circuits: A Design Perspective
	Author	J. Rabaey, A. Chandrakasan and B. Nikolic
	Publisher	Prentice Hall
	Edition	Second Edition, 2003.
2.	Title	VLSI Array Processors
	Author	S. Y. Kung
	Publisher	Prentice, Prentice-Hall, 1988.
	Edition	

Content	**UNIT I: 08** Introduction: VLSI Design flow, general design methodologies; Mapping algorithms into Architectures: Signal flow graph, data dependences, data path synthesis, control structures, critical path and worst case timing analysis, concept of hierarchical system

	design; **UNIT II: 06** Data path element: Data path design philosophies, fast adder, multiplier, driver etc., data path optimization, application specific combinatorial and sequential circuit design, CORDIC unit; **UNIT III: 06** Pipeline and parallel architectures: Architecture for real time systems, latency and throughput related issues, clocking strategy, power conscious structures, array architectures; **UNIT IV: 08** Control strategies: Hardware implementation of various control structures, micro programmed control techniques, VLIW architecture; Testable architecture: Controllability and Observability, boundary scan and other such techniques, identifying fault locations, self-reconfigurable fault tolerant structures; **UNIT V: 08** Trade off issues: Optimization with regard to speed, area and power, asynchronous and low power system design, ASIC (application specific integrated circuits) and ASISP (application specific instruction set processors) design.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 352	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**FIBRE OPTIC SENSORS AND DEVICES**			
Course Coordinator				
Course objectives:	To familiarize about fiber optic sensor technology. To study about Optical resonators. To acquire knowledge about magnetic sensors. To know about Chemical and Biosensors. To gain knowledge about smart structures.			
POs	Upon successful completion of this course, students should be able to: Explain the operation principles of various kinds of fibre sensors Evaluate the performance of simple fibre sensors for different applications. Design simple fibre sensors for specific applications Perform independent studies on new developments in the field of fibre sensors			

Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Fundamentals of Fibre Optics in Telecommunication and Sensor Systems

	Author	Bishnu P PAL
	Publisher	Wiley Eastern Ltd. (1994).
	Edition	
2.	Title	Fiber Optic Sensors: Fundamentals and Applications
	Author	David A. Krohn; Trevor W. MacDougall; Alexis Mendez
	Publisher	SPIE, 2015
	Edition	Fourth
Content	**UNIT I:** **03** Optical Sources and Detectors**:** Light-emitting diode: Principles, Structures, LED characteristics, Modulation of LED. **UNIT II:** **05** Lasers: Principles, Laser diode structures and radiation pattern, Laser characteristics, Modulation of Semiconductor Laser. Photo detectors: Principles, Quantum efficiency, Responsitivity of P.I.N photodiode, and Avalanche photodiode. **UNIT III:** **02** Optical Fiber Sensors and Devices: Overview of fibre optic sensors – advantages over conventional sensors, broadband classification. **UNIT IV:** **08** Intensity Modulated Optical Fibre Sensors: Introduction, intensity modulation through light interruption shutter/ schlieren multimode fibre optic sensors – reflective fibre optic sensors, evanescent wave fibre sensors - microbend optical fibre sensors – fibre optic refractometers, intensity modulated fibre optic thermometers, distributed sensing with fibre optics. **UNIT V:** **08** Interferometric Optical Fibre Sensors: Introduction, basic principles of interferometric optical fibre sensors, components and applications of interferometric sensors. Fused Single Mode Optical Fibre Couplers: Introduction, physical principles (coupling coefficient) polarization effect, experimental properties, theoretical modeling, and comparison with experiment. **UNIT VI:** **05** Single Mode All Fibre Components: Introduction, directional couplers, polarizes, polarization splitters polarization controllers, optical isolators, single mode fibre filters wavelength multiplexers and demultiplexers, switches and intensity modulators, phase and frequency modulators. **UNIT VI:** **02** Fibre Optic Sensor Multiplexing: Introduction, general topological configuration, and incoherent and coherent detection. **UNIT VII:** **03**	

	Signal Processing in Monomode Fibre Optic Sensor Systems: Introduction, Transduction mechanisms, Optical Signal Processing, Electronic Processing.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 353	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**INTEGRATED OPTICS**			
Course Coordinator				
Course objectives:	This course contributes to the following Program Learning Outcomes: • High levels of technical competence in the field • Be able to apply problem-solving approaches to work challenges and make decisions using sound engineering methodologies.			
POs	On completion of this course you will be able to: Describe and explain the fundamental operation of basic integrated optical components such as waveguides, coupler, interferometers, modulators, arrayed waveguide gratings, Bragg gratings and lasers. For a given solution, select appropriate integrated optic technology platforms including silica, lithium niobate, indium phosphide and silicon.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Integrated Optics-Theory and Technology
	Author	R G Hunsperger
	Publisher	Springer, 2009.

	Edition	6th
2.	Title	Optical Waveguide Theory
	Author	A W Snyder and J D Love
	Publisher	Chapman & Hall, London (1983)
	Edition	
Content	**UNIT I:** **16** Planar isotropic waveguide theory: guided and radiation modes, strip waveguides, anisotropic waveguides, end fibre, beam and waveguide couplers in semiconductors, electro-optic, acousto-optic modulators & switches, integrated opto-electronic sources and detectors, integrated optic circuits and their applications, integrated optic logic devices. **UNIT II:** **20** Compensating TE modes of a symmetric step index planar, understanding modes, TE modes of parabolic index planar waveguide, TM modes of a symmetric step index planar waveguide, waveguide theory, Single mode fibers, pulse dispersion in single mode fibers, strip and channel wave guides, anisotropic waveguides, segmented waveguide, electro-optic and acousto optic waveguide devices, directional couplers, optical switch phase and amplitude modulators, filters etc, Y junction, power splitters, arrayed waveguide devices, fiber pigtailing, fabrication and integrated optical waveguides and devices, waveguide characterization, end-fire prism coupling, grating and tapered couplers, nonlinear effects in integrated optical waveguides.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 243	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	No	No	No		Yes
Type of course	Theory		**Elective Engineering Course**		
Course Title	**ANALYTICAL AND COMPUTATIONAL TECHNIQUES IN ELECTROMAGNETICS**				
Course Coordinator					
Course objectives:	Computational techniques for practical applications in electromagnetic fields, devices, scattering, propagation, and radiation. The course reviews the electromagnetic (EM) theory, static and dynamic fields, Maxwell's equations, boundary conditions, wave equations, Lorentz potentials, Green's functions, and basic EM-field theorems. Most popular classes of computational EM methods based on differential and integral equations are studied. Solution techniques include the method of moments, finite difference method, finite element method, physical optics, and hybrid methods. Applications cover static and quasi- static problems, transmission lines, wireless propagation, scattering, radiation problems, EM compatibility, and signal integrity. The course includes about 10 computational EM projects in different techniques and different applications, using MATLAB.				
POs	This course will be suitable as an introductory level course for the technical areas of applied electromagnetics, radar, remote sensing, electronic devices, and lasers and optics. The course will provide students with an overview of the state-of-the-art in applied computational electromagnetics, covering analytical, numerical, and asymptotic techniques for solving complex electromagnetic problems. Students will develop computational skills in applied electromagnetics and related disciplines and ability not only to effectively use electromagnetic software, but also to understand the foundations of various codes. The course will expose students to examples of real-world applications of modern computational tools in electromagnetic scattering, propagation, and radiation.				
Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course					

numbers					
Text Books:					
1.	Title	Analytical and Computational Methods in Electromagnetics			
	Author	Ramesh Garg			
	Publisher	Boston, MA: Artech House			
	Edition	2008			
2.	Title	Analytical Techniques in Electromagnetics			
	Author	Matthew N. O. Sadiku, Sudarshan R. Nelatury			
	Publisher	CRC Press			
	Edition	2015			
Content	**UNIT I:** **12** Complex Variables: Cauchy's integral theorem, Fourier transform integrals with singularity, Singularity extraction technique, Branch point integrals. Saddle point, Stationary phase method for evaluation of radiation integrals. **UNIT II:** **10** Special Functions: Bessel functions, fresnel integrals, etc. **UNIT III:** **14** Computational Techniques: Classification based on integral and differential equation solution, time domain and frequency domain solutions. Introduction to Finite-difference, FDTD, finite element techniques in electromagnetics with applications.				
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%				

Course no: ECL 244	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**OPTICAL NETWORKS**			
Course Coordinator				
Course objectives:	Optical Networking: Introduction and challenges. Optical networking components/building blocks: Optical transmitter, receiver and filters, switching elements, wavelength converter, and optical amplifiers. Single hop and multi hop networks: LAMBDANET, STARNET, SONATA, Rainbow, Shuffle net, De Bruijn Graph, Hypercube. Optical switching: Packet switching, burst switching, MEMs based switching, switching with SOAs. Optical Access Network: Overview of PON technologies, Ethernet access network, WDM-PON. Optical Metro Network: SONET/SDH, Fault management in SONET/SDH.			
POs	The objective of the course is to provide a comprehensive understanding of optical communication systems and networks. The course starts with basics of light waves and their propagation, and single/multimode optical fibers. Then move to broadband (light emitting diode) and narrowband (laser diodes) optical sources and their modulation; PIN and Avalanche photo detectors and other elements of optical systems. We will study basic optical networks then using a design approach to point-to-point fiber links, star, bus and ring topologies. Multiple access techniques such as WDM (Wavelength Division Multiplexing) and SCM (Sub Carrier Multiplexing) also will be covered. Synchronous Optical Networks (SONET) will be covered to good extend.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

<table>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Optical Networks</td></tr>
<tr><td>Author</td><td>R. Ramaswami and K. Sivarajan</td></tr>
<tr><td>Publisher</td><td>Â Morgan Kaufmann Publishers, 2002</td></tr>
<tr><td>Edition</td><td>Second</td></tr>
<tr><td rowspan="3">2.</td><td>Title</td><td>Optical Switching Networks</td></tr>
<tr><td>Author</td><td>Mayer & Martin</td></tr>
<tr><td>Publisher</td><td>Cambridge University Press, 2008</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 05
Introduction: Advantages of optical network, telecom network overview and architecture, WDM optical networks, WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network, Challenges of optical WDM network.
UNIT II: 06
Components: Optical transmitters, semiconductor laser diode, tunable and fixed laser, laser characteristics, photodectors, tunable and fixed optical filters, channel equalizers, optical amplifiers and its characteristics, semiconductor laser amplifier, Raman amplifier, doped fiber amplifier, various switching elements, OADM, OXC, CLOS architecture, MEMS, wavelength convertors.
UNIT III: 05
Single and multi-hop networks: Introduction to single and multi-hop networks, Characteristics of single and multi-hop networks, experimental single hop networks: LAMBDANET, STARNET, SONATA, Rainbow, experimental multi-hop networks: Shufflenet, De Bruijn Graph, Hypercube.
UNIT IV: 06
Optical switching: Optical packet switching basics, slotted and unslotted networks, header and packet format, contention resolution in OPS networks, self-routing, examples on OPS node architecture, optical burst switching, signaling and routing protocols for OBS networks, contention resolution in OPS networks, multicasting, implementation and application. MEMs based switching, switching with SOAs.
UNIT V: 04
Optical access networks: Introduction to access network, PON, EPON and WDN EPON: overview, principal of operation, architecture; dynamic wavelength allocation, STARGATE: overview, need, architecture, operation and application, gigabit Ethernet, radio over fiber network.
UNIT VI: 05
Optical metro network: Introduction to metro network, overview of traffic grooming in SONET ring, traffic grooming in WDM ring, Interconnected WDM networks, packet communication using tunable WADM, RINGOSTAR: architecture, proxy stripping, protectoration and network lifetime.
UNIT VII: 05
Routing and wavelength assignment: Problem formulation, routing sub-problem: fixed routing, fixed alternate routing, adaptive routing, fault tolerant routing, wavelength assignment sub-problem, algorithms: simulated annealing, flow deviation algorithm.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%</td></tr>
</table>

Course no: ECL 245	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**DETECTION AND ESTIMATION THEORY**			
Course Coordinator				
Course objectives:	To use classical and Bayesian approaches to formulate and solve problems for parameter estimation from noisy signals. To use hypothesis testing and Bayesian approaches to formulate and solve problems for signal detection from noisy signals. To derive and apply linear filtering methods for parameter estimation and signal smoothing.			
POs	The subject of signal detection and estimation is concerned with the processing of information-bearing signals for the purpose of making inferences about the information that they contain. The purpose of this course is to provide an introduction to the fundamental theoretical principles underlying the development and analysis of techniques for such processing. This course is generally a first year graduate level course for students interested in signal processing, communications, control systems, computer science and related fields.			

Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Detection, Estimation, and Modulation Theory, Part I
	Author	Harry L. Van Trees
	Publisher	John Wiley & Sons, Inc.

	Edition	2001
2.	Title	Fundamentals of Statistical signal processing, volume-1: Estimation theory
	Author	Steven M. kay
	Publisher	Prentice Hall
	Edition	1993
3.	Title	Fundamentals of Statistical signal processing, volume-2: Detection theory
	Author	Steven M. kay
	Publisher	Prentice Hall
	Edition	1993
4.	Title	Probability, Random Variables and stochastic processes
	Author	A. Papolis and S. Unnikrishna Pillai
	Publisher	The McGraw-Hill
	Edition	4th Edition, 2002
Content	**UNIT I:** **03** Introduction: Representations and models for random processes, Probability Spaces, Random variables, distribution and density functions, expectation, conditional probability, Bayes theorem, General Gaussian models. **UNIT II:** **03** Hypothesis testing: Binary hypothesis testing, MAP criteria, bayes risk, Neyman-Pearson theorem, multiple hypothesis tests, Performance of Binary Receivers in AWGN, Sequential Detection and Performance. **UNIT III:** **05** Signal detection with random parameters: Detection of known signals in noise, Matched filter, Performance evaluations, Composite Hypothesis Testing, Unknown Phase, Unknown Amplitude, Unknown Frequency, White and Colored Gaussian Noise for Continuous Signals, Estimator Correlator. **UNIT IV:** **05** Detection of multiple hypotheses: Bayes Criterion, MAP Criterion, M-ary Detection Using Other Criteria, Signal-Space Representations, Performance of M-ary Detection Systems, Sequential Detection of Multiple Hypotheses, Linear models, Rayleigh fading sinusoid. **UNIT V:** **04** Fundamentals of estimation theory: Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems. **UNIT VI:** **04** Properties of estimators: Unbiasedness, efficiency, Criteria for good estimators, Minimum variance unbiased estimation, Cramer-Rao lower bound, asymptotic properties. **UNIT VI:** **06** Parameter estimation: Random parameter, Bayes estimation, Mean square error (MSE), linear minimum mean-square estimates, linear square estimation, Maximum Likelihood Estimation, Least Square Estimation, Generalized Likelihood Ratio Test, Linear minimum variance estimator, BLUE. **UNIT VII:** **06** Applications: Detection and Estimation in Non-Gaussian Noise Systems, Characterization of Impulsive Noise, Detector Structures in Non-Gaussian	

	Noise, Selected Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 354	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**INFORMATION THEORY AND CODING**			
Course Coordinator				
Course objectives:	To introduce information theory, the fundamentals of error control coding techniques and their applications, and basic cryptography. This class will first introduce the basic concepts of information theory, leading to the channel capacity theorem. After wards, the course will consider error control coding techniques and applications. Finally, the basic concepts of cryptography will be introduced.			
POs	This course covers the fundamental concepts of information theory and error control coding. At the conclusion of the course, several objectives will be achieved: Students will be introduced to the basic notions of information and channel capacity. Students will be introduced to convolutional and block codes, decoding techniques, and automatic repeat request (ARQ) schemes. Students will be understood how error control coding techniques are applied in communication systems. Students will understand the basic concepts of cryptography.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Information Theory, Coding and Cryptography

	Author	R Bose
	Publisher	TMH
	Edition	2007
2.	Title	Multidedia Communications: Applications, Networks, P rotocols and Standards
	Author	Fred Halsall
	Publisher	Perason Education Asia
	Edition	2002
3.	Title	Introduction to Data Compression
	Author	K Sayood
	Publisher	Elsevier
	Edition	3/e, 2006
4.	Title	Introduction to Error Control Codes
	Author	S Gravano
	Publisher	Oxford University Press
	Edition	2007
Content	**UNIT I:** **08** Information: Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding, Joint and conditional entropies, Mutual information, Discrete memoryless channels, BSC, BEC Channel capacity, Shannon limit. **UNIT II:** **06** SOURCE CODING: Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I, II, III, Dolby AC3 - Speech: Channel Vocoder. **UNIT III:** **04** Linear Predictive Coding SOURCE CODING: Image and Video Formats: GIF, TIFF, SIF, CIF, QCIF. **UNIT VI:** **04** Image compression: READ, JPEG, Video Compression: Principles I, B, P frames, Motion estimation, Motion compensation, H.261, MPEG standard. **UNIT V:** **08** ERROR CONTROL CODING: BLOCK CODES: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding, Single parity codes, Hamming codes, Repetition codes, Linear block codes, Cyclic codes, Syndrome calculation. **UNIT VI:** **06** Encoder and decoder– CRC ERROR CONTROL CODING: Convolutional codes code tree, trellis, state diagram, Encoding, Decoding: Sequential search and Viterbi algorithm, Principle of Turbo coding.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 355	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**COMMUNICATION NETWORKS**			
Course Coordinator				
Course objectives:	At the end of the course, the students will be able to: Build an understanding of the fundamental concepts of computer networking. Familiarize the student with the basic taxonomy and terminology of the computer networking area. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.			
POs	After completing this course, the student must demonstrate the knowledge and ability to: • Independently understand basic computer network technology. • Understand and explain Data Communications System and its components. • Identify the different types of network topologies and protocols. • Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer. • Identify the different types of network devices and their functions within a network • Understand and building the skills of subnetting and routing mechanisms. • Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course					

numbers					
Text Books:					
1.	Title	High Performance Communication Network			
	Author	Jean Walrand & Pravin Varaiya			
	Publisher	Elsevier			
	Edition				
2.	Title	Data Communication and Networking			
	Author	Behrouz. a. Forouzan			
	Publisher	Tata McGraw Hill			
	Edition				
Content	**UNIT II:** **08** Queuing Theory: Discrete/continuous state and discrete/continuous parameter RP- independent RP– renewal process –Poisson and exponential processes – Markov process – birth-death process. Discrete and continuous parameter Markov chains – transition probabilities, limiting distributions – theory of M/M/1 and M/M/m queues – Little's theorem **UNIT II:** **06** Review of Networking Concepts: Packet switched Networks: OSI and IP models, Ethernet (IEEE 802.3), token ring (IEEE802.5), fiber distributed data interface (FDDI), distributed-queue dual-bus (DQDB), Frame Relay and switched multimegabit data service (SMDS). **UNIT II:** **12** Internet and TCP/IP networks: Internet protocol, IPV4, Algorithms, Multicast IP, Mobile IP, IPV6, TCP and UDP, FTP, performance of TCP/IP Networks. Circuit switched networks, SONET Frame structure -PON, PPL, Hybrid scheme, Intelligent network, Architecture, CATV, layered network, services. ATM Network: ATM network, features, addressing, signaling, routing, ATM header structure, ATM adaptation layer (AAL), management and control, BISDN, internetworking with ATM. Optical networks, WDM systems, cross connects, optical LAN, Optical paths and Networks. **UNIT II:** **10** Control of Networks: Objectives and methods of control, Circuit switched networks, blocking, routing optimizations, Datagram networks, queuing models for delay analysis, routing optimization, congestion control, ATM networks, deterministic and statistical procedures, comparison, Control of networks, theory of Markov chains and queues, analysis of circuit switched networks, datagram networks and ATM networks.				
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%				

Course no: ECL 246	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**RF COMPONENTS AND CIRCUIT DESIGN**			
Course Coordinator				
Course objectives:	1. To design and analyze basic resonators and RF Filters. 2. To study the operation and device characteristics of RF Active components. 3. To design and analyze RF transistor amplifier. 4. To understand the operation of Oscillators and mixers used in RF design			
POs	1. To discuss design and analysis of filters and amplifiers. 2. To understand the working concepts of RF active components. 3. To study the operation of mixers and oscillators.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Detection, Estimation, and Modulation Theory, Part I
	Author	Harry L. Van Trees
	Publisher	John Wiley & Sons, Inc.
	Edition	2001
2.	Title	RF Circuit Design
	Author	Christopher Bowick
	Publisher	Newnes
	Edition	2nd

Content	**UNIT I: 05** Importance of radiofrequency design, Dimensions and units, frequency spectrum. RF behavior of passive components: High frequency resistors, capacitors and inductors. Chip components and Circuit board considerations: Chip resistors, chip capacitors, surface mounted inductors. Transmission Line Analysis: Two-wire lines, Coaxial lines and Microstrip lines. Equivalent circuit representation, Basic laws, Circuit parameters for a parallel plate transmission line. **UNIT II: 06** General Transmission Line Equation: Kirchhoff voltage and current law representations, Traveling voltage and current waves, general impedance definition, Lossless transmission line model. Microstrip Transmission Lines. Terminated lossless transmission line: Voltage reflection coefficient, propagation constant and phase velocity, and standing waves. Special terminated conditions: Input impedance of terminated lossless line, Short circuit transmission line, Open circuit transmission line, Quarter wave transmission line. **UNIT III: 08** Sourced and Loaded Transmission Line: Phasor representation of source, Power considerations for a transmission line, input impedance matching, return loss and insertion loss. The Smith Chart: Reflection coefficient in Phasor form, Normalized Impedance equation, Parametric reflection coefficient equation, graphical representation, Impedance transformation for general load, Standing wave ratio, Special transformation conditions. Admittance Transformations: Parametric admittance equation, Additional graphical displays. **UNIT IV: 05** Parallel and series Connections: Parallel connections of R and L connections, Parallel connections of R and C connections, Series connections of R and L connections, Series connections of R and C connections, Example of a T Network. RF Filter Design: Filter types and parameters, Low pass filter, High pass filter, Bandpass and Bandstop filter, Insertion Loss. Special Filter Realizations: Butterworth type filter, Chebyshev type filters, De normalization of standard low pass design. **UNIT V: 10** Filter Implementation: Unit Elements, Kuroda's Identities and Examples of Micros trip Filter Design. Coupled Filters: Odd and Even Mode Excitation, Bandpass Filter Design, Cascading bandpass filter elements, Design examples. Active RF Components: Semiconductor Basics: Physical properties of semiconductors, PN-Junction, Schottky contact. Bipolar-Junction Transistors: Construction, Functionality, Temperature behaviour, Limiting values. RF Field Effect Transistors: Construction, Functionality, Frequency response, Limiting values. High Electron Mobility Transistors: Construction, Functionality, Frequency response. Active RF Component Modeling: **UNIT VI: 02** Transistor Models: Large-signal BJT Models, Small-signal BJT Models, Large-signal FET Models, Small-signal FET Models. Scattering Parameter Device Characterization.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECB 247	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**EMI AND EMC TECHNIQUES**			
Course Coordinator				
Course objectives:	To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC To understand EMI sources and its measurements. To understand the various techniques for electromagnetic compatibility.			
POs	At the end of the course the student able to learn the concepts of Real-world EMC design constraints and make appropriate trade- offs to achieve the most cost-effective design that meets all requirements. Designing electronic systems that function without errors or problems related to electromagnetic compatibility. Diagnose and solve basic electromagnetic compatibility problems.			

Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Engineering EMC Principles, Measurements and Technologies
	Author	V. P. Kodali,
	Publisher	IEEE Press, New York
	Edition	1996
2.	Title	Noise Reduction Techniques in Electronic Systems
	Author	Henry W. Ott.
	Publisher	A Wiley Inter Science Publications, John Wiley and Sons
	Edition	1988
3.	Title	Principles of Electromagnetic Compatibility
	Author	Bemhard Keiser,
	Publisher	Artech house, Norwood,
	Edition	3rd, 1986.

Content	**UNIT I: 06** History and concept of EMI, Definitions of EMI/EMC, Electromagnetic environment, Practical experiences and concerns, frequency spectrum conservation, mechanisms of EMI generation, EMI testing, Methods of elimination of EMI and Biological effects of EMI. **UNIT II: 07** Sources of Electromagnetic noise, typical noise paths, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electromagnetic pulse (EMP). Electromagnetic emissions, noise form relays and switches, non-linearity in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction. **UNIT III: 07** Open area test sites: OATS measurements, measurement precautions. Anechoic chamber, TEM cell, reverberating chamber, GTEM cell, comparison of test facilities. Characterization of conduction currents / voltages, conducted EM noise and power line, conducted EMI from equipment, immunity to conducted EMI, characteristics of EMI filters and power line filter design. **UNIT IV: 10** Safety and signal grounds, low and high frequency grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding, types of cables, mechanism of EMI emission / coupling in cables. Effectiveness of shielding, near and far fields / impedances, methods of analysis, total loss due to absorption and reflection effects, composite absorption and reflection losses for electric fields / magnetic fields, magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets Electrical Bonding, Shape and Material for Bond straps, General Characteristics of good bonds. **UNIT V: 06** Choice of capacitors, inductors, transformers and resistors, EMC design components National / International EMC standards, military and civilian standards.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 356	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**ANTENNA THEORY AND DESIGN**			
Course Coordinator				
Course objectives:	• To study relevant antennas for different applications • To prepare students to know the fundamental theories of electromagnetics and wave propagation for antenna analysis. • To train students the antenna design and optimization using electromagnetic simulation, antenna fabrication and measurement. • To introduce students the electromagnetic radiation measurement			
POs	This course primarily contributes to ECE program outcomes that develop students abilities to: a. Ability to apply knowledge of mathematics, science and engineering. e. Ability to identify, formulate and solve engineering problems. k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice. This course secondarily contributes to ECE program outcomes that develop students abilities to: b. Ability to design and conduct experiments. c. Ability to design a system, component or process to meet desired needs l. Ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.			

Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Antenna Theory and Design
	Author	Warren L Stutzman and Gary a Thiele
	Publisher	John Wiley and Sons Inc.
	Edition	2ndEd, 1998
2.	Title	Antenna Theory- Analysis and Design
	Author	Constantine. A. Balanis
	Publisher	Wiley India

	Edition	2nd Edition, 2008
3.	Title	Antennas
	Author	Kraus
	Publisher	Tata McGraw Hill, New Delhi
	Edition	3" Edition, 2003
4.	Title	Antennas and Microwave propagation
	Author	R. E. Collin
	Publisher	Tata Mc-Graw Hill
	Edition	2004
5.	Title	Antenna Engineering hand book
	Author	R. C. Johnson and H. Jasik
	Publisher	Mc-Graw Hill
	Edition	1984
Content	**UNIT I:** **08** Fundamental Concepts: Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions. **UNIT II:** **08** Wire Antennas and Antenna Arrays: Wire antennas: Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Polynomial representation, Array with non-uniform Excitation-Binomial Array. **UNIT III:** **08** Types of Antennas: Traveling - wave antennas, Helical antennas, Biconical antennas, sleave antennas, and Principles of frequency independent Antennas, spiral antennas, and Log - Periodic Antennas. Aperture Antennas- Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice. **UNIT VI:** **08** Radio Wave Propagation: Calculation of Great Circle Distance between any two points on earth, Ground Wave Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction, Wave propagation in complex Environments, Tropospheric Propagation, Tropospheric Scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation, Whistlers.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 357	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**RADAR ENGINEERING**			
Course Coordinator				
Course objectives:	This course is an introduction to radar. Its objective is to provide an understanding of the basic concepts, operation, and applications of modern radar systems. It is designed to develop the knowledge and techniques necessary to analyze the performance of radar systems so that ultimately, the student is able to specify the subsystem performance requirements in a radar system design.			
POs	On completion of this course, students should be able to: • Understand the essential principles of operation of radar systems • Apply appropriate mathematical and computer models relevant to radar systems to calculate system performance, and assess the limitations of particular cases • Understand the design of radar signals, and FM radar • Understand the principles of Synthetic Aperture Radar, its use in geophysical remote sensing and surveillance applications, and the digital processing used to form SAR images • Design simple radar systems and the associated signal processing, at block diagram level • Understand the principles of Electronic Warfare, stealth and counter stealth, and bistatic radar, and apply the appropriate design equations to calculate performance • Analyse the performance of simple tracking radar systems • Apply the relevant design equations to phased array antennas, and understand the advantages and constraints of phased array radar • Understand the principles of radio navigation systems (including secondary radar and GPS).			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

<table>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Modern Radar System Analysis</td></tr>
<tr><td>Author</td><td>David Barton. K</td></tr>
<tr><td>Publisher</td><td>Artech House</td></tr>
<tr><td>Edition</td><td>1988</td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>Radar Design Principles Signal Processing and The Environment</td></tr>
<tr><td>Author</td><td>Fred Nathanson E,</td></tr>
<tr><td>Publisher</td><td>McGraw Hill</td></tr>
<tr><td>Edition</td><td>1969</td></tr>
<tr><td rowspan="4">3.</td><td>Title</td><td>Radar Signals</td></tr>
<tr><td>Author</td><td>Cook CE. Bernfield. M</td></tr>
<tr><td>Publisher</td><td>Academic Press</td></tr>
<tr><td>Edition</td><td>1967</td></tr>
<tr><td rowspan="4">4.</td><td>Title</td><td>Introduction to radar systems</td></tr>
<tr><td>Author</td><td>Skolnik</td></tr>
<tr><td>Publisher</td><td>McGraw hill</td></tr>
<tr><td>Edition</td><td>2nd Edition 2003</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 06
Radar Range Equation: Radar fundamentals, Derivation of range equation, the search radar equation, Jamming and radar range with jamming, Radar clutter and radar range with clutter, Radar range with combined interferences sources.
UNIT II: 06
Theory of Target Detection: Noise and false alarms, Detection of one sample of signal with noise, Integration of pulse trains, Detection of fluctuating targets, CFAR, Optimum and matched filter Theory, Loss factors in detection.
UNIT III: 05
Targets and Interference: Definition of radar cross section, Radar cross section of simple and complex objects, Spatial distribution of cross section, Bistatic cross section.
UNIT IV: 07
CW and FM Radar: Doppler Effect, CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar. MTI Radar: Delay lines and line cancellers, Subclutter Visibility. MTI using range gates and filters, Pulse Doppler radar, Non-coherent MTI radar, Application of Digital signal processing to radar system.
UNIT V: 04
Tracking Radar: Different types of tracking techniques, tracking in range, Tracking in Doppler, Search Acquisition radar, Comparison of Trackers.
UNIT VI: 08
Introduction to Pulse Compression Radar: Height finding radars, Air traffic control Radars and data handling, Atmospheric effects of radar, Electromagnetic compatibility aspects, Airborne Radars, Synthetic Aperture Radar, Secondary surveillance Radars.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%</td></tr>
</table>

Course no: ECL 358	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory		**Elective Engineering Course**	
Course Title	**SATELLITE COMMUNICATION**			
Course Coordinator				
Course objectives:	Through a series of intensive lectures and a hands-on project the course aims to: • Provide an in-depth treatment of satellite communication systems operatio and planning. • Provide in-depth understanding of modern satellite multiple access, modulation and coding schemes. • Review the state of the art in new research areas such as speech and video coding, satellite networking and satellite personal communications.			
POs				
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Satellite Communications
	Author	Trimothy Pratt, Charles W. Bostian
	Publisher	John Wiley & Sons
	Edition	1986
2.	Title	Satellite Communications
	Author	Dr. D.C. Aggarwal
	Publisher	Khanna Publishers
	Edition	2001
3.	Title	Satellite Communications
	Author	Dennis Roddy
	Publisher	McGraw Hill
	Edition	1996

Content	**UNIT I:** **12** Introduction to Satellite Communication Origin, Brief History, Current state and advantages of Satellite Communication, Active & Passive satellite, Orbital aspects of Satellite Communication, Angle of Evaluation, Propagation Delay, Orbital Spacing, System Performance Satellite Link Design Link design equation, system noise temperature, C/N & G/T ratio, atmospheric & econospheric effects on link design, complete link design, interference effects on complete link design, earth station parameters. **UNIT II:** **06** Earth space propagation effects, Frequency window, Free space loss, Atmospheric absorption, Rainfall Attenuation, Ionospheric scintillation, Telemetry, Tracking and command of satellites. **UNIT III:** **10** Satellite Multiple Access System FDMA techniques, SCPC & CSSB systems, TDMA frame structure, burst structure, frame efficiency, super-frame, frame acquisition & synchronization, TDMA vs FDMA, burst time plan, beam hopping, satellite switched, Erlang call congestion formula, DA-FDMA, DA-TDMA. Satellite Services INTELSAT, INSAT Series, VSAT, Weather forecasting, Remote sensing, LANDSAT, Satellite Navigation, Mobile satellite Service. **UNIT IV:** **08** Laser & Satellite Communication Link analysis, optical satellite link Tx & Rx, Satellite, beam acquisition, tracking & pointing, cable channel frequency, head end equation, distribution of signal, n/w specifications and architecture, optical fibre CATV system.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSL	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	NO
Type of course	Theory		Core Engineering Course	
Course Title	**COMPUTER NETWORKS**			
Course Coordinator				
Course objectives:	To build a strong understanding of the fundamental concepts of computer networking. Fiber optics and wireless communication are introduced to the students since these are technologies of the future. Modern routing algorithms are introduced in this course. Deep understanding on Data link, Network and Transport Layer providing more focus on Internet and network performance.			
POs				

Semester	**Autumn: No**		**Spring Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	ECB 205				
Prerequisite credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1	Title	Computer Networks
	Author	AS Tanenbaum, DJ Wetherall
	Publisher	Prentice-Hall
	Edition	5th Edition, 2010
Reference Book:		
1.	Title	Computer Networks: A Systems Approach
	Author	LL Peterson, BS Davie,
	Publisher	Morgan-Kauffman
	Edition	5th Edition, 2011

2.	Title	Computer Networking: A Top-Down Approach
	Author	JF Kurose, KW Ross
	Publisher	Addison-Wesley
	Edition	5th Edition, 2009
3.	Title	Data Communication and Network
	Author	Behrouz A. Forouzan
	Publisher	McGraw Hill
	Edition	5th Edition, 2012
4.	Title	Data and Computer Communications
	Author	William Stallings
	Publisher	Pearson
	Edition	8th Edition, 2007

Content	**UNIT I:** **08** Introduction: history and development of computer networks, Basic Network Architectures: OSI reference model, TCP/IP reference model, and Networks topologies, types of networks (LAN, MAN, WAN, circuit switched, packet switched, message switched, extranet, intranet, Internet, wired, wireless) **UNIT II:** **08** Physical layer: line encoding, block encoding, scrambling, Different types of transmission media. Data Link Layer services: framing, error control, flow control, medium access control. Error & Flow control mechanisms: stop and wait, Go back N and selective repeat. MAC protocols: Aloha, slotted aloha, CSMA, CSMA/CD, CSMA/CA, polling, token passing, scheduling. **UNIT III:** **08** Local Area Network Technology: Token Ring. Error detection (Parity, CRC), Ethernet, Fast Ethernet, Gigabit Ethernet, Personal Area Network: Bluetooth and Wireless Communications Standard: Wi-Fi (802.11) and WiMAX, **UNIT VI:** **12** Network layer: Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Supernetting, Classless addressing, Network Address Translation. **UNIT V:** **12** Transport layer: UDP, TCP. Connection establishment and termination, sliding window, flow and congestion control, timers, retransmission, TCP extensions, Queuing theory, Single and multiple server queuing models, Little's formula. Application Layer. Network Application services and protocols including e-mail, www, DNS, SMTP.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECB 351**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	No	No	Yes	No	
Type of course			**Core Engineering Course**		
Course Title	**BASICS OF VLSI**				
Course Coordinator					
Course objectives:	After learning this course the student will be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect. Students will be able to create models of moderately sized CMOS circuits that realize specified digital functions. Be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects. It will provide an understanding of the characteristics of CMOS circuit construction. Be able to complete a significant VLSI design project having a set of objective criteria and design constraints. To introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI). To provide experience designing integrated circuits using Computer Aided Design (CAD) Tools. Students will ne able to design static CMOS combinational and sequential logic at the transistor level, including mask layout. It will describe the general steps required for processing of CMOS integrated circuits and stimate and optimize combinational circuit delay using RC delay models and logical effort, design of functional units including adders, multipliers, ROMs, SRAMs, and PLAs, effects of clock skew.				
POs	The learning outcomes for this course will be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect. The student will be able to create models of moderately sized CMOS circuits that realize specified digital functions. Student will be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects. To have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes. Students will be able to complete a significant VLSI design project having a set of objective criteria and design constraints.				
Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**

Contact Hours 48 Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	ECB 201 ECB 252				
Prerequisite credits	8				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Analysis and Design of Digital Integrated Circuits
	Author	David A. Hodges, Horace G. Jackson, and Resve A. Saleh
	Publisher	McGraw-Hill
	Edition	Third edition, 2004.
2.	Title	CMOS circuit design, layout, and simulation
	Author	R. J. Baker, H. W. Li, and D. E. Boyce
	Publisher	Wiley-IEEE Press
	Edition	2007
3.	Title	CMOS Digital Integrated Circuits - Analysis & Design
	Author	Sung-Mo Kang & Yusuf Leblebici
	Publisher	Tata McGraw Hill
	Edition	Third edition, 2003
4.	Title	Modern VLSI design
	Author	Wayne Wolf
	Publisher	Pearson Education
	Edition	2003
5.	Title	IC layout basics: A practical guide

	Author	Christopher Saint and Judy Saint
	Publisher	Tata McGraw Hill Professional
	Edition	2001
Content	**UNIT I:** **12** Introduction MOSFET, threshold voltage, current, Channel length modulation, body bias effect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models for calculation- Transistors and Layout, CMOS layout elements, parasitics, wires and vias-design rules-layout design SPICE simulation of MOSFET I-V characteristics and parameter extraction **UNIT II:** **12** CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input rise time and fall time, static and dynamic power dissipation, energy & power delay product, sizing chain of inverters, latch up effect-Simulation of static and dynamic characteristics, layout, post layout simulation **UNIT III:** **12** Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, low power design techniques, logical effort for transistor sizing, ratioed logic, pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gate logic, dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, C2MOS, TSPC registers, NORA CMOS – Course project **UNIT IV:** **12** Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design - SRAM and DRAM, BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic. **List of experiments of VLSI Design Laboratory** • Based on VHDL (Xilinx) platform and implementation on FPGA boards: • Logic expression s, modulo synchronous and asynchronous up down counters. Multiplexers/ decoders, arithmetic logic unit, priority encoder, models based on Moore's law, mealy model etc. • **CADENCE CAD tool** based experiments: • Design of MOS transistor circuits, DC characteristics, AC small signal analysis and extraction of parameters, design of sample and hold circuits, measurement of switching times, design of PLL and measurement of all characteristics parameters, design of 3-8 decoder using MOS technology.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECB 352	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Theory + Lab		Core Engineering Course	
Course Title	**DIGITAL SIGNAL PROCESSING**			
Course Coordinator				
Course objectives:	Represent discrete-time signals analytically and visualize them in the time domain. Understand the meaning and implications of the properties of systems and signals. Understand the Transform domain and its significance and problems related to computational complexity. Be able to specify and design any digital filters using MATLAB			
POs	Student should learn principles and algorithms of Digital Signal Processing (DSP), and implementation.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	ECB 204				
Prerequisite credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Digital Signal Processing: A Computer-Based Approach
	Author	S. K. Mitra
	Publisher	McGraw-Hill
	Edition	Third edition, 2006
2.	Title	Discrete-Time Signal Processing

	Author	A. Oppenheim and R. Schafer
	Publisher	Prentice Hall
	Edition	Second edition, 1999
3.	Title	Schaum's Outline of Digital Signal Processing
	Author	M. Hays
	Publisher	McGraw-Hill
	Edition	1999
4.	Title	Digital Signal Processing: Principles, Algorithms and Applications
	Author	J. Proakis, D. Manolakis
	Publisher	Prentice-Hall
	Edition	4th edition, 2006
5.	Title	A Course in Digital Signal Processing
	Author	B. Porat
	Publisher	J. Wiley and Sons
	Edition	1996
6.	Title	Computer-Based Exercises for Signal Processing Using MATLAB 5
	Author	J. McClellan (Ed.)
	Publisher	Prentice Hall
	Edition	1997
7.	Title	Understanding Digital Signal Processing
	Author	R. Lyons
	Publisher	Prentice-Hall
	Edition	1996
Reference Book:		
1.	Title	Theory and Application of Digital Signal Processing
	Author	L.R. Rabiner and B. Gold
	Publisher	Phi Learning
	Edition	1st Edition, 2008
Content	**UNIT I:** **08** Introduction to Digital signal processing, Overview of Typical Digital signal processing in real-world applications, Discrete time signals and sequence operations, properties. Discrete time systems, their properties, Linear time invariant systems. **UNIT II:** **08**	

	Z-transforms by summation of left, right, and two-sided sequences, Regions of convergence and Z-transform properties, Inverse Z-transform, Stability and causality, Solution of Difference Equations Using Z-transform. **UNIT III: 08** Definition of Discrete Fourier Transform (DFT) and relation to Z-transform, Properties of the DFT, Matrix Formulation of the DFT and IDFT, Linear and periodic convolution using the DFT, Zero padding, spectral leakage, resolution and windowing in the DFT. **UNIT IV: 12** Structures and properties of FIR and IIR filters, IIR - Direct, parallel and cascaded realizations, FIR – Direct and cascaded realizations, Coefficient quantization effects in digital filters. **UNIT V: 12** Digital filter design, Finite impulse response (FIR) filters- Window design techniques, Kaiser Window design technique, Equi-ripple approximations, Infinite impulse response (IIR) filters- Bilinear transform method, Examples of bilinear transform method. **List of experiments for Digital Signal Processing Laboratory:** • Study of Floating Point Digital Signal Processor & Fixed Point Digital Signal Processor. • Realisation of Circular & Linear Convolution and Correlation of two sequences. • Computation of DFT & IDFT of a given Sequence using DSP Processors. • Radix-2 & Radix-4 algorithm FFT Calculation using DSP Processors. • FIR & IIR Filter Implementation using the DSP Processors. • Basics of MATLAB-Realisation of Unit Impulse, Unit Step & Unit Ramp signals. • Linear & Circular Convolution of two Sequences, Correlation of two sequences. • DFT & IDFT Computation. • Radix-2 & Radix-4 algorithms FFT Calculation. • Generation of Gaussian Distributed Numbers.
Course Assessment	**Theory:** Continuous Evaluation 10% **Theory:** Mid Semester 20% **Theory:** End Semester 30% **Lab:** Continuous Evaluation 20% **Lab:** End Semester Lab Exam 20%

Course no: EEB 351	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**Yes**	**No**
Type of Course	Theory and Practical		Core Engineering Course	
Course Title	**POWER ELECTRONICS**			
Course Coordinator				
Course objectives:	The course aims at familiarizing the students with the operating characteristics of semiconductor devices, triggering circuits and their applications for power control. The course also deals with the detailed analysis and operation of power controllers.			
POs				

Semester	**Autumn:** No		**Spring:** Yes		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers	EEB 100				
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	--				

Text Books:		
1.	Title	Modern Power Electronics
	Author	B. K. Bose
	Publisher	IEEE Press

<table>
<tr><td rowspan="3">2.</td><td>Title</td><td>Power Electronics-Circuits, Devices & Applications</td></tr>
<tr><td>Author</td><td>M.H. Rashid</td></tr>
<tr><td>Publisher</td><td>Pearson Education</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 05

Introduction, power semiconductor devices: power diode, power transistor, MOSFET, Thyristor & its two transistor model, Triac, Gate turn off thyristor (GTO), insulated gate bipolar transistor (IGBT), comparison of switching power devices, turn on & turn off characteristics, driver circuits.

UNIT II: 07

Commutation, single phase and three phase bridge rectifiers, semicontrolled & fully controlled rectifiers, dual converters, effect of load and source inductance.

UNIT III: 08

Principle of operation, control strategies, step-up, step-down choppers, types of chopper circuits, steady state analysis, multiphase chopper.

UNIT IV: 08

Voltage source inverters, single phase inverter, three phase inverter, harmonic reduction techniques and PWM techniques, current source inverter.

UNIT V: 08

Single phase & 3-phase AC voltage controllers using thyristors, phase control and integral cycle control, AC choppers, single phase cyclo-converters, applications, effects of harmonics.

<u>Power Electronics Laboratory:</u>

Study of characteristics of power semiconductor switching devices (SCR, Triac, MOSFET, IGBT), Study of two-pulse fully controlled rectifier, feeding R, RL and RLC (DC-motor) loads, Study of a six-pulse half controlled rectifier feeding R, RL and RLE loads, Study of a six-pulse fully controlled rectifier feeding R and RL loads- Closed-loop control of a six-pulse fully controlled rectifier, Study of a 1-phase inverter with square wave, quasi-square wave and SPWM control, Speed control of induction motor with V/f control method using 3-phase inverter, Open –loop control of a separately excited DC motor drive with a 6-phase fully controlled rectifier, Study of characteristics of a class –D commutated thyristorized step-down chopper, Study of AC chopper with R and RL loads to achieve power control, Study of performance of a PWM controlled AC-DC converter, Study of performance of a 1-phase cyclo-converter.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Lab: Continuous Evaluation 50% End Semester 50%

60% weightage to theory and 40 % weightage to laboratory for overall grading</td></tr>
</table>

Course no: **ECL 361**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Departmental Elective
Course Title	**ANALOG VLSI CIRCUITS**			
Course Coordinator				
Course objectives:	The objectives of this course is: To analyze bias circuit using CMOS current mirror, to design and analyze the single stage and differential MOS amplifiers, to analyze the MOS OP-AMP circuits and to study the frequency response of MOS amplifiers, To understand the noise analysis of MOS amplifier			
POs	This course provides the foundation education in CMOS analog circuits suitable for low and high frequency applications and will enable the students to discuss the small-, large-signal and noise analysis of MOS circuits, Analyze and deign MOS op-amp circuits and the MOS subcircuits like switch, references and current mirrors and Design basic circuits based on the knowledge acquired in the course.			

Semester	**Autumn: No**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Design of Analog CMOS Integrated Circuits
	Author	Behzad Razavi

	Publisher	Tata McGraw Hill Publication.
2.	Title	CMOS: Circuit Design, Layout and Simulation
	Author	R. Jacob Baker, Harry W. Li, and David E. Boyce
	Publisher	Prentice Hall of India
Reference Books:		
1.	Title	Analog Integrated Circuit Design
	Author	David A. Johns and Ken Martin
	Publisher	John Wiley & Son
Content	**UNIT I:** **04** Introduction*:* Analog integrated circuit design, Circuit design consideration for MOS challenges in analog circuit design, Recent trends in analog VLSI circuits. **UNIT II:** **04** Analog MOSFET Modeling: MOS transistor, Low frequency MOSFET Models, High frequency MOSFET Models, Temperature effects in MOSFET, Noise in MOSFET. **UNIT III:** **06** Current Source, Sinks and References**:** MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references. **UNIT IV:** **08** CMOS Amplifier: Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier. CMOS Feedback Amplifier**:** Feedback equation, Properties of negative feedback on amplifier design, Feedback Topology, Stability. **UNIT V:** **08** CMOS Differential Amplifier: Differential signaling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. CMOS Operational amplifier: Block diagram of Op-amplifier, Ideal characteristics of Op-Amplifier, Design of two stage Op-Amplifier, Compensation of Op-Amplifier, Frequency response of Op-Amplifier, **UNIT VI:** **06** CMOS Comparator: Characteristic of a comparator, Two stage open loop comparator, Special purpose comparator, Regenerative comparator, High output current amplifier, High speed comparator.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 362**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	NO	**NO**	**NO**	**YES**	
Type of course	Theory			**Elective Engineering Course**	
Course Title	**DIGITAL VLSI CIRCUITS**				
Course Coordinator					
Course objectives:	Students will learn the design flow of VLSI circuit and will be able to design and analyze various combinational & sequential circuits based on CMOS technology. The course also aims at giving concepts about introduction to low power logic circuits and different semiconductor memories used in present day technology.				
POs					
Semester	**Autumn: NO**		**Spring: YES**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours **36 Hours**	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	CMOS Digital Integrated Circuits – Analysis and Design			
	Author	Sung-Mo Kang, Yusuf Leblebigi			
	Publisher	TMH			

	Edition	3rd Edition
2.	Title	CMOS: Circuit Design, Layout & Simulation
	Author	R. Jacob Baker
	Publisher	John Wiley & Sons, Inc., Hoboken, New Jersey
	Edition	3rd Edition, 2010
3.	Title	Principles of CMOS VLSI Design
	Author	NEIL H. E. Weste, David Money Harris
	Publisher	Pearson
	Edition	4th Edition
Reference Book:		
1.	Title	Modern VLSI Design
	Author	Wayne Wolf
	Publisher	Prentice Hall PTR
	Edition	3rd Edition

Content

UNIT I: **09**

Issues of Digital IC Design: General overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles; Basic Circuit Concepts: sheet resistance and area capacitances of layers, driving large capacitive loads, super-buffers, propagation delay models of cascaded pass transistors, wiring capacitances,

UNIT II: **08**

Logic Design: switch logic, gate restoring logic, Programmable Logic Array (PLAs), Finite State Machine (FSM) as a PLA, personality matrix of a PLA, PLA folding, pseudo-nmos logic, BiCMOS logic gates; switching delay in BiCMOS logic circuits; Bipolar ECL Inverter: features of ECL gate, robustness and noise immunity, logic design in ECL, single-ended and differential ECL gates;

UNIT III: **07**

Dynamic CMOS design: steady-state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, problems in single-phase clocking, two-phase non-overlapping clocking scheme, different logic families like CPL, DCVSL etc.; Sequential CMOS Logic Circuits: basic regenerative circuits, digital phase-locked loop (DPLL);

UNIT IV: **06**

Low-power CMOS Logic Circuits: low-power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits; Subsystem Design: design of arithmetic building blocks like adders and multipliers, barrel and logarithmic shifters, area-time tradeoff, power consumption issues;

	UNIT V: **06** Semiconductor Memories: Dynamic Random Access Memories (DRAM), Static RAM, non-volatile memories, flash memories, low-power memory; A RISC Processor - Instruction Set, Pipeline Architecture, Major Logic Blocks, Layout, Functional Verification.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 363**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory		**Core Engineering Course**	
Course Title	**INTRODUCTION TO MEMS**			
Course Coordinator				
Course objectives:	Be familiar with the important concepts applicable to MEMS, their fabrication. Be fluent with the design, analysis and testing of MEMS AND apply the MEMS for different applications. To introduce the students various opportunities in the emerging field of MEMS.			
POs	This course enables them to design, analayse, fabricate and and test the MEMS based components.			

Semester	**Autumn:**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Foundations of MEMS
	Author	Chang Liu
	Publisher	Pearson International
	Edition	2006
Reference Books:		
1.	Title	RF MEMS Theory, Design and Technology
	Author	Gaberiel M. Rebiz

	Publisher	John Wiley and Sons
	Edition	2003
2.	Title	Introduction to nanotechnology
	Author	Charles P. Poole, Frank J. Owens
	Publisher	John Wiley & sons
	Edition	2003
Content	**UNIT I: 06** History of MEMS Development, Characteristics of MEMS-miniaturization - micro electronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process- silicon based MEMS pro cesses- new material and fabrication processing- points of consideration for processing. **UNIT II: 08** Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- deflection of beam-longitudinal stain under pure bending- spring constant, torsional deflection, intrinsic stress, resonance and quality factor. **UNIT III: 10** Electrostatic sensing and actuation-parallel plate capacitor – Application-Inertial, pressure and tactile sensor- parallel plate actuator- comb drive. Thermal sensing and Actuations-thermal Sensors-Actuators- Applications-Inertial, Flow and Infrared sensors. Piezoresistive sensors- piezoresistive sensor material- stress in flexural cantilever and membrane- Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF –ZnO-Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation- Micro magnetic actuation principle- deposition of magnetic Materials-Design and fabrication of magnetic coil. **UNIT IV: 06** Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micromachining process-structural and sacrificial material, stiction and antistiction methods, Foundry process. **UNIT V: 06** Polymers in MEMS- polymide-SU-8 liquid crystal polymer(LCP)-PDMS-PMMA-Parylene- Flurocorbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-Mirrors-Actuation for active optical MEMS
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 364**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**WIRELESS AND ADHOC NETWORKS**			
Course Coordinator				
Course objectives:	To familiarize the fundamentals of end to end and security aspects of Network and MAC layer in modern wireless Adhoc network. To design the protocols of different layers for given QoS.			
POs	1. Understand need for ad hoc networks. 2. Explain the constraints of physical layer that affect the design and performance of ad hoc network. 3. Understand why protocols required for wired network may not work for wired network at MAC, Network and Transport Layer. 4. Explain the operations and performance of various MAC layer protocols, unicast routing protocols and transport layer protocols proposed for ad hoc networks. 5. Understand security issues and QoS requirements.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Ad hoc Networking
	Author	Charles E. Perkins
	Publisher	Pearson Education. 2007
	Edition	Wesley, 2000nd Edition
2.	Title	Adhoc Wireless Networks Architectures and Protocols
	Author	C.Siva Ram Murthy and B.S. Manoj

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">3.</td><td>Title</td><td>Mobile Adhoc Networking</td></tr>
<tr><td>Author</td><td>Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic</td></tr>
<tr><td>Publisher</td><td>Wiley-IEEE press</td></tr>
<tr><td>Edition</td><td>2004</td></tr>
<tr><td rowspan="4">4.</td><td>Title</td><td>Cross Layer Design Optimization in Wireless Protocol Stacks</td></tr>
<tr><td>Author</td><td>V.T. Raisinhani and S. Iyer</td></tr>
<tr><td>Publisher</td><td>Comp. Communication</td></tr>
<tr><td>Edition</td><td>Vol. 27 no. 8, 2004</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 06
Introduction to adhoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - Indoor and outdoor models.

UNIT II: 07
MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III: 08
Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV: 08
Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V: 06
Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Integration of adhoc with Mobile IP networks.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%</td></tr>
</table>

Course no: ECL 365	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	**Theory**			Elective Engineering Course
Course Title	**OPTICAL SIGNAL PROCESSING**			
Course Coordinator				
Course objectives:	To introduce the basic principles required for the understanding of optical signal processing techniques.			
POs	Student will understand the optical technology in depth.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Optical signal processing
	Author	Anthony Vanderlugt
	Publisher	Wiley-Interscience
	Edition	First Edition
2.	Title	Ultrafast All-Optical Signal Processing Devices
	Author	Hiroshi Ishikawa

	Publisher	Wiley
	Edition	First Edition, 2008
Reference Book:		
1.	Title	Optical data Processing-Applications
	Author	D. Casasent
	Publisher	Springer-Verlag, Berlin
	Edition	First Edition
2.	Title	Optical Signal Processing, Computing, and Neural Networks
	Author	Francis T. S. Yu, Suganda Jutamulia
	Publisher	Krieger Publishing Company
	Edition	2nd Edition
Content	**UNIT I:** **05** Characterization of a General signal, examples of signals, Spatial signal. Basic laws of geometrical optics, Refractions by mirrors, the lens formulas, General Imaging conditions, the optical invariant, Optical Aberrations. **UNIT II:** **07** Physical optics: The Fresnel Transforms, the Fourier transform, Examples of Fourier transforms, the inverse Fourier transform, Extended Fourier transform analysis, Maximum information capacity and optimum packing density, System coherence. **UNIT III:** **08** Spectrum Analysis and Spatial Filtering: Light sources, spatial light modulators, The detection process in Fourier domain, System performance parameters, Dynamic range. Some fundamentals of signal processing, Spatial Filters **UNIT IV:** **08** Binary spatial filters: Magnitude Spatial Filters, Phase Spatial Filters, Real valued Spatial Filters, Interferometric techniques for constructing Spatial Filters. Optical signal processor and filter generator, Applications for optical signal processing. **UNIT V:** **08** Acousto-optic cell spatial light modulators: Applications of acousto-optic devices. Basic Acousto-optic power spectrum analyzer. Heterodyne systems: Interference between two waves, the optical Radio.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 366**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**ERROR CONTROL CODING**			
Course Coordinator				
Course objectives:	In order to transfer data without error from source to destination, focus must be made on coding. This syllabus is highly intended to emphasize bulk and burst error-correcting codes.			
POs	To understand life cyclic redundancy codes and convolution codes. To get a clear concept of different error correcting codes and convolution codes.			

Semester	**Autumn: Yes**		**Spring: Yes**		
Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Error Control Coding
	Author	Shu Lin & D.J. Costello
	Publisher	PHI, 2004.
	Edition	2rd edition
Reference Books:		
1.	Title	Application of Error Control

	Author	Shu Lin
	Publisher	PHI
	Edition	1974 edition
2.	Title	Digital Communication
	Author	Simon Haykin
	Publisher	John Wiley and Sons
	Edition	1988
Content	**UNIT I:** **05** Basics of vector algebra Galois Filed arithmetic in detail, Implementation of Galois Field Arithmetic. **UNIT II:** **07** BCH Codes, Decoding of BCH Codes, implementation of error correction, Non binary BCH and Recd-Solomon Codes, error detection of binary BCH codes. **UNIT III:** **08** Burst error correcting codes, decoding of single burst error correcting cyclic codes, Fire code interleaved codes, phased burst error correcting codes, Concatenated codes. **UNIT IV:** **08** Covolutional codes, Maximum likelihood decoding of convolutional codes, sequential decoding convolutional codes - stack and fano algorithm Application of Viterbi decoding **UNIT V:** **08** Turbo codes - Coding - Performance - BCJR algorithm - Applications	
	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 367**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**TELECOMMUNICATION SWITCHING AND NETWORKS**			
Course Coordinator				
Course objectives:	The objective of this course is to enable the students to: 1. will be familiar with the basics of switching technique, signaling. 2. will also learn Time division Multiplexing. 3. will also learn Practical programing and software skills through Lab work of theoretical concepts learnt in this course.			
POs	1. Students will learn the basics of Telecom switching. 2. Students will learn signaling in communication. 3. Students will understand practical use of switching technique.			
Semester	**Autumn:**		**Spring: yes**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Telecommunication Switching Systems and Networks
	Author	Thiagarajan Viswanathan,
	Publisher	PHI
	Edition	2011
2.	Title	Telecommunication system
	Author	Roger L. Freeman
	Publisher	Prentice Hall
Reference Books:		
3.	Title	Wireless Mobile Communication

	Author	Theodore S. Rappaport
	Publisher	Pearson
	Edition	3rd
4.	Title	RF Circuit Design
	Author	R. Ludwig and P. Bretchko
	Publisher	Pearson
	Edition	2000
Content	**UNIT I:** **05** Basic Switching System, Simple Tele-Phone Communication, Telephone Transmitter, Telephone receiver, Telephone's bell & dialer pulsing mechanism, subscribers telephone sets, dialing types, signaling tones. **UNIT II:** **07** Introduction to Electromagnetic Exchanges, Basic line circuits in telephony and telegraphy; long-haul communication circuits; statistical bandwidth sharing, principles of traffic switching. **UNIT III:** **08** crossbar switches; switching system hierarchy, SPC switching, basic call processing, Level l, 2 & 3 controls, interface controller, network control processor, central processor, single stage and multi-stage switching network, principles of large-scale, switch design. Space Division Switching Stored Programme Control – Centralized SPC, Distributed SPC, Software Architecture, Application Software – Enhanced Services, Multi Stage Switching Networks. **UNIT IV:** **08** Basic terminologies: BHCA, BHCR, CCR, CCS, CM, Erlang, Grade of Service and Blocking Probability - Telephone Networks, Subscriber Loops, Switching Hierarchy and Routing, Signaling Techniques: In Channel, Common Channel. Transmission media, Markov process, birth death process, Erlang formulas, Queuing theory **UNIT V:** **08** Time Division space switching, Time Division Time Switching, Time multiplexed space switching, Time multiplexed Time Switching, Combination Switching	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 368	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**DSP PROCESSORS AND ARCHITECHTURES**			
Course Coordinator				
Course objectives:	To impart the knowledge of basic DSP filters and number systems to be used, different types of A/D, D/A conversion errors. To gain concepts of digital signal processing techniques, implementation of DSP & FFT algorithms and also to learn about interfacing of serial & parallel communication devices to the processor.			
POs	At the end of the course the student will be able to Comprehends the knowledge & concepts of digital signal processing techniques. Acquire knowledge of DSP computational building blocks and knows how to Achieve speed in DSP architecture or processor. Develop basic DSP algorithms using DSP processors. Acquire knowledge about various addressing modes of DSP TMS320C54XX and are able to program DSP processor. Discuss about interfacing of serial and parallel communication devices			
Semester	**Autumn:**		**Spring: yes**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Avtar Singh and S. Srinivasan
	Author	Digital Signal Processing
	Publisher	Thomson Publications
	Edition	2004
2.	Title	DSP Processor Fundamentals, Architectures & Features
	Author	Lapsley et al

	Publisher	S. Chand & Co, 2000
Reference Books:		
3.	Title	Digital Signal Processors, Architecture, Programming and Applications
	Author	B. Venkata Ramani and M. Bhaskar
	Publisher	TMH, 2000
	Edition	
Content	**UNIT I:** **05** Introduction to Digital Signal Processing: Review of a digital signal-processing system, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time Invariant Systems, Digital filters IIR and FIR, Decimation and interpolation. **UNIT II:** **06** Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, ADC and DAC conversion errors, DSP computational errors, Compensating filter. **UNIT III:** **05** Architectures for Programmable DSP Devices: Basic Architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, Programmability and program execution, Speed issues, Features for external interfacing. **UNIT IV:** **06** Execution Control and Pipelining: Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models. **UNIT V:** **05** Programmable Digital Signal Processors: Commercial DSP Devices, Data Addressing modes of TMS320C54XX, DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors. **UNIT VI:** **05** Implementations of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpola-tion Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum. **UNIT VII:** **05** Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA), A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 369**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**Y**
Type of Course	Theory			Elective Engineering Course
Course Title	**ANTENNA FOR WIRELESS COMMUNICATION SYSTEMS**			
Course Coordinator				
Course objectives:	The purpose of the course is to provide a comprehensive coverage of coding techniques for multiple-input, multiple-output (MIMO) communication systems.			
POs	To learn about 1. Basic MIMO communication systems, 2. Understanding of the concept of micro strip antennas. 3. Learning the various methods of antenna measurements. 4. MIMO systems for frequency-selective (FS) fading channels 5. Studying Smart antennas for wireless systems.			
Semester	**Autumn:No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Antenna Theory Analysis and Design
	Author	Balanis A
	Publisher	ohn Wiley and Sons

	Edition	2004
2.	Title	Antenna theory
	Author	Collin R.E. and Zucker F.
	Publisher	Tata Mc Graw Hill
	Edition	2001
3.	Title	Coding for MIMO Communication system
	Author	Tolga M. Duman and Ali Ghrayeb
	Publisher	John Wiley & Sons
	Edition	2007
Reference Books:		
1.	Title	Space-time processing for MIMO communications
	Author	A.B. Gershman and N.D. Sidiropoulus
	Publisher	Wiley, Hoboken
	Edition	2005
Content	**UNIT I:** **05** Wireless channels – Error/Outage probability over fading channels – Diversity techniques – Channel coding as a means of time diversity – Multiple antennas in wireless communications **UNIT II:** **07** Capacity and Information rates of noisy, AWGN and fading channels – Capacity of MIMO channels –Capacity of non-coherent MIMO channels – Constrained signaling for MIMO communications. **UNIT III:** **08** Patch antenna, microstrip array. Gain directivity, impedance, polarization and radiation pattern measurements. **UNIT IV:** **08** Spatial processing for wireless systems: Vector channel impulse response & the spatial signature. Spatial processing receivers, fixed beam forming networks, switched beam systems, Adaptive antenna systems, Wide band smart antennas, Digital radio receiver & software radio for smart antennas. **UNIT V:** **08** Non-coherent & coherent CDMA spatial processors, spatial processing rake receiver, Multi-user spatial processing, dynamic resectoring, downlink beam forming for CDMA.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 370**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	YES
Type of Course	Theory			Elective Engineering Course
Course Title	**RADIO AND MICROWAVE WIRELESS SYSTEM**			
Course Coordinator				
Course objectives:	To understand the how propagation through Radio waves and microwaves takes place, the system design considerations and the use of radio waves and microwaves in satellite communication.			
POs	On the completion of this course students will be able to understand satellite communication, the system design parameters for radio and microwave communication, and networks using radio and microwave communication			
Semester	**Autumn: No**		**Spring: Yes**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Microwave and RF Design of Wireless Systems
	Author	D. M. Pozar
	Publisher	Wiley
	Edition	2000
2.	Title	Radiowave Propagation: Physics and Applications

	Author	C. A. Lewis, J. T. Johnson, and F. L. Texeira
	Publisher	Wiley 2010
Reference Books:		
3.	Title	Field and Wave Electromagnetics
	Author	D. Cheng
	Publisher	Addison-Wesley
	Edition	1989
Content	**UNIT I:** **05** Analysis and design of systems employing radio waves, covering both the underlying electromagnetic and the overall system performance aspects such as signal-to-noise ratios. Antennas **UNIT II:** **07** Transmission/reception phenomena include: electromagnetic wave radiation and polarization; elementary and linear dipoles; directivity, gain, efficiency; integrated, phased-array and aperture antennas; beam-steering; Friis transmission formulas **UNIT III:** **08** Propagation phenomena include: diffraction and wave propagation over obstacles; multipath propagation; atmospheric and ionospheric effects. **UNIT IV:** **08** Receiver design aspects include: radio receiver architectures, receiver figures of merit, noise in cascaded systems, noise figure, and noise temperature **UNIT V:** **08** System examples are: terrestrial communication systems; satellite communications; radar; radiometric receivers; software-defined systems.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 371**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	No	N	N	Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	**MICRO-CONTROLLERS FOR EMBEDDED SYSTEM DESIGN**				
Course Coordinator					
Course objectives:	The aim of this course to provide the student with a detailed understanding of Microcontrollers and Embedded systems. The course covers fundamentals of The 8051 Architecture, Assembly Language Programming, Instruction set, Serial Communication and Interfacing techniques of 8051 Microcontroller. To mould fresh electronics engineers and to retrain working engineers into High Caliber Embedded System Designers by enhancing their knowledge and skills in various hardware and software design aspects of Embedded Systems.				
POs	On completion of the Course, the Participants shall get: 1. Exposure with different families and architectures of Embedded System tools such as ARM Microcontrollers, FPGAs etc. 2. Expertise required designing any embedded system (H/w or S/w or both) based on any of the above devices. 3. Expertise in Embedded Software particularly in real-time programming with industry standard RTOS such as VxWorks.				
Semester	**Autumn:**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per					

proposed course numbers					

Text Books:		
1.	Title	ARM Systems Developer's Guides- Designing & Optimizing System Software
	Author	Andrew N. Sloss, Dominic Symes, Chris Wright
	Publisher	Elsevier
	Edition	2008
2.	Title	Embedded Microcomputer Systems, Real Time Interfacing,
	Author	Jonathan W. Valvano –Brookes / Cole
	Publisher	Thomas Learning
	Edition	1999
Content	**UNIT I:** **07** ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. **UNIT II:** **09** Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. **UNIT III:** **10** Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. **UNIT IV:** **10** Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Context Switch	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 372**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**MICROPROCESSORS AND APPLICATIONS**			
Course Coordinator				
Course objectives:	To introduce the basic concepts of microprocessor, assembly language programming and to provide extensive knowledge of microprocessor based systems and interfacing techniques.			
POs	After successful completion of the course students should be able to: Understand the architecture of 8085 8-bit Microprocessor. Describe the importance and function of each pin 8085 Microprocessor. Write assembly language program. Interface Memory, Input/output with 8085 Microprocessor. Summarize the functionality of various peripheral chips.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Microprocessor: Architecture, Programming and Application with 8085
	Author	Ramesh S. Gaonkar
	Publisher	John Wiley Eastern Ltd. Publication

	Edition	
2.	Title	Microprocessors and Interfacing
	Author	Douglas V. Hall
	Publisher	Tata McGraw Hill Publication.
Reference Books:		
1.	Title	Fundamentals of Microprocessors and Microcomputers
	Author	B. Ram
	Publisher	Dhanpat Rai Publications, New Delhi.
Content	**UNIT I:** **06** Introduction: Microcomputer and microprocessor, Evolution of microprocessors, types of buses. Architecture of 8085 microprocessors: Internal architecture of Intel's 8085 Microprocessor and its functional blocks, types of registers and their functions, IC pin outs and signals, address, data and control buses, addressing, Opcode Fetch and execution procedure. **UNIT II:** **04** Addressing Modes: Register addressing mode, direct addressing mode, Indirect addressing mode, Implicit addressing mode. **UNIT III:** **06** Instruction Set of 8085 and its assembly Language programming**:** Data Transfer Instructions, Arithmetic and Logical Instructions, Branching Instructions, Stack Instructions. **UNIT IV:** **06** Timing diagrams: Clock signals, instruction cycles, machine cycles, and timing states, instruction timing diagrams. **UNIT V:** **08** Interrupts: Interrupts, Interrupt vector table, Types of interrupts (Software and Hardware). Interfacing of Memory and I/O devices: Importance of interfacing, memory interfacing, I/O interfacing. **UNIT VI:** **06** Programmable Interfaces: 8255 PPI, 8253 PIT, 8259 PIC, 8279 KDI.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: HMP 352	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	YES	**YES**	**YES**	**YES**
Type of Course	Practical			
Course Title	**TECHNICAL COMMUNICATION**			
Course Coordinator				
Course objectives:	The course aims to inculcate soft skills and technical writing in students. The practical sessions will prepare students to face job interviews and Group Discussion.			
POs				
Semester	**Autumn:** No		**Spring:** Yes	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	0	0	2	1	**12**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	New International Business English
	Author	Jones, L &R. Alexander
	Publisher	UK: CUP
	Edition	2006
2.	Title	Effective Technical Communication
	Author	Rizvi, M. A.
	Publisher	New Delhi: McGraw Hills Education
	Edition	2005
Content	**UNIT I:** **02** WRITTEN COMMUNICATION: Writing Resume, Curriculum Vitae, and Bio-	

	data (Design, Style); Writing Cover letter, Job Applications, Statement of Purpose (SoPs), Life Essay etc. Writing Technical Correspondences: Report Writing, Process Writing, Technical Description: Instructions, manuals etc. Proposals writing, Journal Articles and Conference Papers, Review and Research Articles. (Focus would be given to Grammar, Foreign Words &Phrases, Appropriate use of Prepositions and other aspects). **UNIT II: 02** ORGANISATIONAL COMMUNICATION: Samples of technical letters (Letter of Inquiry, replies to Inquiry Letters, Letters Placing Orders, Instruction Letters, Letters Urging Action, Complaint Letters, and Adjustment Letters) E-mail Correspondences: Format, Standard Practices and Strategies **UNIT III: 02** PRESENTATION SKILLS: Oral presentation Skills: How to make presentation (Focus on Paralinguistic features of speech: Pause, Voice, Stress, and Intonation etc. and Non-verbal cues: Body-language etc.). Preparing the Presentation: Develop the central idea, main ideas and supporting materials, visual aids. Rehearsing the presentation: Improving Delivery and handling stage Fright **UNIT IV: 02** Techniques for Group DiscussionSubject Knowledge, Communication Skills, Leadership Skills, Group BehaviourGroup Contribution: Contributing Systematically; Creating Cooperative Environment, Optimal Participation, Handling Conflict, Effective Closure.Individual Contribution: Topic analysis; Discussing Opinion, Problems, Case Studies.Exchanging Opinions, Suggestions and Proposals. **UNIT V: Job Interviews 04** Job Interviews: Pre-interview Presentation Techniques, Self-Analysis, Research the Organisation. Job Analysis, revise your Subject Knowledge, Develop your Interview file. Interview questions: types, Answering Strategies **Good manners and Positive Behaviour**
Course Assessment	Laboratory: Continuous Evaluation 50% End Semester 50%

Course no: ECB 401	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	NO
Type of Course			**Core Engineering Course**	
Course Title	**RF and MICROWAVE ENGINEERING**			
Course Coordinator				
Course objectives:	The goal of this course is to introduce students to the concepts and principles of the microwave engineering. To understand the operation of different types of Microwave sources. Scattering parameters are defined and used to characterize devices and system behavior. The free space communication link is examined and equations developed to determine the link carrier-to-noise ratio performance factor			
POs	Acknowledge about the microwave frequencies and the waveguides that are used to carry them. Study the various parameters and characteristics of the various waveguide components. Implement waveguide components for various applications. Analyze the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves. Study and the operation and working of the various tubes or sources for the transmission of the microwave frequencies. Analyze mathematically the operation and working of the various tubes or sources for the transmission of the microwave frequencies. Know the significance, types and characteristics of the slow wave structures used for the transmission of the microwave frequencies. Acquire knowledge about the measurements to be done at microwaves. Acquire complete knowledge about the applications of the microwave devices.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**48**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed					

course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Microwave Devices and Circuits
	Author	Samuel Y. Liao
	Publisher	Prentice Hall of India
2.	Title	Microwave Engineering
	Author	David M. Pozar
	Publisher	John Wiley & Sons
3.	Title	Foundations for Microwave Engineering
	Author	R.E. Collin
	Publisher	Wiley
Reference Books:		
1.	Title	Microwave Engineering, Passive Circuits
	Author	P.A. Rizzi
	Publisher	Prentice Hall of India

Content	**UNIT I:** **06** Electromagnetic Spectrum, Introduction, characteristic, features and applications of microwaves, Microwave Region and Band Designation, Advantage of microwaves matrix: Z, Y, h, ABCD Parameters-Cascaded networks, Circuit and S parameter representation of N port microwave networks, properties of S-matrix, Reciprocity Theorem- Lossless networks and unitary conditions. Hybrid Circuits: T junctions -E plane tee, H-plane Tee, Magic tee, Directional Coupler, Application of Magic Tee, Rat Race Junction, Directional coupler, isolator, circulators. **UNIT II:** **06** Transmission Lines: Introduction, Two wire parallel transmission lines, Voltage and Current Relationship in a Transmission Line, Characteristic Impedance, Reflection Coefficient, Transmission Coefficient, Input Impedance, Standing Waves, VSWR, Numerical Problems Microwave Measurements: Microwave Basics, Slotted line VSWR measurement, VSWR through return loss measurements, Power measurement, impedance measurement insertion loss and attenuation measurements- measurement of scattering parameters, Power measurement, impedance measurement insertion loss and attenuation measurements, measurement of scattering

	parameters, Numerical Problems. **UNIT III: 06** Transit time limitations: Transit time limitations in transistors, Microwave bipolar transistors, power frequency limitations microwave field effect transistors, Gunn Effect: HEMT, Gunn Effect - RWH theory, high - field domain and modes of operation microwave amplification Differential Negative Resistance, Two-Valley Model Theory. High-Field Domain, Modes of Operation, LSA Diodes, InP Diodes, CdTe Diode, Microwave Generation and Amplification. **UNIT IV: 06** Avalanche transit-time devices: Introduction, Read Diode, Physical Description, Avalanche Multiplication, Carrier Current Io(t) and External Current I¬e¬(t), Output Power and Quality Factor, IMPATT Diodes: Physical Structures, Negative Resistance, Power Output and Efficiency, TRAPATT Diodes, Physical Structures, Principles of Operation, Power Output and Efficiency, BARITT Diodes, Physical Description, Principles of Operation, Microwave Performance, Parametric Devices, Physical Structures, Nonlinear Reactance. Manley - Rowe Power Relations, Parametric Amplifiers, Applications. **UNIT VI: 06** Microwave Linear Beam Tubes: Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, State of the Art, Multicavity Klystron Amplifiers, Beam-Current Density, Output Current Output Power of Two-Cavity Klystron, Output Power of Four-Cavity Klystron, Reflex Klystrons, Velocity Modulation, Power Output and Efficiency, Electronic Admittance, Helix Traveling-Wave Tubes (TWTs), Slow-Wave structures, Amplification Process, Convection Current, Axial Electric Field, Wave Modes, Gain Consideration, Microwave Crossed-Field Tubes: Magnetron Oscillators, Cylindrical Magnetron, Coaxial Magnetron, Tunable Magnetron, Ricke diagram. **List of Experiments for RF and Microwave Laboratory:** • Characteristic of the Reflex klystron tube • Characteristics of Gunn diode • Characteristics of Multihole Directional coupler • Determination of Standing Wave Ratio and Reflection • Impedance and Frequency Measurement • Attenuation Measurement • Time Division Multiplexing • Differential Phase Shift Keying • Ask Modulation & Demodulation **List of Experiments using CST Studio Suite, comprises the following**

	modules • CST MICROWAVE STUDIO® (CST MWS) is the leading edge tool for the fast and accurate 3D simulation of high frequency devices and market leader in Time Domain simulation. It enables the fast and accurate analysis of antennas, filters, couplers, planar and multi-layer structures and SI and EMC effects etc. • CST EM STUDIO® (CST EMS) is an easy-to-use tool for the design and analysis of static and low frequency EM applications such as motors, sensors, actuators, transformers, and shielding enclosures. • CST PARTICLE STUDIO® (CST PS) has been developed for the fully consistent • Simulation of free moving charged particles. Applications include electron guns, cathode ray tubes, magnetrons, and wake fields. • CST CABLE STUDIO® (CST CS) for the simulation of signal integrity and EMC/EMI • Analysis of cable harnesses. • CST PCB STUDIO® (CST PCBS) for the simulation of signal integrity and EMC/EMI • EMI on printed circuit boards. • CST MPHYSICS® STUDIO (CST MPS) for thermal and mechanical stress analysis. CST DESIGN STUDIO™ (CST DS) is a versatile tool that facilitates 3D EM/circuit co-simulation and synthesis.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 451	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)	
	No	No	No	Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	**NANO-ELECTRONICS AND NANO-PHOTONICS**				
Course Coordinator					
Course objectives:	This course provides a blend of photonic and electronic fundamentals and applications to the fast moving technology involved in optical communication systems and devices in terms of nano-structures. Electronics and Photonics are becoming increasingly important as limitations of speed, size and bandwidth affect many electronic devices and systems. Moreover, integration of electronics and photonics becomes an important issue related to modern technical aspects like optical interconnects etc. Here the fundamentals of semiconductors, quantum structures and transport properties related to quantum structures will be first discussed. That will be followed by electronic and optical properties and details of strain engineering. Students will also be encouraged to learn hands-on-training in analysis/ simulation of some electronic-photonic devices using MATLAB/ SILVACO TCAD software.				
POs	At the end of this course students will have a concept on basic of quantum mechanics and its application to state of the art and emerging semiconductor devices used in computers, communication and networking systems as well as in consumer products.				
Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					

1.	Title	Electronic and Optoelectronic Properties of Semiconductor Structures
	Author	Jasprit Singh
	Publisher	Cambridge University Press,
	Edition	2003
2.	Title	Physics of Photonic Devices
	Author	S. L. Chuang
	Publisher	Wiley Series in Pure and Applied Optics
	Edition	2009
3.	Title	Semiconductor Physics and Devices – Basic Principles
	Author	D. A. Neamen
	Publisher	Tata McGraw Hill
	Edition	

Content

UNIT I: **08**

Introduction and Overview: What is nanotechnology, Developments in nano-technology. Semiconductor Fundamentals in Nanotechnology: Details of band theory, Energy bands and sub bands, density of states and effective mass, carrier density, degeneracy, Kronig- Penney model, crystal momentum, band alignment, carrier mobility.

UNIT II: **06**

Introduction to low dimensional nano-structures and Quantum Mechanics: Fundamentals of Quantum mechanics, quantization and low dimensional electron gas, alloying, electrons in nanostructures- Quantum wells, wires and dots, Schrodinger equation and its applications.

UNIT III: **04**

Electronic transport in nano-structures: Ohms' Law, mobility, Scattering mechanisms, Diffusion, Excess carriers, Transport in 1D and 2 D systems, Resonant tunneling, carrier lifetimes and recombination mechanisms, Statistics of electron transport.

UNIT IV: **06**

Optical properties of nano-structures: Basics of EM field, Photons, Scattering mechanisms, phonons, absorptions, spontaneous and stimulated emissions, Interband and intraband transitions, excitons. Strain Engineering: Basics of strain, classifications of strain, effect of strain in various quantum structures.

UNIT V: **06**

Photonic devices based on nano-structures: LEDs, Quantum Well and Multiple QW lasers, QD Lasers, Transistor laser, vertical cavity surface emitting lasers (VCSEL), Contemporary and advanced (Multi junction, intermediate band etc.) solar cells, Photonic crystals, surface plasmons, spintronic devices, photo detectors etc.

	UNIT VI: **06** Electronic Devices based on nano structures: Advance Heterostructure Devices: HBT and HEMT, downscaling of the MOSFETs., resonant tunneling Devices and circuits, single Electron Transistor and Coulomb blockade - applications of all devices in present day electronic circuits.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 452**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	NO	**NO**	**NO**	**YES**	
Type of course	Theory			Elective Engineering Course	
Course Title	**LOW POWER DEVICES AND SYSTEMS**				
Course Coordinator					
Course objectives:	Students will know about the importance behind the need of low power devices & systems. This course explains different sources of power dissipation in circuits and also the possible strategies to control them. Finally, students will get an insight about different low power consuming devices such as adder, multiplier and memories.				
POs					
Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours **36 Hours**	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	CMOS Digital Integrated Circuits – Analysis and Design			
	Author	Sung-Mo Kang, Yusuf Leblebici			
	Publisher	TMH			
2.	Title	Low-Voltage, Low-Power VLSI Subsystems			
	Author	Kiat-Seng Yeo, Kaushik Roy			
	Publisher	TMH Professional Engineering			
3.	Title	Practical Low Power Digital VLSI Design			
	Author	Gary K. Yeap			

	Publisher	KAP
Reference Book:		
1. 1.	Title	Low Power Design Methodologies
	Author	Rabaey, Pedram
	Publisher	Kluwer Academic
2.	Title	Low Power Design in Deep Sub-Micron Electronics
	Author	W. Nebel and J. Mermet
	Publisher	Kluwer Academic
	Edition	
Content	**UNIT I:** **10** Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect. **UNIT II:** **08** Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **UNIT III:** **06** Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders. **UNIT IV:** **06** Low-Voltage Low-Power Logic Styles. Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier. **UNIT V:** **06** Low-Voltage Low-Power Memories**:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of RAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 453**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
		N	N	Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	**FPGA BASED PHYSICAL DESIGN**				
Course Coordinator					
Course objectives:	The objective of the course is to convey knowledge to the core and front end design aspects of Very large scale integration. To learn field programmable gate array (FPGA) technologies and utilize associated computer aided design (CAD) tools. To synthesize digital systems with testing strategies and construct test benches.				
POs	This topic covers the analysis and design of various architectures and device technologies of PLD's and Comprehend FPGA Architectures, Analyze System Level Design and their application for Combinational and Sequential Circuits and the technology used.				
Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	Field Programmable Gate Array Technology			

	Author	Stephen M. Trimberger
	Publisher	Springer International Edition
2.	Title	Digital Systems Design
	Author	Charles H. Roth Jr, Lizy Kurian John
	Publisher	Cengage Learning
	Edition	2008
Reference Book:		
Content	**UNIT I:** **06** Introduction to Programmable Logic Devices**:** Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex, Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD. **UNIT II:** **10** Field Programmable Gate Arrays**:** Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs. **UNIT III:** **10** SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 andXC4000 Architectures. **UNIT IV:** **10** Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3Architectures.Basic concept, Digital Design and FPGA, Permanently Programmed FPGA.s, Architecture of FPGA fabrics, Logic implementation of FPGA Architecture.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 454	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)	
	NO	NO	No	Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	MICRO FABRICATION TECHNOLOGY				
Course Coordinator					
Course objectives:	Students will learn basic fabrication techniques of crystal growth and various IC fabrication steps and procedures. Students will also learn fabrication of various ICs, testing and their packaging.				
POs					
Semester	Autumn: YES		Spring: NO		
	Lecture	Tutorial	Practical	Credits	Total Teaching Load
Contact Hours 36 Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	VLSI Fabrication Principles			
	Author	S.K. Ghandhi			
	Publisher	John wiley			

2.	Title	VLSI Technology
	Author	S.M. Sze
	Publisher	Tata. MH
3.	Title	Solid State Electronics Devices
	Author	Ben G. Streetman & Sanjay Banerjee
	Publisher	PHI
	Edition	6th Edition
Reference Book:		
1.	Title	Silicon VLSI Technology
	Author	James D. Plummer, Michael D. Deal, Peter B. Griffin
	Publisher	Prentice Hall
Content	**UNIT I: 08** Silicon crystal growth and wafer preparation. Electronic grade silicon, theory of crystal growing, Czochralski technique, Testing, measurements of parameters of crystals and its characteristics, cleaning and processing considerations. **UNIT II: 10** Crystal growth for device applications epitaxial growth, Oxidation, Doping techniques: diffusion, ion implantation. Deposited thin films: polysilicon, silicon dioxide, silicon nitride, metals, Metallization and contacts, Lithography: optical, electron beam, X-ray. Etching techniques: wet chemical, dry plasma, Defects and Contamination. **UNIT III: 10** NMOS, PMOS process, control of threshold voltage, Silicon gate technology, isolation and wells. Self aligned MOSFET structure, Short channel MOS structures, Twin well CMOS process, Monolithic resistors and capacitors. NPN, PNP fabrication, power transistors, P-N junction isolation, dielectric isolation, Integrated diodes, Resistors and capacitors, BiCMOS fabrication in an n-well process. **UNIT IV: 03** Introduction to GaAs technology, doping process, energy band structure. **UNIT V: 05** Advantages of IC and Types of IC, Fabrication of Monolithic and Hybrid IC, Testing and Bonding, Packaging-types and considerations, IC failure modes, soft errors, functionality tests, manufacturing tests, Reliability evaluation.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 455	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	**Theory**			Elective Engineering Course
Course Title	**DIGITAL IMAGE PROCESSING**			
Course Coordinator				
Course objectives:	Overview of digital image processing field; understand the fundamental DIP algorithms and implementation; gain experience in applying image processing algorithms to real problems.			
POs	Student will understand basics of image processing.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	Tutorial	Practical	Credits	Total Teaching Load
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Digital Image Processing using MATLAB
	Author	Gonzalez, Woods, Eddins
	Publisher	Gatesmark Publishing
	Edition	2nd Edition
Reference Book:		
1.	Title	Fundamentals of Digital Image Processing
	Author	Anil K Jain
	Publisher	PHI Publication

	Edition	First Edition
2.	Title	Digital Image Processing
	Author	William K Pratt
	Publisher	Wiley
Content	**UNIT I: 05** Digital image fundamentals: Visual perception, image sensing and acquisition, sampling and quantization, basic relationship between pixels and their neighborhood properties; Image enhancement in spatial domain: Gray-level transformations, histogram equalization, **UNIT II: 07** Spatial filters- averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks; **UNIT III: 06** Image filtering in frequency domain: One and two-dimensional DFT, properties of 2-D DFT, periodicity properties, convolution and correlation theorems, Fast Fourier Transforms, Smoothing and sharpening filtering in frequency domain, ideal and Butterworth filters, homomorphic filtering; **UNIT IV: 04** Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering, geometric transformations **UNIT V: 06** Color image processing: Color models RGB, HSI, YUV, pseudo-color image processing, full-color image processing, color transformation, color segmentation, noise in color images; **UNIT VI: 05** Morphological Image Processing: Basic operations- dilation, erosion, opening, closing, Hit-Miss transformations, Basic morphological algorithms- boundary extraction, region filling, connected components, convex hull, thinning, thickening, skeletons, pruning, extensions to gray-scale morphology; **UNIT VII: 03** Image segmentation: Edge linking and boundary detection, Hough transforms, graph-theoretic techniques, global and adaptive thresholding, Region based segmentation, Segmentation by morphological watersheds, motion based segmentation; Texture Analysis: Co-occurrence matrix, Gabor filter	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 456	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**NEXT GENERATION NETWORKS**			
Course Coordinator				
Course objectives:	The objective of this course is to familiarize the students to area of next generation networks (NGN) and introduce them to the basic concepts related to NGN such as their architecture, applications, challenges and opportunities.			
POs	To propose and implement a network, which is capable of handling very high data, rates, especially multimedia data providing QoS and backward compatible with old networks.			
Semester	**Autumn: Yes Sem: VII**		**Spring: NO**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					

1.	Title	Next generation Telecommunication Networks, Services and Management
	Author	Edited by Thomas Plevyak, Veli Sahin
	Publisher	Wiley & IEEE Press Publications
	Edition	2012
2.	Title	Next Generation Network Services.
	Author	Robet Wood.
	Publisher	Pearson Pvt. Ltd
	Edition	3rd Edition
3.	Title	Next Generation Network Services
	Author	Neill Wilkinson
	Publisher	John Wiley Publications
	Edition	2002
Reference Books:		
1.	Title	Next Generation Networks
	Author	Monique J. Morrow
	Publisher	CISCO Press
	Edition	2007
2.	Title	Next Generation Networks: Perspectives and Potentials
	Author	Jingming Li Salina, Pascal Salina
	Publisher	John Wiley Publications
	Edition	2008
Content	**UNIT I:** **06** Convergence: what is convergence and why is it possible now? Network convergence, service convergence, device convergence, convergence in content. From technology push to service pull. Introduction to Next Generation Networks (NGN): what is NGN? Evolution trends in ICT network platform towards NGN. Difference between existing telecommunication environment and next generation converged environment. Factors motivating NGN: economic, technological and social. Building blocks for NGN. NGN services, challenges, opportunities. NGN applications: Internet connectivity, e-commerce, call center, third party application service provision, integrated billing, security and directory enable networks. **UNIT II**: **13** NGN: numbering, naming and addressing. Conceptual model for NGN:	

	access layer, transport layer, control layer, service layer. NGN architecture: soft-switch based, IMS based and TISPAN. IMS architecture: nodes, S-CSCF, P-CSCF, I-CSCF, application servers, BGCF, PSTN/CS gateway, media resource functions. IMS advantages. NGN protocol stack: fundamental protocols: SIP, SDP, AAA, RTP, RTCP, Megaco/H.248. Supporting protocols: XCAP, SOAP. Fixed mobile convergence (FMC). Convergence using IMS- a case study. IMS based NGN IPTV architecture. **UNIT III: 10** Next generation access network: wireline: fiber to the premises (FTTP), long-haul managed Ethernet. Broadband wireless access: Local area network (Wi-Fi), Wide area network (WiMAX), satellite networks, and mobile networks: 3G, 4G, LTE, and 5G. Next generation core network: role of core network, enabling control and re-configurability. VoIP: principles, how telephony is provided over IP network, various VoIP scenarios. **UNIT IV: 07** NGN management and provisioning- configuration, accounting, performance and security. Future enhancements- adaptive self healing networks. Software defined networking (SDN): basic concepts, SDN software stack. Applications: network virtualization, data-center traffic management, wide area traffic management. SDN systems challenges: scalability, security, fault tolerance. Future of SDN.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 457**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**STATISTICAL SIGNAL ANALYSIS**			
Course Coordinator				
Course objectives:	This course aims to familiarize several algorithms for processing and estimation of random signals. This course teaches filtering methods for stochastic processes and covers the spectral analysis.			
POs	1. Students can perform rudimentary statistical analysis of univariate and bivariate signals. 2. Students can estimate and filter signals in different wireless communication scenarios. 3. Student utilizes estimation and filter theory to other engineering problems.			
Semester	**Autumn: Yes**		**Spring: NO**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Discrete Random Signals and Statistical Signal Processing,

	Author	Charles W. Therrien
	Publisher	Prentice Hall Signal Processing Series
	Edition	2004
2.	Title	Statistical Digital Signal Processing and Modeling
	Author	M. H. Hayes
	Publisher	John Wiley & Sons, Inc
	Edition	2004
3.	Title	Statistical and Adaptive Signal Processing
	Author	D.G. Manolakis, V.K. Ingle and S.M. Kogon
	Publisher	McGraw Hill,
	Edition	2000
Reference Books:		
1.	Title	Statistical Digital Signal Processing and Modeling
	Author	Monson Hayes
	Publisher	John Wiley & Sons, Inc.,
	Edition	2002
Content	**UNIT I:** **05** Review of random variables Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and auto-covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process. Random signal modeling: MA(q), AR(p), ARMA (p, q) models **UNIT II:** **07** Parameter Estimation Theory Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties; Baysean estimation: Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation **UNIT III:** **08** Estimation of signal in presence of white Gaussian Noise Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Non Causal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.	

	UNIT IV: **09** Adaptive Filtering: Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Application of Adaptive filters; RLS algorithm, derivation, Matrix inversion Lemma, Initialization, tracking of non -stationarity. Kalman filtering: State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter. **UNIT V:** **07** Spectral analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 458	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	**Theory**			Elective Engineering Course
Course Title	**MULTIMEDIA COMMUNICATIONS AND SYSTEM**			
Course Coordinator				
Course objectives:	The objective of the paper is to facilitate the student with the idea of how multimedia content is processed the issues in transportation and the use of compression techniques needed wireless free space communications The prerequisites are to have basic understanding of voice, video and data, basic processing techniques.			
POs	Industry oriented course which will lead students to learn Image and Video coding and their transmission.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Multimedia Communication Systems
	Author	Rao, Bojkovic, Milovanovic,
	Publisher	PHI Learning Pvt. Ltd.
	Edition	First Edition

2.	Title	Multimedia System Design
	Author	Andleigh, Thakrar
	Publisher	PHI Learning Pvt. Ltd.
	Edition	First Edition
Reference Book:		
1.	Title	Multimedia Information Networking
	Author	Sharda
	Publisher	Prentice Hall Inc.
	Edition	First Edition
2.	Title	Multimedia making it work
	Author	Vaughan
	Publisher	Tata Mc Graw Hill
	Edition	First Edition
Content	**UNIT I:** **06** Multimedia Communication: Introduction, Network requirements, multimedia terminals, multimedia Requirement for ATM networks, Multimedia terminals. Audio visual Integration. Audio to visual mapping. **UNIT II:** **10** Multimedia Processing in Communications: Introduction, Digital Media, Signal processing elements, Challenges in multimedia information processing, Perceptual coding of Digital audio signals, Transform audio coders, Image coding, Video Coding. **UNIT III:** **10** Distributed multimedia systems, Resource management of DMS, IP networking, Multimedia operating systems, distributed multimedia servers, Distributed multimedia applications, Multimedia File Formats **UNIT IV:** **10** Multimedia communication standards, MPEG-1, MPEG-2, MPEG-4Audio/Video, MPEG-4 Visual Texture coding (VTC), Multimedia communication across networks. Compression Techniques: JPEG, MPEG	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 459**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**MICROWAVE DEVICES AND CIRCUITS**			
Course Coordinator				
Course objectives:	This course is aimed to cover basics of microwaves and circuits. This course also aimed to learn microwave link. It also aims to understand microwave generators tubes and oscillator.			
POs	1. Students will learn the basics of microwaves and circuits. 2. Students will learn microwave link. 3. Students will understand microwave generators tubes and oscillator.			
Semester	**Autumn: Yes**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Microwave Devices and Circuits
	Author	Samuel Y Liao.
	Publisher	Pearson Pub.
	Edition	3rd

2.	Title	Microwave Engg
	Author	David M. Pozar
	Publisher	John Wiley and Sons
	Edition	3rd
Reference Books:		
1.	Title	Foundations for Microwave Engineering
	Author	R E. Collins
	Publisher	International student edition
	Edition	2008
Content	**UNIT I: 07** Introduction on Microwaves Frequency allocations and frequency plans, Microwave waveguide, Rectangular waveguide and its analysis, circular waveguide, modes of propagation, dominant modes, cut off wavelength, mode excitation. **UNIT II: 08** Microwave generators and amplifiers Limitations of conventional tubes at microwave frequency, reflex klystron, two and multi cavity klystron amplifiers and oscillators and their analysis, Basics on Magnetrons and traveling wave tube and their applications. **UNIT III: 07** Microwave devices Scattering matrix of microwave waveguide junction, properties of S-matrix, E-plane tee, Hplane tee, magic tee, attenuators, directional couplers, ferrite devices, Faraday rotation, gyrator, isolator, circulators and cavity resonators **UNIT IV: 08** Gunn diode and its modes of operation, Avalanche IMPATT diode, TRAPATT diode, operations and V-I characteristics of Tunnel diode, Schottky diode, Backward diode and Varactor diodes, PIN diode and its applications. **UNIT V: 07** Micro-Strip Lines Introduction on Micro strip lines, characteristic impedance of micro strip lines, losses in micro strip lines, quality factor of micro strip, parallel strip lines, coplanar strip lines and shielded strip lines **UNIT VI: 07** Microwave Link Microwave radio station, microwave transmitter and receiver, multiplexing equipment, microwave link.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 460**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**RF INTEGRATED CIRCUITS**			
Course Coordinator				
Course objectives:	To understand the basic Characteristics of passive IC components at RF frequencies To understand High frequency and low noise amplifier design To understand the design of RF power amplifiers, oscillator and synthesizer**.**			
POs	Students will understand: 1. The basic Characteristics of passive IC components at RF frequencies 2. High frequency and low noise amplifier design 3. Design of RF power amplifiers, oscillator and synthesizer**.**			

Semester	**Autumn: yes**		**Spring: No**		
Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	The Design of CMOS Radio-Frequency Integrated Circuits
	Author	Thomas H. Lee
	Publisher	Cambridge, UK: Cambridge University
	Edition	2rd ed. (2004)
2.	Title	RF Microelectronics
	Author	Behzad Razavi

	Publisher	Prentice Hall
Reference Books:		
3.	Title	Integrated Circuits for Wireless Communications
	Author	A.A. Abidi, P.R. Gray, and R.G. Meyer
	Publisher	IEEE Press
	Edition	1999
4.	Title	RF Circuit Design
	Author	R. Ludwig and P. Bretchko
	Publisher	Pearson
	Edition	2000
Content	**UNIT I:** **05** Characteristics of passive IC components at RF frequencies: Interconnects, resistors, capacitors, inductors and transformers – Transmission lines. Noise – classical two-port noise theory, noise models for active and passive components **UNIT II:** **10** High frequency amplifier design: Zeros as bandwidth enhancers, shunt-series amplifier, fT doublers, neutralization and unilateralization **Low** noise **amplifier design**: LNA topologies, power constrained noise optimization, linearity and large signal performance **UNIT III:** **05** Mixers: Nonlinear systems as linear mixers, multiplier-based mixers, subsampling mixers, diode-ring mixers **UNIT VI:** **08** RF power amplifiers: Class A, AB, B, C, D, E and F amplifiers, modulation of power amplifiers, design and linearity considerations **UNIT IV:** **08** Oscillators & synthesizers: Basic topologies, VCO, describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 461**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of course	Theory			Elective Engineering Course
Course Title	**RADAR SIGNAL PROCESSING**			
Course Coordinator				
Course objectives:	To provide the student with an understanding of the physics and signal processing of radar systems and how the radar is used for controlling the air traffic.			
POs	The students will be able to analyze the concepts of signal processing used in the modern radar systems. They will clearly understand the applications of radar signal processing and the latest techniques that are being researched in this filed.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Rader Adaptive signal processing
	Author	I. Haykin, Simon S

	Publisher	John Wiley & Sons
2.	Title	Fundamentals of Radar signal processing
	Author	Mark A Richards
	Publisher	M C Graw Hill
Reference Book:		
1.	Title	Radar Principles
	Author	Peyton Z. Peebles
	Publisher	Wiley
2.	Title	Radar Principles
	Author	Nadav Levanon
	Publisher	Wiley
Content	**UNIT I:** **05** Analysis of discrete time signal, sampling theorem, estimation of frequency content in a signal, discrete Fourier transform, random discrete signal analysis. Review of probability, auto and cross correlation, power spectral density, cross spectra **UNIT II:** **07** The Radar System, the radar range equation, scattering and RCS, RCS models, propagation, antennas, receivers, noise figure. **UNIT III:** **08** Radar Signal Processing Fundamentals, detection and likelihood ratio, binary detection, matched filtering, radar ambiguity functions, pulse compression and radar waveforms, radar resolution. **UNIT IV:** **08** Neyman-Pearson criteria for radar application to air traffic control, radar sub optimum processor, detection of variable amplitude signals, matched filters, detection of random signal and estimation of signals in noise **UNIT V:** **08** Applications of Radar Signal Processing: Pulse-Doppler radar, CFAR detection, synthetic aperture radar (SAR), inverse synthetic aperture radar (ISAR), moving target indication (MTI), displaced-phase-center-antenna technique (DPCA), adaptive radar, super resolution (MUSIC), space-time adaptive processing (STAP).	
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 462**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory			Elective Engineering Course
Course Title	**MILLIMETER WAVE TECHNOLOGY**			
Course Coordinator				
Course objectives:	To explain how the various devices of a microwave/millimeter-wave circuit operate and how they are assembled into a system. To explain how microwave/millimeter-wave devices and circuits are characterized in terms of their "S"-parameters. To describe the new devices that is extending this technology to sub-millimeter wavelengths (terahertz frequencies).			
POs	The students will learn the design of various microwave/millimeter-wave devices and circuits.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Microwave, Millimeter wave and sub-millimeter wave vacuum electron devices
	Author	Rajeshwari Chatterji

	Publisher	Affiliated East - West Press
Reference Books:		
1.	Title	Foundations for Microwave Engineering
	Author	R E Collin
	Publisher	IEEE
2.	Title	Microwave Engineering
	Author	David M Pozar
	Publisher	John Wiley
	Edition	2nd
Content	**UNIT I:** **06** Analysis of rectangular and circular waveguides and resonators, TE and TM modes, Q of the cavity, loss mechanisms, scattering matrix, directional coupler, waveguide tees, hybrid couplers, Faraday rotation in ferrites, isolator, circulator. Passive microwave circuits: Microstrip and stripline, filter implementation with transmission lines and strip lines **UNIT II:** **06** Klystron – velocity modulation and bunching, Travelling wave tube – slow wave structure and Brillouin diagram. Maser – population inversion, pumping and stimulated emission **UNIT III:** **06** BJTs, MESFETs, tunnel diode, parametric amplifiers – Principle and analysis of amplifier configurations and parameters like gain, bandwidth, noise figure, dynamic range - Single stage and broad band transistor amplifier designs – stability **UNIT IV:** **06** Reflex klystron, magnetron, Gunn diode, IMPATT and TRAPPAT diodes, parametric oscillators – Principle and analysis of oscillator configurations, efficiency, tunability.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 463**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of Course	Theory			Elective Engineering Course
Course Title	**EMBEDDED SYSTEM DESIGN**			
Course Coordinator				
Course objectives:	The course will enable the students to understand the basics of an embedded system and program an embedded system. The student will also learn the method of designing an Embedded System for any type of applications and understand operating systems concepts, types and RTOS.			
POs	A student who successfully fulfils the course requirements should be able to design, implement and test an embedded system. Upon completion of this course, the student will be able to understand and design embedded systems. The student will learn basic of OS and RTOS, understand types of memory and interacting to external world and understand embedded firmware design approaches			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					

1.	Title	Introduction to Embedded Systems
	Author	Shibu K. V
	Publisher	Mc Graw Hill
Reference Books:		
1.	Title	Embedded Systems
	Author	Lyla
	Publisher	Pearson
	Edition	2013
2.	Title	An Embedded Software Primer
	Author	David E. Simon
	Publisher	Pearson
Content	**UNIT I:** **06** Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. **UNIT II:** **06** Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off- The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces **UNIT III:** **06** Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages. **UNIT IV:** **06** RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. **UNIT V:** **06** Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 464	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
				Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	**CPLD AND FPGA ARCHITECTURES AND APPLICATIONS**				
Course Coordinator					
Course objectives:	Acquire Knowledge about various architectures and device technologies of PLD's and Comprehend FPGA Architectures, Analyze System Level Design and their application for Combinational and Sequential Circuits.				
POs	This course covers the analysis, design and testing of Memory Circuits starting from basic building blocks. Memory technologies like DRAM, SRAM, FLASH and interfacing circuits are covered.				
Semester	Autumn:		Spring		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Field Programmable Gate Array Technology -,
	Author	Stephen M. Trimberger
	Publisher	Springer International Edition
	Edition	2013
2.	Title	Digital Systems Design
	Author	Charles H. Roth Jr , Lizy Kurian John
	Publisher	Cengage Learning
3.	Title	Field Programmable Gate Arrays,

	Author	John V. Oldfield, Richard C. Dorf
	Publisher	Wiley India
4.	Title	Digital Design Using Field Programmable Gate Arrays
	Author	Pak K. Chan/Samiha Mourad
	Publisher	Pearson Low Price Edition
5.	Title	FPGA based System Design
	Author	Wayne Wolf
	Publisher	Prentice Hall Modern Semiconductor
Reference Book:		
1.	Title	Field Programmable Gate Arrays
	Author	J. Old Field, R. Dorf
	Publisher	John Wiley & Sons
	Edition	New York, 1995
Content	**UNIT I: 05** Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation **UNIT II: 07** Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs **UNIT III: 08** Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures, Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures **UNIT IV: 08** General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: HML 451	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No			
Type of course	Theory			
Course Title	**INDUSTRIAL MANAGEMENT**			
Course Coordinator				
Course objectives:	To provide the knowledge of the industry and the managerial economics and skills.			
POs	To enhance the students with the knowledge of theory of management for future development and practical implication in the professional wellbeing.			
Syllabus outcome:	Industrial Management teaches students about the design, planning and optimization of production and manufacturing processes. It is a study that integrates methods and techniques from the engineering as well as management science.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Introduction to Management
	Author	John R. Schermerhorn
	Publisher	Wiley Student Edition.
	Edition	10
2	Title	Human Resource Management
	Author	Gupta C. B
	Publisher	Sultan Chand & Sons New Delhi
	Edition	2006
Reference Book:		
1.	Title	Organizational Behaviour
	Author	Dubey, C.H
	Publisher	Prentice Hall in India (PHI)

	Edition	2015
Content	**UNIT I:** **08** General Management: Evolution of Management thought; Schools of Management Thought; Scientific Management; Management Concepts; Characteristics of Management; Basic functions of Management; Management and Administration. **UNIT II:** **08** Production Management; Production Process; Plant Location and Layout. Market; Marketing Management, Marketing Management Concepts; Market mix, Market Segmentation. **UNIT III:** **12** Principle and practice of management: Leadership; Meaning of Leadership, The principal task of Leadership, Approach to Leadership. Communication: Meaning and Importance of Communication, Process of communication. Motivation; Needs, Theories of motivation. Coordination; Concept and Nature of Coordination, need for coordinating, types of coordination, methods of coordination. **UNIT IV:** **08** Inventory Management: Classifications of Inventories, Functions of Inventories, Costs of Inventories, Economic Order Quantity. Project Management; Total Quality Management, Quality circles, Statistical Quality control.	
Curse Assessment	Continuous Evaluation: 20% Mid Semester: 30% End Semester: 50%	

Course no: **ECL 471**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**ANALOG AND MIXED SIGNAL IC DESIGN**			
Course Coordinator				
Course objectives:	This course is aimed to introduction to Analog IC design and design Flow of Analog ICs. It also aims to understand design of differential Amplifiers, operation Amplifiers and CMOS op amp design.			
POs	Students will understand 1. Introduction to Analog IC design and design Flow of Analog ICs. 2. Design of differential Amplifiers, operation Amplifiers and CMOS op amp design.			

Semester	**Autumn: Yes**		**Spring: No**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	CMOS Analog Circuit Design
	Author	P. E. Allen and D. R. Holberg
	Publisher	Oxford University Press

	Edition	2004
2.	Title	Analog MOS Integrated Circuits for Signal Processing
	Author	R. Gregorian and G. C. Temes
	Publisher	John Wiley and Sons
	Edition	2004
Reference Books:		
1.	Title	CMOS Circuit Design, Layout, and Simulation
	Author	R. J. Baker, H. W. Li, D. E. Boyce
	Publisher	PHI
	Edition	2002
Content	**UNIT I:** **12** Introduction to Analog IC Design, The Design Flow of Analog ICs, MOSFET Parameters, MOSFET models, MOS Diode, MOS Capacitors, MOS Switch, Noise in MOSFETs, MOS Current sources and current sink circuits, Voltage and Current reference circuits, MOS Gain stages, Source Followers, Amplifiers. **UNIT II:** **12** Differential Amplifiers, Operation Amplifiers, Stability Theory and Compensation in CMOS Operational Amplifiers, Op-amp Design Techniques and practical consideration in design of op-amp, High Performance **UNIT III:** **12** CMOS Op-amp Design, Design of MOS Comparators, Data Converter Fundamentals, Digital-to-analog Converters, Analog-to-Digital Converters, Switch Capacitor Filters, Mismatch Issues in Analog Layouts, Phase locked loops, Introduction to RF IC Design	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 472	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			Departmental Elective Course
Course Title	**NON-LINEAR FIBRE OPTICS**			
Course Coordinator				
Course objectives:	The major objective of this course is to present the underlying physical concepts and mechanisms of miscellaneous nonlinear optical phenomena. The course provides a comprehensive presentation on most of the major topics in nonlinear optics, which includes topics such as Pockels effect, parametric processes, Raman and Brillouin effects, four-wave mixing, and Kerr effect. Explanations are given in either classical or semi-classical terms and thus detailed treatment of processes necessitating quantum theory is avoided when possible.			
POs	• Understand sources of and propagation of optical electromagnetic waves. • Simulate and measure experimentally commonly used nonlinear optical phenomena commonly used in industry. • Understand nonlinear phenomena from the fundamental perspective of quantum mechanics. • Communicate basic concepts and applications effectively. • Gain the ability to perform research and development projects using advanced theoretical and experimental skills and tools			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Nonlinear Fiber Optics
	Author	Govind P. Agrawal
	Publisher	Academic Press, New York, 1995.
2.	Title	Applications of Nonlinear Fiber Optics
	Author	Govind P. Agrawal
	Publisher	Academic Press, New York, 2001.
Content	**UNIT I:** **08** Introduction - Nonlinear Refraction - Maxwell's Equations - Fiber Modes - Eigen value Equations - Single Mode Condition - Nonlinear Pulse Propagation - Higher Order Nonlinear Effects. Gaussian Pulse - Chirped Gaussian Pulse - Higher Order Dispersions - Changes in Pulse Shape **UNIT II:** **10** Self Phase Modulation (SPM) induced Spectral Broadening - Non-linear Phase Shift - Effect of Group Velocity Dispersion - Self Steepening - Application of SPM- Cross Phase Modulation (XPM) - Coupling between Waves of Different Frequencies - Non-linear Birefringence - Optical Kerr Effect - Pulse Shaping. **UNIT III:** **12** Soliton Characteristics - Soliton Stability - Dark Solitons – Other kinds of Solitons - Effect of Birefringence in Solitons - Solitons based Fiber Optic Communication System (Qualitative treatment) – Demerits - Dispersion Managed Solitons (DMS). Non-linear Fiber Loop Mirrors - Soliton Lasers - Fiber Raman Lasers - Fiber Raman Amplifiers - Fiber Raman Solitons - Erbium doped fiber amplifiers. **UNIT IV:** **06** DMS for single channel transmission – WDM transmission - Fiber Gratings- Fiber Couplers – Fiber Interferometers – Pulse Compression – Soliton Switching – Soliton light wave systems.	
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 473	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	YES
Type of course				Elective Engineering Course
Course Title	VLSI INTERCONNECTS			
Course Coordinator				
Course objectives:	Introduce students to the basic interconnect parameters and its model. Students will learn Scaling and crosstalk issues of interconnects. They will also learn the repeater design methods and various advanced interconnects technique.			
POs				
Semester	Autumn: NO		Spring: YES	

	Lecture	Tutorial	Practical	Credits	Total Teaching Load
Contact Hours 36 Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Analysis and Design of Digital Integrated Circuits– A design Perspective
	Author	Jan M. Rabaey
	Publisher	Tata Mc-Graw Hill (TMH)
	Edition	2nd Edition 2003
2.	Title	Interconnection Noise in VLSI Circuits
	Author	F. Moll, M. Roca
	Publisher	Kluwer Academic Publishers
	Edition	

<table>
<tr><td colspan="3">Reference Book:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Introduction to VLSI Circuits and Systems</td></tr>
<tr><td>Author</td><td>John P. Uymera,</td></tr>
<tr><td>Publisher</td><td>Wiley Student Edition</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>CMOS Digital Integrated Circuits-Analysis and Design</td></tr>
<tr><td>Author</td><td>S.M. Kang and L. Yusuf</td></tr>
<tr><td>Publisher</td><td>Tata Mc-Graw Hill (TMH)</td></tr>
<tr><td>Edition</td><td>3rd Edition</td></tr>
<tr><td>Content</td><td colspan="2">UNIT I: 10
Introduction: Moore's law, Technological trends, Interconnect scaling, 3D interconnect view; Interconnect Parameters: Resistance, Inductance, and Capacitance, skin effect and its influence on resistance and inductance Interconnect RC Delays: Elmore Delay Calculation. Interconnect Models: The lumped RC Model, the distributed RC Model, the transmission line model. SPICE Wire Models: Distributed RC lines in SPICE, Transmission line models in SPICE.

UNIT II: 08
Scaling issues in interconnects: Gate and Interconnect Delay; CMOS Repeater: The Static Behavior- Switching Threshold, Noise Margins, The Dynamic Behavior- Computing the capacitances, Propagation Delay: First order Analysis, Propagation Delay from a Design perspective, Power, energy and Energy-Delay- Dynamic Power Consumption, Static Consumption, Analyzing Power Consumption using SPICE

UNIT III: 08
Repeater Design: Driving Interconnects for Optimum speed and power; Short channel model of CMOS Repeater - Transient Analysis of an RC loaded CMOS repeater, Delay Analysis, Analytical power expressions: Dynamic power, Short circuit Power, Resistive Power Dissipation, CMOS Repeater insertion: Analytical expressions for delay and power of a repeater chain driving an RC load.

UNIT IV: 04
Advanced Interconnect Techniques: Reduced-swing Circuits, Current-mode Transmission Techniques

UNIT V: 06
Crosstalk: Theoretical basis and circuit level modeling of crosstalk, Energy dissipation due to crosstalk: Model for energy calculation of two coupled lines. Contribution of driver and interconnect to dissipated energy, Crosstalk effects in logic VLSI circuits: Static circuits, Dynamic circuits and various remedies.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Continuous Evaluation 25%
Mid Semester 25%
End Semester 50%</td></tr>
</table>

Course no: ECL 474	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	Theory			Elective Engineering Course
Course Title	**FAULT DIAGNOSTICS IN ELECTRONIC CIRCUITS**			
Course Coordinator				
Course objectives:	Introduction of testing and faults in circuits, Modeling of faults, Fault detection and redundancy, Fault Sampling, Fault Simulation, Functional testing, Design for Testability, Compression techniques, BIST Concepts, PLAs testing			
POs	On the Completion of this Subject, students will be familiar with various faults in digital circuits, Fault Models and various Testing Methodologies.			
Semester	**Autumn: Yes**		**Spring No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Digital Systems and Testable Design
	Author	M. Abramovici, M.A. Breuer and A.D. Friedman
	Publisher	Jaico Publishing House
2.	Title	Digital Circuit Testing and Testability
	Author	P.K. Lala
	Publisher	Academic Press
	Edition	2002
3.	Title	Design Test for Digital IC's and Embedded Core Systems

	Author	A.L. Crouch
	Publisher	Prentice Hall
Reference Book:		
1.	Title	Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits
	Author	M.L. Bushnell and V.D. Agrawal
	Publisher	Kluwer Academic Publishers
Contents	**UNIT I:** **05** Introduction to Testing, Faults in digital circuits. Modeling of faults, Functional Modelling at the Logic Level, Functional Modelling at the Register, Structural Model and Level of Modelling. Logic Simulations, Applications, Problems in Simulations based Design Verification, Types of Simulation, Complied Simulation, Event Driven Simulation, Delay Models, Element Evaluation, Hazard Detection, Gate Level Event-Driven Simulation, Simulation Engines. **UNIT II:** **07** Fault Modeling, Logical Fault Models, Fault Detection and Redundancy, Fault Equivalence and Fault Location, Fault Dominance, The Single - Multiple Stuck Fault Models, Fault Variables, Fault Simulation, Applications, General Fault Simulation Techniques, Fault Simulation for Combinational Circuits, Fault Sampling, Statistical Fault Analysis. **UNIT III:** **08** Testing for Single stuck Faults, Basic Concepts, ATG for SSFs in Combinational and Sequential Circuits, Testing for Bridging Fault, Bridging Fault Models, Detection of Feedback- Non Feedback Bridging Faults, Bridging Faults Simulation, Test Generation for Bridging Faults. **UNIT IV:** **08** Functional Testing, Basic Concept, Functional testing without fault Models, Exhaustive and Pseudo-exhaustive testing, Functional testing and Specific Fault Models, Test Generation Procedure. Design for Testability, Ad Hoc Design for Testability Techniques, Controllability and Observability by means of scan register, Generic Scan based Designs, Storage cells for scan design, Classical Scan Design Costs, Scan Standards. **UNIT V:** **08** Compression Techniques, Introduction to Built-in-self-test(BIST) Concept, Test pattern Generation for BIST, BIST Architecture, Advance BIST Concepts, Design for Self-test at Board Level. Self-Checking Design, Introduction to PLA Testing, PLA testing Problems, Test Generation Algorithms for PLAs, Teatable PLA Designs, Evaluation of PLAs Test methodologies.	
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 475	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	Yes
Type of course	**Theory**			Elective Engineering Course
Course Title	**WAVELET TRANSFORMS**			
Course Coordinator				
Course objectives:	To understand the terminology that is used in the wavelets literature. Explain the concepts, theory, and algorithms behind wavelets from an interdisciplinary perspective that unifies harmonic analysis (mathematics), filter banks (signal processing), and multi-resolution analysis (computer vision). Understand how to use the modern signal processing tools using signal spaces, bases, operators and series expansions. Apply wavelets, filter banks, and multi-resolution techniques to a problem at hand, and justify why wavelets provide the right tool.			
POs	Student will be able to use the discrete Fourier transform and able to describe the relation between the discrete and the continuous Fourier transform. Also can construct various wavelet bases and know how to use them as a tool for analysing functions along with describe properties of various wavelet bases. Student will be able to understand computational aspects of Fourier and wavelet transforms and multi-resolution analysis.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Insight into Wavelets: From Theory to Practice
	Author	K. P. Soman, K. I. Rmachandran, N. G. Resmi
	Publisher	PHI Learning Pvt. Ltd.

	Edition	Third Edition, 2010
2.	Title	Multiresolution signal Decomposition: Transforms Sub-bands and Wavelets
	Author	A.N. Akansu and R.A. Haddad
	Publisher	Academic Press, Oranld, Florida, 1992
	Edition	First Edition
3.	Title	Digital Signal Processing
	Author	John G. Proakis, Dimitris G. Manolakis
	Publisher	Pearson Prentice Hall
	Edition	First Edition
4.	Title	Digital Image Processing
	Author	Rafael C. Gonzalez, Richard E. Woods
	Publisher	Pearson International Edition
	Edition	Third Edition, 2009.
Reference Book:		
1.	Title	Introduction to Wavelets and Wavelet Transform,
	Author	C. S. Burrus, Ramose and A. Gopinath,
	Publisher	Prentice Hall Inc.
	Edition	First Edition
Content	**UNIT I:** **05** Signal representation with continuous and discrete STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling, Why wavelet transform? **UNIT II:** **07** The origins of wavelets, Wavelets and other wavelet like transforms, History of wavelet from Morlet to Daubechies via Mallat, Different communities and family of wavelets, Different families of wavelets within wavelet communities **UNIT III:** **08** Wavelet Transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform **UNIT IV:** **08** Haar scaling functions and function spaces, Translation and scaling of $\phi(t)$, Orthogonality of translates of $\phi(t)$, Function space *V0,* Finer Haar scaling functions, Concepts of nested vector spaces, Haar wavelet function, Scaled and translated Haar wavelet functions, Orthogonality of $\phi(t)$ and $\psi(t)$, Normalization of Haar bases at different scales, Refinement relation with respect to normalized bases, Support of a wavelet system, Daubechies wavelets, Plotting the Daubechies wavelets,	

	UNIT V: **08** Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, **Condition-1:** Unit area under scaling function, **Condition-2:** Orthonormality of translates of scaling functions, **Condition-3:** Orthonormality of scaling and wavelet functions, **Condition-4:** Approximation conditions (Smoothness conditions), Designing Daubechies orthogonal wavelet system coefficients, Constraints for Daubechies' 6 tap scaling function.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 476	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	**No**	**No**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**ADVANCED OPTICAL COMMUNICATION SYSTEMS**			
Course Coordinator				
Course objectives:	• Understand the basic concepts and advantages of fiber optics communication. • Calculate pulse spread in optical fiber and use it to calculate the bandwidth and data rate of an optical fiber link. • Be able to solve the wave equation and apply it in the analysis of symmetric slab waveguide. • Understand the concept and conditions for light guidance. • Understand the difference between single mode/multimode fibers as well as step index and graded index fibers and perform relevant calculations. • Know the origin of fiber optics losses, including intrinsic and extrinsic loss and know how to calculate link losses. • Design a basic optical fiber link. • To understand various optical amplifiers, WDM systems and Soliton systems			
POs	• Understand various principles of optical communications system operating characteristics • Knowledge of the basic design rules and trade-offs of modern optical transmitters and receivers • To understand various optical amplifiers • Know about multiplexing techniques • Understand Soliton systems			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old					

course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	Optical Networks – A Practical Perspective			
	Author	R. Ramaswami, K. N. Sivarajan and G. H. Sasaki			
	Publisher	Elsevier			
	Edition	Third edition, 2010.			
2.	Title	Optical Fibre Communications			
	Author	G. Keiser			
	Publisher	Tata McGraw Hill			
	Edition	Third Edition, 2000			
3.	Title	Fibre-Optic Communication Systems			
	Author	G. P. Agarwal			
	Publisher	John Wiley and Sons. , Inc			
	Edition	3rd edition			
Content	**UNIT I:** **08** Introduction to optical communication systems, Signal Propagation in Optical Fibre, optical fibre principle, classification of fibres, fibre modes and related definitions, optical fibre as a waveguide and different waveguide equations. Attenuation and Dispersion, **UNIT II:** **10** Loss and band width windows, various losses in optical fibres, dispersion effects, intermodal, chromatic, waveguide dispersions, dispersion compensation and shifted fibres. Fiber Non-Linear effects, Effective length and area, SBS and SRS effects, self-phase modulation, SPM induced chirp for Gaussian pulses, cross – phase modulation, four wave mixing, introduction to soliton and photonic crystal fibres. **UNIT III:** **06** Optical Components, Couplers, isolators, multiplexers and filters, optical amplifiers, wavelength converters, optical Transmitters and Detectors, LEDs, lasers, Tunable lasers, photo detectors, switch. **UNIT IV:** **06** Modulation and Demodulation, Modulation, sub carrier modulation and multiplexing schemes, different modulation formats, spectral efficiency, demodulation, bit error rate and noise effects in receivers, coherent detection, errors and detection, cross talk. **UNIT V:** **03** Power launching and Coupling, Source to fibre power launching, LED coupling to fibres, fibre splicing, and optical fibre connectors.				

	UNIT VI: **03** Optical Networks, Client layers, SONET/ SDH, transport network, Ethernet, IP, protocols, WDM network elements.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 477	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
				Yes
Type of course	**Theory**			**Elective Engineering Course**
Course Title	**PATTERN RECOGNITION AND MACHINE LEARNING**			
Course Coordinator				
Course objectives:	This course provides foundations of Pattern Recognition and Machine Learning, which extract useful information for classification and decision making from real-world large-scale data. Their applications to Artificial Intelligence, Intelligent Media Processing, and Large-scale Data Processing are also reviewed.			
POs	The course aims at making students acquire foundations of Pattern Recognition and Machine Learning and understand data driven computing. The exercises are for students to ensure the contents and to making use of them.			

Semester	**Autumn: Yes**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	**Title**	Pattern Classification
	Author	Richard O. Duda, Peter E. Hart, David G. Stork
	Publisher	John Wiley and Sons Interscience Publication
	Edition	2001
2.	**Title**	Pattern Recognition
	Author	M. Narasimha Murthy, V. Susheela Devi
	Publisher	Springer Science & Business Media

	Edition	2011
3.	**Title**	Data Mining (Practical Learning Tools and Techniques)
	Author	Ian H. Witten, Eibe Frank
	Publisher	Morgan Kaufmann Publishers
	Edition	2005
4.	**Title**	Big Data, Data mining and machine Learning
	Author	Jared Dean
	Publisher	Wiley Big Data Series
	Edition	2014
Reference Book:		
1.	**Title**	Machine Learning for Big Data
	Author	Jason Bell
	Publisher	John Wiley and Sons
	Edition	2015
Contents	**UNIT I:** **06** Introduction of Pattern Recognition, Feature vectors and features spaces, prototypes and the nearest neighbourhood method, Discriminant Functions: Linear discriminant functions, piece-wise linear discriminant function, quadratic discriminant functions, over fitting. Statistical Learning: Bayes decision, loss function, maximum likelihood estimation, normal distribution, parametric learning. **UNIT II:** **10** Discriminant Learning: Non-parametric learning, perceptrons, neural networks, support vector machines. Feature Extraction: feature normalization, KL expansion, principal component analysis, discriminant analysis. **UNIT III:** **10** Machine Learning from Discrete Data: Decision Tree, Bag of words, N-gram Model, Distance and Clastering: hierarchical clustering, distances between discrete data, the K-means method, the EM algorithm. **UNIT IV:** **10** Validation and Evaluation: cross validation, ROC, precision and recall Association Rules: the Apri-ori algorithm, maximal frequent item sets, the FP-growth algorithm (a divide-and-conquer algorithm), closed item sets learning from various types of Data: finding frequent substrings, teating tree structure.	
Course Assessment	**Continuous Evaluation 25%** **Mid Semester 25%** **End Semester 50%**	

Course no: **ECL 478**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course	Theory			Elective Engineering Course
Course Title	**DIGITAL COMMUNICATION TECHNIQUES**			
Course Coordinator				
Course objectives:	To learn the advanced digital communication standards and techniques.			
POs	Students will be able to demonstrate the ability to analyze various modern communication technologies and coding schemes.			
Semester	**Autumn: NO**		**Spring: YES**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Digital communication techniques
	Author	M.K. Simon, S.M. Hinedi and W.C. Lindsey
	Publisher	Prentice Hall India, New Delhi, 1995
2.	Title	Digital communications
	Author	Simon Haykin
	Publisher	John Wiley and sons, 1998
Reference Books:		
3.	Title	Modern Digital Communication Technique – Fundamental &

		Applications
	Author	Bernard Skler
	Publisher	Prentice Hall, 2001 edition, ISBN – 0130847881
4.	Title	Digital Communications
	Author	Ian Glover & Peter Grant
	Publisher	Prentice Hall 2003 edition
Content	**UNIT I:** **09** Power spectrum and communication over memoryless channel: PSD of a synchronous data pulse stream; M-ary Markov source; Convolutionaly coded modulation; Continuous phase modulation – Scalar and vector communication over memoryless channel – Detection criteria. **UNIT II:** **09** Coherenet and non- Coherent communication: Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; M-FSK receivers – Rayleigh and Rician channels – Partially coherent receives – DPSK; M-PSK; M-DPSK, BER Performance Analysis. **UNIT III:** **09** Bandlimitted Channels and Digital Modulation: Eye pattern; demodulation in the presence of ISI and AWGN; Equalization techniques – IQ modulations; QPSK; QAM; QBOM; - BER Performance Analysis. – Continuous phase modulation; CPFM; CPFSK; MSK, OFDM. **UNIT IV:** **09** Block coded digital communication: Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators – Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes. **UNIT V:** **09** Convolutional coded digital communication: Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 479	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
		No	No	Yes
Type of course				Elective Engineering Course
Course Title	**MODERN RADAR AND AVIONICS SYSTEM**			
Course Coordinator				
Course objectives:	This course covers the basics of Navigation, Guidance, and Control used in aerospace systems. To understand basic avionic systems and aerospace systems and how navigation is done by the global positioning system.			
POs	The student will be able to understand the practical implementation of radars and their use in navigation, their performance parameters. Also the they will be able to the role of avionics in civil and military applications and the working of GPS			
Semester	**Autumn:**		**Spring**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Introduction to Radar Systems
	Author	M.I. Skolnik
	Publisher	Tata McGraw-Hill 2007
2.	Title	Digital Avionics Systems
	Author	Spitzer, C. R
	Publisher	Prentice Hall, Englewood Cliffs, N.J., U.S.A.
	Edition	1987
3.	Title	Avionics Navigation System
	Author	M. Kayton and W. Fried
	Publisher	Wiley Interscience

	Edition	1997
Reference Book:		
1.	Title	The Avionics Handbook
	Author	Cary R. Spitzer
	Publisher	CRC Press
	Edition	2000
2.	Title	Introduction to Avionics
	Author	Collinson R. P. G
	Publisher	Chapman and Hall
	Edition	1996
Content	**UNIT I: 5** Introduction to radars; Radar equation. Block Diagram and Operation; Radar Frequencies. Application of Radars; Range performance of radars. Minimum detectable signal; Noise effects. Continuous wave and Frequency modulated radars; Doppler effect. CW Radar **UNIT II: 07** Guided missiles; Classifications; Description of tactical missiles. Guidance phases during flight; Categories of Homing and command guidance. The kinematic equations **UNIT III: 08** Aircraft Navigation; Kinds of navigation - Position Fixing and Dead-reckoning systems. LORAN; DECCA; OMEGA. Very High Frequency Omni-Directional Range (VOR). Celestial navigation and GPS based navigation; Inertial Navigation Systems.Integrated navigation systems **UNIT IV: 08** Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems and design, defining avionics System/subsystem requirements, Avionics system architectures **UNIT V: 08** Trends in avionics display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 480**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	YES
Type of Course	Theory			Elective Engineering Course

Course Title	**SIGNATURE ANALYSIS AND RADAR IMAGING**				
Course Coordinator					
Course objectives:	To objective of this course is to study the working of radar and processing of the data collected by the radar.				
POs	On the completion of this course students will be able to understand how a moving target is detected by the radar and what are imaging radars.				
Semester	**Autumn: yes**		**Spring: Yes**		
Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Fundamentals of radar signal processing
	Author	Mark A Richards
	Publisher	TMH
	Edition	2005
2.	Title	Introduction to radar systems
	Author	Merrill I. Skolink
	Publisher	Tata McGraw hill Publications 2001
Reference Books:		
3.	Title	Radar Signal Principles
	Author	Nathanson
	Publisher	Mcgraw hill publications
	Edition	1964

Content	**UNIT I:** **05** Resolution, spatial frequency, Fourier transforms, sampling theorem and spectrum replication, vector representation of signals, data integration, correlation, components of a radar signal, amplitude models, clutter, noise model and SNR, jamming, Frequency models: the Doppler shift, spatial models, spectral model. **UNIT II:** **07** Radar equation and Radar Cross Section. Methods for RCS estimation: GO, PO, GTD and PTD techniques. Ray tracing. RCS of simple and complex targets. RCS enhancement Scattering by imperfectly conducting surfaces; Maliuzhinets' formulation and characterization of Absorbers. Methods of RCS reduction. **UNIT III:** **08** Waveform matched filter, matched filtering of moving targets, frequency-modulated pulse compression waveforms, range side lobe control for fm waveforms, Costas Frequency domain target signatures. Real array Imaging radars. Synthetic array Radars. Signal processing methods. **UNIT IV:** **08** Moving target indication (MTI), pulse Doppler processing, dwell-to-dwell stagger, pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, mti for moving platforms: adaptive displaced phase centre antenna processing. **UNIT V:** **08** radar detection as hypothesis testing, threshold detection in coherent systems, threshold detection of radar signals constant false alarm rate (CFAR) detection, the effect of unknown interference power on false alarm probability, cell averaging cfar, the effect of varying pfa, analysis of cell averaging cfar, ca cfar limitations.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 481**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	Yes
Type of Course				Departmental Elective course
Course Title	**RF AND MICROWAVE NETWORKS**			
Course Coordinator				
Course objectives:	The goal of this course is to introduce students to the advance concepts and principles of the microwave engineering, To Understand Microwave devices, components, their characteristics, their working, and their applications			
POs	After successful completion of the course students should be able to: Understand the various microwave circuits, Microwave Waveguide Components, Microwave Passive Components, Microwave Resonators and Filters.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Foundations of Microwave Engg
	Author	R.E. Collins
	Publisher	Tata McGraw Hill Publication.
2.	Title	Microwave Engineering, Passive Circuits
	Author	P.A. Rizzi
	Publisher	Prentice Hall of India
Reference Books:		

Content	**UNIT I:** **06** Microwave Circuits: One port junction, Terminal voltages and currents in multi-port junctions, Poynting's energy theorem, Normalized waves and scattering matrix, Properties of [S] matrix, Wave amplitude transmission matrix [A], Impedance matching techniques: Quarter-wave and Tapered line Impedance transformers, Two Port Networks analysis with Transmission matrices, S-Parameter and signal flow graphs **UNIT II:** **06** Microwave Waveguide Components: Microwave junctions, Bends, Scattering matrix E and H plane tee junctions, Magic-T , Applications of Magic-T, Microwave propagation in ferrites, Principles of Faraday rotation, Gyrator, Isolator and Circulator, **UNIT III:** **06** Waveguide Components, Mode transducers, Waveguide discontinuities, Terminations, Attenuators and Phase shifters, Rotary joints, Mechanical and gas type switches. **UNIT IV:** **08** Microwave Passive Components: Wave meters, Attenuators, Directional coupler, Scattering matrix of directional couplers, Coaxial and Strip line components: Terminations, Connectors and Transitions, Attenuators and phase shifters, Transmission line discontinuations, DC Returns and blocks, Low pass filters, MICS. **UNIT V:** **08** Microwave Resonators and Filters: Review of resonant circuits, Principles of microwave resonators, Field analysis of cavity resonators, Narrow band microwave filters, Wideband microwave filters, Some applications, Introduction to YIG filter, Scattering matrix of two-port gyrator networks.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: **ECL 482**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
		N	N	Yes	
Type of course	Theory			Elective Engineering Course	
Course Title	**MIXED SIGNAL & RF DESIGN**				
Course Coordinator					
Course objectives:	This course covers theory and concepts to Integrate both Analog and Digital subsystems on a single monolithic chip to create an electronic system. The syllabus includes primitive cells, biasing and references, op-amp designs, switched capacitor A/D and D/A converters, and clock generation systems for digital and mixed signal The objective of this course is to cover the circuit design theory and their implementation techniques at RF frequencies specific to CMOS technologies.				
POs	On successful completion of this unit, students will be able to: 1. Apply specialized technical RF and mixed signal design to the developed circuit; 2. Utilize a systems approach to evaluate RF circuit performance in terms of noise isolation and interference; 3. Critically review and implement various circuit design tools in order to insure proper performance; 4. Survey and investigate the operation of the key RF and mixed signal design standards; 5. Propose and justify procedures for the operation and identification of strengths and weaknesses of popular RF circuit design techniques for both analogue and digital systems				
Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	Mixed signal circuit design			

	Author	R Jacob Baker
	Publisher	Wiley-IEEE Press
	Edition	Second edition 2008
2.		
Reference Book:		
1.	Title	Analog/RF and Mixed-Signal Circuit Systematic Design
	Author	Rafael Castro-Lopez
	Publisher	Springer Publishing Company
	Edition	Incorporated ©2013
Content	**UNIT I:** **05** Introduction to Mixed-signal design; Advanced data converters: Working principle and architecture of a folding-and-interpolation ADC, Design of sample and hold amplifier, Design of folding amplifier and interpolation network, Design of decimation filter, Working principle and architecture of a Sigma-delta ADC **UNIT II:** **07** Design of basic and multistage sigma-delta converters, working principle and architecture of a pipeline ADC, Design of one-and-half-bit converter, Working principle and various architectures of high speed DAC, Working principle and architecture of a high resolution DAC **UNIT III:** **08** Clock and timing: Block diagram of a PLL, PLL based frequency synthesizer, Application and block diagram of a DLL, Design of a multiphase generator; Implementation of system on a chip and the associated issue: Precautionary measure for integrating analog and digital modules within an IC, Signal integrity, floor planning and physical design of mixed signal IC design **UNIT IV:** **08** Overview of RF system: Introduction to RF Transceiver architectures, Multiple access techniques, Different wireless standards, Various modulation techniques used in RF system; Aspects and considerations of RF design: Low voltage and low power design, RF-models of devices; Building blocks of RF: Design of oscillator and mixer, Frequency synthesizer, Design of low noise amplifiers, Design of narrowband and wideband amplifiers **UNIT V:** **08** Design of high efficiency power amplifier, Matching network design; RF system design and testing: Design of RF system, Noise and distortion measures and mitigation methods.	
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: **ECL 483**	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
		Yes	Yes	YES	
Type of course	Theory			Elective Engineering Course	
Course Title	**EMBEDDED REAL TIME OPERATING SYSTEMS**				
Course Coordinator					
Course objectives:	Introduction to Real Life applications of Embedded System, Real time operating Systems (RTOS), Task states and scheduling, Task Operations, Semaphores, Message Queues, Kernel Objects: Pipes, Event Registers, Signals, Condition Variables, RTOS Services, Exceptions and Interrupts, Timer and Timer Services, I/O Subsystems, Memory Management, Synchronization and Communication, Deadlocks				
POs	On the Completion of this Subject, students will be familiar with Real Life applications of Embedded System, Real time operating Systems (RTOS), Task, Semaphores, Kernel Objects.				
Semester	**Autumn:**		**Spring**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1.	Title	Real Time Concepts for Embedded Systems			
	Author	Qing Li, Elsevier			
	Edition	2011			
2.	Title	Embedded Systems- Architecture, Programming and Design			
	Author	Rajkamal			
	Publisher	TMH			
	Edition	2007			

3.	Title	Embedded Linux: Hardware, Software and Interfacing
	Author	Dr. Craig Hollabaugh
	Publisher	Addison-Wesley Professional
	Edition	2002
Reference Book:		
1.	Title	Advanced UNIX Programming
	Author	W. Richard Stevens
	Publisher	Addison-Wesley Professional
	Edition	3rd Edition, originally published in 1992
Contents	**UNIT I:** **05** Real life examples of Embedded system, Basics of Developing for Embedded system, Embedded system Initialization. **UNIT II:** **07** Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, Tasks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. **UNIT III :** **08** Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use. **UNIT IV:** **08** Other Kernel Objects: Pipes, Event Registers, Signals, Condition Variables, Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem, Port-mapped v/s Memory mapped I/O and DMA, Exceptions and Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations, RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS. **UNIT V:** **08** Memory management, Dynamic Memory Allocation in Embedded Systems, Fixed size memory management in Embedded systems, Blocking v/s Non blocking memory functions, Synchronizations and Communications, Resource Classification, Deadlocks Detection and Recovery, Priority Inversions.	
Curse Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECL 484	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Elective Engineering Course
Course Title	**NEURAL NETWORK**			
Course Coordinator				
Course objectives:	• To understand the fundamentals of neural network and learning. • To survey of attractive applications of artificial neural networks. • To acquire a practical approach for using artificial neural networks in various technical, organizational and economic applications.			
POs	A student who successfully fulfills the course requirements will demonstrate an ability to apply a correct neural network model with varied precision to various practical problems, and will deduce the important characteristics of that problem.			

Semester	**Autumn: NO**		**Spring: Yes SEM VIII**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Neural Networks: A comprehensive foundation.
	Author	Simon Haykin

	Publisher	Pearson Education
	Edition	2nd Edition, 2004
2.	Title	Artificial Neural Networks
	Author	B. Vegnanarayana
	Publisher	Prentice Hall of India, Pvt. Ltd
	Edition	2005
3.	Title	Neural Networks in Computer Intelligence
	Author	Li Min Fu
	Publisher	Tata McGraw Hill
	Edition	2003
Reference Books:		
1.	Title	Neural Networks
	Author	James A Freeman David M S kapura
	Publisher	Pearson Education
	Edition	2004

Content

UNIT I: **06**

Review of linear algebra, norms and distance concepts, classical optimization techniques, Lagrange multiplier method, derivative free optimization methods, no free lunch theorem, basics of probability theory, state variable analysis of dynamical systems. What is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

UNIT II: **06**

Error Correction learning, Memory based learning, Hebbian learning, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process,

UNIT III: **08**

Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception –convergence theorem, Relation between perception and Bayes classifier for a Gaussian Environment

UNIT IV: **08**

Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, Computer experiment, feature detection, BACK PROPAGATION - back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

UNIT V: **08**

Two basic feature mapping models, Self-organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization,

	Adaptive patter classification, Hierarchal Vector quantizer, contexmel Maps, Dynamical systems, stavility of equilibrium states, attractors, neurodynamical models, manipulation of attractors' as a recurrent network paradigm, Hopfield models.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 700	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Open Elective Engineering Course
Course Title	**Introduction to Nano science and Nano technology**			
Course Coordinator				
Course objectives:	Enabling the Students to learn the basics of Nanotechnology.			
POs	1. To understand the fundamentalsof Nanotechnology 2. To give a general introduction to different classes of nanomaterials 3. To impart basic knowledge on various synthesis and characterization techniques involved in Nanotechnology 4. To make the learner familiarize with nanotechnology potentialities			
Semester	**Autumn: NO**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	A Textbook of Nanoscience and Nanotechnology
	Author	Pradeep T.
	Publisher	Tata McGraw Hill Education Pvt. Ltd

	Edition	2012
2.	Title	Nanostructured Materials and Nanotechnology
	Author	Hari Singh Nalwa
	Publisher	Academic Press
	Edition	2002
3.	Title	Organic and Inorganic Nanostructures
	Author	Nabok A
	Publisher	Artech House
	Edition	2005
Reference Books:		
1.	Title	Nanoscience: Nanotechnologies and Nanophysics
	Author	Dupas C., Houdy P., Lahmani M.
	Publisher	Springer-Verlag Berlin Heidelberg
	Edition	2007

Content

UNIT I: **07**

Basics and Scale of Nanotechnology: Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem –Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress- surface defects -Properties at nanoscale (optical, mechanical, electronic, and magnetic).

UNIT II: **06**

Different Classes of Nanomaterials: Classification based on Dimensionality- Quantum Dots, Wells and Wires- Carbon- based nano materials (buckyballs, nanotubes, graphene)– Metalbased nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics - Biological nanomaterials.

UNIT III: **06**

Synthesis of Nanomaterials: Chemical Methods: Metal Nanocrystals by Reduction - Solvothermal Synthesis- Photochemical Synthesis - Sonochemical Routes- Chemical Vapor Deposition (CVD) – Metal Oxide - Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

UNIT IV: **09**

Fabrication and Characterization of Nanostructures: Nanofabrication: Photolithography and its Limitation-Electron-beam lithography (EBL)-Nanoimprint – Softlithography patterning. Characterization: Field Emission Scanning Electron Microscopy (FESEM) – Environmental Scanning

	ElectronMicroscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)- X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy (AES) – Rutherford backscattering spectroscopy (RBS). **UNIT V: 08** Applications: Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with aspecial architecture – Liquid crystalline systems - Linear and nonlinear optical and electro-optical properties, Applicationsin displays and other devices -Nanomaterials for data storage - Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology – Nanotoxicology challenges.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 702	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Open Elective Engineering Course
Course Title	**Growth, Fabrication and Manufacturing of Electronic Devices**			
Course Coordinator				
Course objectives:	1. To learn crystal structures of elements used for fabrication of semiconductor devices. 2. To study energy band structure of semiconductor devices. 3. To understand fermi levels, movement of charge carriers, Diffusion current and Drift current. 4. To study behavior of semiconductor junction under different biasing conditions. Fabrication of different semiconductor devices, Varactor diode, Zener diode, Schottky diode, BJT, MOSFET, etc. 5. To study the VI Characteristics of devices and their limitations in factors like current, power frequency. 6. To learn photoelectric effect and fabrication of opto electronic devices.			
POs	To have fundamental knowledge about structure of devices, VI characteristics of devices like PN Junction diode, Zener diode, MOSFET, BJT and Opto electronic.			

Semester	**Autumn: NO**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Solid State Electronic Devices
	Author	Ben. G. Streetman & Sanjan Banerjee
	Publisher	PHI Private Ltd
	Edition	5th Edition, 2003
2.	Title	Operation & Mode line of The MOS Transistor
	Author	Yannis Tsividis
	Publisher	Oxford University Press
	Edition	2nd Edition, 1999
3.	Title	Semiconductor Devices Modeling a Technology
	Author	Nandita Das Gupta & Aamitava Das Gupta
	Publisher	PHI Private Ltd
	Edition	2004

Content

UNIT I: **07**

Crystal Properties and Growth of Semiconductors**:** Semiconductor materials-Periodic Structures- Crystal Lattices- Cubic lattices -Planes and Directions-The Diamond lattice- Bulk Crystal Growth-Starting Materials-Growth of Single Crystal lngots-Wafers-Doping- Epitaxial Growth -Lattice Matching in Epitaxial Growth -Vapor -Phase Epitaxy-Atoms and Electrons-Introduction to Physical Models-Experimental Observations-The Photoelectric Effect-Atomic spectra-The Bohr model- Quantum Mechanics -Probability and the Uncertainty Principle-The Schrodinger Wave Equation -Potential Well Equation -Potential well Problem-Tunneling.

UNIT II: **07**

Energy Bands and Charge Carriers In Semiconductors: Bonding Forces and Energy bands in Solids-Bonding Forces in Solids-Energy Bands-Metals, Semiconductors, and Insulators - Direct and Indirect Semiconductors -Variation of Energy Bands with Alloy Composition-Charge Carriers in Semiconductors-Electrons and Holes-Effective Mass-Intrinsic Material-Extrinsic Material - Electrons and Holes in Quantum Wells-Carrier Concentrations-The Fermi Level-Electron and Hole Concentrations at Equilibrium-Temperature Dependence of Carrier Concentrations-Compensation and Space Charge Neutrality-Drift of Carrier in Electric and Magnetic Fields conductivity and Mobility-Drift and Resistance -Effects of Temperature and Doping on Mobility-High -Field effects-The Hall Effect -invariance of the Fermi level at equilibrium -Excess Carrier in Semiconductors-Optical Absorption- Luminescence-Photoluminescence-Electro luminescence-Carrier Lifetime and Photoconductivity -Direct Recombination of Electrons and Holes - Indirect Recombination ; Trapping -Steady State Carrier Generation ; Quasi-Fermi Levels-Photoconductive Devices-Diffusion of Carriers-

	Diffusion of Processes-Diffusion and Drift of Carrier; **UNIT III:** **07** Junctions: Fabrication of P-N Junctions-Thermal Oxidation-Diffusion -Rapid Thermal Processing-Ion Implantation-Chemical Vapor Deposition Photolithography-Etching -Metallization-Equilibrium Conditions-The Contact Potential-Equilibrium Fermi Levels -Space Charge at a Junction-Forward -and Reverse -Biased Junctions; -Steady state conditions-Qualitative Description Of current flow at a junction-Carrier Injection-Reverse Bias-Reverse -Bias Breakdown-Zener Breakdown -Avalanche Breakdown-Rectifiers-The Breakdown Diode-Transient and AC Conditions -Time variation of stored charge-Reverse Recovery Transient -Switching Diodes -Capacitance of P-N Junctions-The Varactor Diode-Deviations from the Simple Theory-Effects of contact Potential on carrier injection-Recombination and Generation in the Transition Region-Ohmic Losses -Graded Junctions-Metal -Semiconductor Junctions-Schottky Barriers-Rectifying contacts-Ohmic Contacts-Typical Schottky Barriers-Hetrojunctions **UNIT IV:** **08** The Metal -Semiconductor-Fet: The GaAS MESFET-The High Electron Mobility Transistor -Short channel Effects-The Metal Insulator Semiconductor FET-Basic Operation and Fabrication -THE ideal MOS Capacitor-Effects of Real Surfaces-Threshold Voltage -MOS capacitance Measurements- current -Voltage Characteristics of MOS Gate Oxides -The MOS Field -Effect Transistor -Output characteristics-Transfer characteristics- Mobility Models-Short channel MOSFET I-V characteristics -Control of Threshold Voltage -Substrate Bias Effects-Sub threshold characteristics -Equivalent Circuit for the MOSFET-MOSFET Scaling and Hot Electron Effects-Drain -Induced Barrier Lowering -short channel and Narrow Width Effect-Gate -Induced Drain Leakage-BJT Fabrication -Minority carrier distribution and Terminal currents-Solution of the Diffusion Equation in the Base Region-Evaluation of the Terminal currents -Current Transfer Ratio-Generalized Biasing -The coupled -Diode Model-Charge control analysis. **UNIT V:** **07** Optoelctronic Devices: Photodiodes-Current and Voltage in illuminated Junction-Solar Cells-Photo detectors-Noise and Bandwidth of Photo detectors-Light-Emitting Diodes-Light Emitting Materials-Fiber Optic Communications Multilayer Heterojunctions for LEDs- Lasers-Semiconductor lasers-Population Inversion at a Junction Emission Spectra for p-n junction-The Basic Semiconductor lasers-Materials for Semiconductor lasers-Integrated Circuits -Background -Advantages of Integration -Types of Integrated circuits-Monolithic and Hybrid Circuits-Evolution of Integrated Circuits-Monolithic Device Elements CMOS Process Integration -Silicon -on - Insulator (SOI)-Integration of other Circuit Elements -Charge Transfer Devices -Dynamic Effects in MOS capacitors -The basic CCD-Improvements on the Basic Structure -Applications of CCDs.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 703	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Open Elective Engineering Course
Course Title	**Neural Networks and Fuzzy Logic**			
Course Coordinator				
Course objectives:	The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals, Program the related algorithms and Design the required and related systems			
POs	Knowledge and understanding: Understanding principles of neural networks and fuzzy logic fundamentals; Design the required and related systems.			

Semester	**Autumn: NO**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications
	Author	Rajasekharan and Rai
	Publisher	PHI Publication
	Edition	

2.	Title	Introduction to Neural Networks using MATLAB 6.0
	Author	S. N. Sivanandam, S. Sumathi, S. N. Deepa
	Publisher	TMH
	Edition	2006
Content	**UNIT I:** **05** Introduction to Neural Networks Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. **UNIT II:** **05** Essentials of Artificial Neural Networks Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application. **UNIT III:** **04** Single Layer Feed Forward Neural Networks Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. **UNIT IV:** **04** Multilayer Feed Forward Neural Networks Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements. **UNIT V**: **09** Associative Memories Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications. **UNIT VI:** **03** Classical & Fuzzy Sets Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. **UNIT VII:** **03**	

	Fuzzy Logic System Components Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. **UNIT VIII:** **03** Applications Neural network applications: Process identification, control, fault diagnosis and load forecasting. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECL 707	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	**N**	**N**	**Yes**
Type of Course	Theory			Open Elective Engineering Course
Course Title	**Green Technologies**			
Course Coordinator				
Course objectives:	Green Technology is an approach to the design, manufacture and use of chemical products so as to reduce or eliminate chemical hazards intentionally. The goal of Green Technology is to create better, safer, chemicals while choosing the safest, most efficient ways to synthesise them. The main goal of Green Technology is to eliminate hazards right at the design stage. The principles of Green Technology demonstrate how chemical production could be achieved without posing hazard to human health and environment while at the same time being efficient and profitable.			
POs	Green Chemists are trained to integrate this information into design of molecules to avoid or reduce toxic properties. Green Chemists also take a life cycle approach to reduce the potential risks throughout the production process. They work to ensure that a product will pose minimal amount of threat to human health and the environment during production and moreover, its disposal and reuse and at the end of its useful life. A Green Technology approach is one of continual improvement; discovery and innovation that tends to bring us even closer to processes and products that are much safer to natural ecosystem. Ultimately a product should either be able to safely degrade as a biological nutrient or it should have better recyclability.			
Semester	**Autumn: NO**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Load**
Contact Hours	3	0	0	3	**36**
Prerequisite course code as per proposed course numbers					
Prerequisite Credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per					

proposed course numbers					
Text Books:					
1.	Title	Green Chemistry: Environmentally Benign			
	Author	V. K. Ahluwalia			
	Publisher	Ane Books India, New Delhi			
	Edition	2006			
2.	Title	Green chemistry: Environment Friendly Alternatives			
	Author	ReactionsRashmi Sanghi and M M Srivastava			
	Publisher	Narosa Publishing House			
	Edition				
Content	**UNIT I :** **07** Introduction of Green Technologies: Ecosystem, need, Goal & Limitation of Green Technology, Principle with their explanation and examples of sustainable development, atom economy, reaction of Toxicity. **UNIT II:** **08** Waste: Quantification of different waste products, analysis technique, production, prevention, problems Bio waste, chemical, industrial, electronics, agricultural waste, waste minimum technique & 3R technique (3R=Reduce, Reuse, Recycle) waste treatment and recycling. **UNIT III:** **07** Green reagents and solvents: Green oxidation reaction, photochemical reaction, microwave, ultrasound assisted reactions, green reagents and solvents. **UNIT IV:** **07** Industrial case studies: Greener approach of acetic acid manufacture, leather manufacture, greener approach of dyeing, polyethylene echo friendly pesticides, paper and pulp industry, pharmaceutical industry. Case study: Ranitidine/omeprazole. **UNIT V:** **07** Greenhouse effect and Global warming: Impact of green house, effect on global climate, and consequence of greenhouse effect.				
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%				