Scheme and Syllabus

of

B. Tech.

Electronics and Communication Engineering

(2022-2023 onwards)

Offered by:

Department of Electronics & Communication Engineering

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

Delhi-110036

(An autonomous Institute under the aegis of Ministry of Education, Govt. of India)

Approved in the Board of Studies-Dept. of ECE held on March 1st, 2023.

Department of Electronics and Communications Engineering
National Institute of Technology Delhi

1.1 About the Department

Welcome to the Department of Electronic and Communication Engineering (ECE), National Institute of Technology Delhi. It was established in 2010, immediately with the beginning of the Institute under the aegis of the Ministry of Human Resource and Development (MHRD), Govt. of India. Currently, it is offering one Undergraduate Program as B. Tech (ECE) and two Postgraduate programs as M. Tech. ECE and M. Tech. ECE (VLSI). The Department also offers Ph.D. and Post-Doctoral Fellowship (PDF) Programme in relevant areas. It has excellent laboratories and research facilities in electronic devices and circuits, electronic measurement and instrumentation, microprocessor and microcontroller, microwave and antenna design, optical fiber communication and optical device, multimedia, and advanced communication and design automation and simulation laboratory. The Department has received projects, grants, and fellowships from the Ministry of Electronics and Information Technology (MeitY), the Department of Science and Technology (DST)-SERB, and other funding agencies. The Department has active collaborations with academic Institutes & research institutes in India and abroad.

The Department of ECE has a blend of young as well as experienced dynamic faculty members and is committed to providing quality education and research in the field. Faculty members of the department have excellent academic & research credentials and published numerous peer-reviewed journal articles/papers, Books, Book Chapters, etc. in the diversified field and have adequate experience in advanced research. The department of ECE provides a creative learning environment to the students for excellence in technical education. Here the students learn to face the challenges related to emerging technologies in electronics and communication engineering. The department of ECE promotes a self-learning attitude, entrepreneurial skills, and professional ethics. The department hopes to achieve the national goals and objectives of industrialization and self-reliance. As a result, it hopes to produce graduates with strong academic and practical backgrounds so that they can fit into the industry immediately upon graduation.

1.2 Vision

Create an educational environment to prepare the students to meet the challenges of the modern electronics and communication industry through state of art technical knowledge and innovative approaches beneficial to society

1.3 Mission

- To promote teaching and learning by engaging in innovative research and by offering state-of-the-art undergraduate, postgraduate, and doctoral programs.
- To cultivate an entrepreneurial environment and industry interaction, leading to the emergence of creators, innovators, and leaders.
- To promote co-curricular and extra-curricular activities for the overall personality development of the students.
- Building of responsible citizens through awareness and acceptance of ethical values.

B. Tech. in Electronics and Communication Engineering

2.1 Preamble

B. Tech. (Electronics and Communication Engineering) program offered at NIT Delhi is designed to equip students with a unique blend of skill sets that include:

- Strong theoretical foundation
- Predominantly practice-oriented approach with access to well-equipped and specialized laboratories, and supervised internship via the Practice School
- Hands-on technical training
- Life skills orientation
- Hard and soft skills
- Business perspective, along with emphasis on innovation and entrepreneurship

2.2 Salient Features

- Minimum Credits requirements for completion of B.Tech. program is 160.
- The Curriculum is based on the guidelines of National Education Policy (NEP) – 2020.
- The curriculum has embedded the Multi Exit/ Multi Entry in the B. Tech. program.
- There is provision of Major degree and Minor Degree for students.
- The curriculum is designed to meet the prevailing and ongoing industrial requirements.
- The curriculum includes Project based Education with Projects every year.
- The curriculum is flexible and offers Choice Based Credit System (CBCS).
- The curriculum inherits the Value based Education and offers Interdisciplinary/ Multidisciplinary Courses.
- The Curriculum offers Digital Pedagogy & Flipped Learning with adequate motivation for Entrepreneurship/ Startups.
- The curriculum aims the Holistic Development of the students.

2.3 Cardinal Mentions

- Students exiting after completing 1st Year, 2nd Year and 3rd Year will be awarded Certificate, Diploma and Advanced Diploma in Electronics Engineering respectively. A minimum Credit requirement for Certificate is 40 Credits, Diploma is 80 Credits and Advanced Diploma is 120 Credits respectively.
- The students can opt for Minor Degree across any specialization offered in the Institute from 5th Semester e.g. a student pursuing B. Tech. (Electronics and Communication Engineering) may opt for Minor Degrees offered by the different Departments in the Institute depending upon his/her interest.
- The students opting for Minor Degree will have to earn additional credits for the Minor Degree as per Institute norms which may vary from time to time.

2.4 Program Educational Objectives (PEOs)

PEO-1	Engineering Graduates will excel in Electronics & Communication fields both in the industry and academics by analyzing and applying their knowledge in a professional manner.
PEO-2	Demonstrate multi-disciplinary knowledge and skills to analyze, interpret and create solutions to the real-life electronics engineering problems.
PEO-3	Embrace capability to expand horizons beyond engineering for creativity, innovation and entrepreneurship.
PEO-4	Imbibe competence and ethics for social and environmental sustainability with a focus on the welfare of humankind.

2.5 Program Outcomes (POs)

PO-1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO-2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO-3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO-4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO-5	**Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO-6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO-7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO-8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO-9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO-10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO-11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

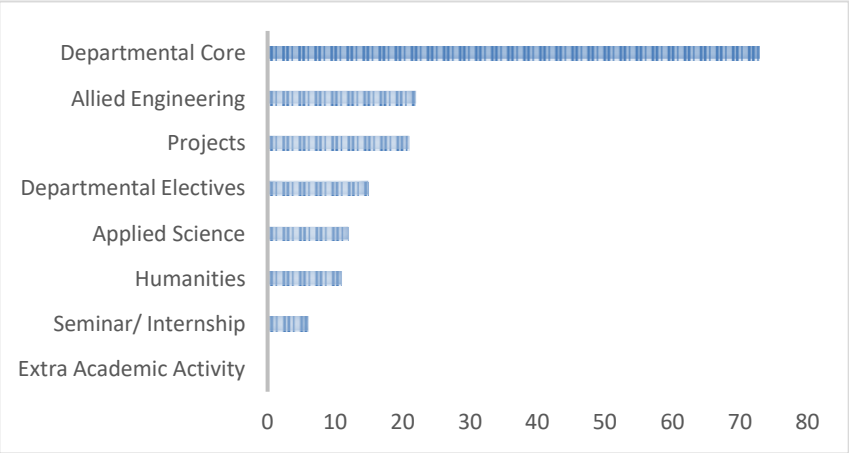
2.6 Program Specific Objectives (PSOs)

PSO -1	Capability to analyze the problems and develop solutions in the area of Electronics and Communication.
PSO -2	An ability to make use of acquired technical knowledge for a successful career, contribution to research and entrepreneurship.

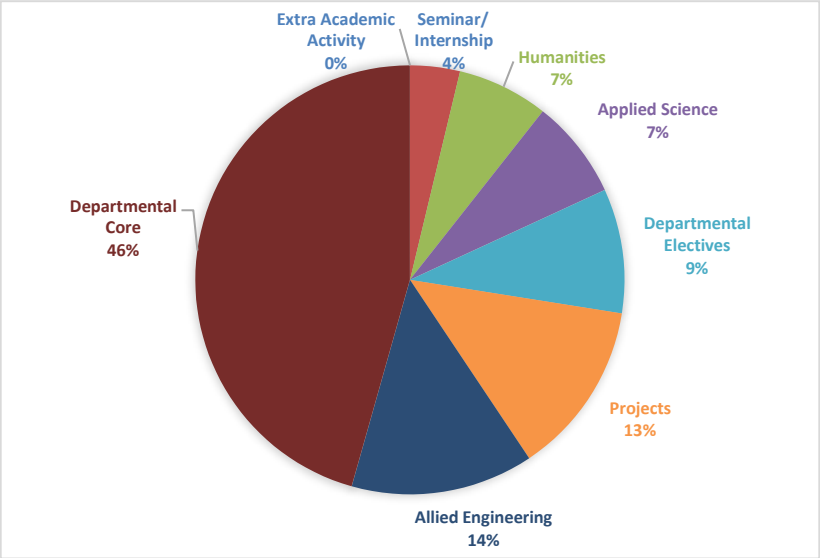
3.1 Semester wise Credit Structure

Sl. No.	**Category of Courses**	**1st Year**		**2nd Year**		**3rd Year**		**4th Year**		**Total**
		Semester I	**Semester II**	**Semester III**	**Semester IV**	**Semester V**	**Semester VI**	**Semester VII**	**Semester VIII**	
1.	Departmental Core	04	07	19	12	16	11	04	0	73
2.	Departmental Electives	--	--	--	--	03	03	09	--	15
3.	Allied Engineering	04	08	--	04	--	03	03	--	22
4.	Applied Sciences	08	04	--	--	--	--	--	--	12
5.	Seminar/ Summer Internships/ Independent Study and Seminar	--	--	--	--	01	---	01	04	06
6.	Project	--	01	--	01	--	03	--	16	21
7.	Extra Academic Activity	00	--	--	--	--	--	--	--	00
8.	Humanities	04	--	01	03	--	--	03	--	11
Total		20	20	20	20	20	20	20	20	160

3.2 Credits Distribution



3.3 Credits Distribution (%)



Course Coding Pattern	
Semester	**B. Tech in Electronics and Communication Engineering**
Autumn Semester	ECXB Y01 (onwards)
Spring Semester	ECXB Y51 (onwards)

Y = Year Number (1 = 1st Year; 2=2nd Year; 3 = 3rd Year and 4 = 4th Year)

Y = 5 (stands for Departmental Electives)

X = Course Type (Lecture course = L; Laboratory/ Practical course = P; Lecture + Practical course = B (both))

Teaching Scheme
for
B. Tech Electronics and Communication Engineering Curriculum

Semester I						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
MALB 101	Advanced Calculus	Applied Sciences	3	1	0	4
PHBB101	Engineering Physics	Applied Sciences	3	0	2	4
ECBB 101	Basics of Electronics and Electrical Engineering	Departmental Core	3	0	2	4
MEPB 121	Product Design and Realization Laboratory	Allied Engineering	0	0	2	1
HMBB 101	Theory and Practices of Human Ethics	Humanities and Management	2	0	2	3
CELB 101	Environmental Sciences	Allied Engineering	2	0	0	2
CEPB 121	Nature and Care	Allied Engineering	0	0	2	1
HMPB 102	Communication Skills	Humanities and Management	0	0	2	1
EAPB 101	Extra Academic Activity	Extra Academic Activity	0	0	2	0
Total Credits			13	1	14	**20**

Semester II						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
MALB 151	Linear Algebra and Complex Analysis	Applied Sciences	3	1	0	4
ECLB 151	Basic Communication Systems	Departmental Core	3	0	0	3
CSBB 181	Problem Solving and Computer Programming	Allied Engineering	3	0	2	4
MEBB 162	Engineering Visualization	Allied Engineering	3	0	2	4
ECBB 152	Digital Electronics & Logic Design	Departmental Core	3	0	2	4
ECPB 151	Mini Project	Departmental Core	0	0	2	1
Total Credits			15	1	8	**20**

Semester III						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECBB 201	Solid State Devices	Departmental Core	3	0	2	4
ECLB 202	Network Analysis and Synthesis	Departmental Core	3	1	0	4
ECLB 203	Electromagnetic Theory	Departmental Core	3	1	0	4
ECBB 204	Signals and Systems	Departmental Core	3	0	2	4
ECLB 205	Control Theory	Departmental Core	3	0	0	3
HMPB 103	Technical Report Writing	Humanities and Management	0	0	2	1
Total Credits			15	2	6	**20**

Semester IV						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECBB 251	Analog Electronics	Departmental Core	3	0	2	4
ECBB 252	Analog Communication	Departmental Core	3	0	2	4
ECBB 253	Electronic Measurement and Instrumentation	Departmental Core	3	0	2	4
CSBB 255	Data Structures	Allied Engineering	3	0	2	4
HMBB 251	Professional Communication	Humanities and Management	2	0	2	3
ECPB 251	Mini Project	Departmental Core	0	0	2	1
Total Credits			12	0	14	**20**

Summer Internship (6-8 weeks) is mandatory during the summer vacation in between semester IV and V for each student to continue the programme and the corresponding valuation will take place in the next semester (semester V).

Semester V						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECBB 301	Microprocessor and Microcontroller	Departmental Core	3	0	2	4
ECBB 302	Computer Networks	Departmental Core	3	0	2	4
ECBB 303	Digital Communication	Departmental Core	3	0	2	4
ECBB 304	IC Applications	Departmental Core	3	0	2	4
ECLB 3xx	Elective – I	Departmental Elective	3	0	0	3
ECPB 301	Seminar/ Summer Internship I	Departmental Core	0	0	2	1
Total Credits			15	0	10	**20**

Semester VI						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECLB 351	Antenna and Wave Propagation	Departmental Core	3	0	0	3
ECBB 352	Basics of VLSI	Departmental Core	3	0	2	4
ECBB 353	Digital Signal Processing	Departmental Core	3	0	2	4
ECLB 3xx	Elective – II	Departmental Elective	3	0	0	3
	Open Elective – I	Allied Engineering	3	0	0	3
ECPB 351	Project	Departmental Core	0	0	6	3
Total Credits			15	0	10	**20**

Summer Internship (6-8 weeks) is mandatory during the summer vacation in between semester VI and VII for each student to continue the programme and the corresponding valuation will take place in the next semester (semester VII).

Semester VII						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECBB 401	RF and Microwave Engineering	Departmental Core	3	0	2	4
ECLB 4xx	Elective – III	Departmental Elective	3	0	0	3
ECLB 4xx	Elective – IV	Departmental Elective	3	0	0	3
ECLB 4xx	Elective – V	Departmental Elective	3	0	0	3
	Open Elective – II		3	0	0	3
HMLB 401	Management Principles and Practices	Humanities and Management	3	0	0	3
ECPB 402	Seminar/ Summer Internship II	Departmental Core	0	0	2	1
Total Credits			18	0	4	**20**

Semester VIII						
Course Code	**Course Name**	**Type**	**L**	**T**	**P**	**Credit**
ECPB 451	Project	Departmental Core	-	-	-	16
ECPB 452	Independent Study and Seminar	Departmental Core	0	0	6	04
Total Credits						**20**

***Open electives are such subjects which will be offered by other departments. Like ECE department students have to opt open electives from CSE/ EEE etc. departments, as per will be offered.**

List of Electives: Bouquets with Specializations

Specialization: Photonics and Optical Communication

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 321	Semiconductor Laser Theory	3	0	0	3	Elective I
2.	ECLB 322	Optical Fiber Communication	3	0	0	3	
3.	ECLB 371	Semiconductor Device Modelling	3	0	0	3	Elective II
4.	ECLB 372	Fibre Optic Sensors and Devices	3	0	0	3	
5.	ECLB 421	Integrated Optics	3	0	0	3	Elective III + Elective IV + Elective V
6.	ECLB 422	Optical Networks	3	0	0	3	
7.	ECLB 423	Non- Linear Fibre Optics	3	0	0	3	
8.	ECLB 424	Advanced Optical Communication Systems	3	0	0	3	

Specialization: Circuit Design and Networks

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 323	Analytical and Computational Techniques in Electromagnetics	3	0	0	3	Elective I
2.	ECLB 324	Detection and Estimation Theory	3	0	0	3	
3.	ECLB 373	Information Theory and Coding	3	0	0	3	Elective II
4.	ECLB 374	Communication Networks	3	0	0	3	
5.	ECLB 425	RF Components and Circuit Design	3	0	0	3	Elective III + Elective IV + Elective V
6.	ECLB 426	Analog and Mixed Signal IC Design	3	0	0	3	
7.	ECLB 427	Architectural Design of ICs	3	0	0	3	

Specialization: Microprocessor and VLSI

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 325	Analog VLSI Circuits	3	0	0	3	Elective I
2.	ECLB 326	Digital VLSI Circuits	3	0	0	3	
3.	ECLB 375	DSP Processors and Architecture	3	0	0	3	Elective II
4.	ECLB 376	Microcontrollers for Embedded System Design	3	0	0	3	
5.	ECLB 428	Microprocessors and Applications	3	0	0	3	Elective III + Elective IV + Elective V
6.	ECLB 429	Analog and Mixed Signal IC Design	3	0	0	3	
7.	ECLB 430	VLSI Interconnects	3	0	0	3	

Specialization: RF and Microwave Engineering

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 327	Telecommunication Switching and Networks	3	0	0	3	Elective I
2.	ECLB 328	Antenna for Wireless Communication	3	0	0	3	
3.	ECLB 377	Radio and Microwave Wireless Systems	3	0	0	3	Elective II
4.	ECLB 431	RF Integrated Circuits	3	0	0	3	Elective III +
5.	ECLB 432	Microwave Devices and Circuits	3	0	0	3	Elective IV +
6.	ECLB 433	RF and Microwave Networks	3	0	0	3	Elective V

Specialization: Embedded System Design

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 329	Low Power Devices and Systems	3	0	0	3	Elective I
2.	ECLB 378	FPGA based Physical Design	3	0	0	3	Elective II
3.	ECLB 434	Micro Fabrication Technology	3	0	0	3	Elective III +
4.	ECLB 435	Embedded System Design	3	0	0	3	Elective IV +
5.	ECLB 436	CPLD and FPGA Architectures and Applications	3	0	0	3	Elective V

Specialization: Communication and Signal Processing

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 330	Digital Image Processing	3	0	0	3	Elective I
2.	ECLB 331	Next Generation Networks	3	0	0	3	
3.	ECLB 379	Statistical Signal Processing	3	0	0	3	Elective II
4.	ECLB 380	Multimedia Communication and Systems	3	0	0	3	
5.	ECLB 437	Satellite Communication	3	0	0	3	Elective III +
6.	ECLB438	Wireless and Adhoc Networks	3	0	0	3	Elective IV +
7.	ECLB 439	Optical Signal Processing	3	0	0	3	Elective V
8.	ECLB 440	Error Control Coding	3	0	0	3	
9.	ECLB 441	Digital Communication Techniques	3	0	0	3	

Specialization: Antenna Theory

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 332	RF Integrated Circuits	3	0	0	3	Elective I
2.	ECLB 381	Radar Signal Processing	3	0	0	3	Elective II
3.	ECLB 382	Millimetre Wave Technology	3	0	0	3	
4.	ECLB 442	Antenna Theory and Design	3	0	0	3	Elective III + Elective IV + Elective V
5.	ECLB 443	Modern Radar and Avionics Systems	3	0	0	3	
6.	ECLB 444	Radar Engineering	3	0	0	3	

Specialization: Machine Learning and Internet-on-Things

Sl. No.	Course Code	Course Title	L	T	P	Credits	Applicability
1.	ECLB 333	Wavelet Transforms	3	0	0	3	Elective I
2.	ECLB 383	Pattern Recognition and Machine Learning	3	0	0	3	Elective II
3.	ECLB 390	Introduction to Artificial Intelligence and Machine Learning	3	0	0	3	
4.	ECLB 384	Signature Analysis and Radar Imaging	3	0	0	3	
5.	ECLB 445	Embedded Real Time Operating Systems	3	0	0	3	Elective III + Elective IV + Elective V
6.	ECLB 446	Neural Networks	3	0	0	3	

List of Open Electives to be offered to Other Departments

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	ECLB 385	Introduction to Nano science and Nano technology	3	0	0	3
2.	ECLB 386	Growth, Fabrication and Manufacturing of Electronic Devices	3	0	0	3
3.	ECLB 387	Neural Networks and Fuzzy Logic	3	0	0	3
4.	ECLB 388	Electronic Materials and their Applications	3	0	0	3
5.	ECLB 389	Optimization Techniques	3	0	0	3
6.	ECLB 448	Green Technologies	3	0	0	3
7.	ECLB 449	Machine Learning and Pattern recognition	3	0	0	3
8.	ECLB 450	Wireless Communication and Sensor Networks	3	0	0	3
9.	ECLB 451	Data Communication and Networking	3	0	0	3
10.	ECLB 452	Micro-electronics and VLSI Technology	3	0	0	3

Course no: MALB 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	**ADVANCED CALCULUS**			
Course Coordinator				
Course objectives:	• To learn about the differential, integral for functions of one and more than one variable. • To learn the fundamentals of vectors and coordinate geometry. • To provide students with the foundations of set theory, • To apply the above mathematical tools and methods in physical sciences, and engineering problems.			
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	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

Content	**UNIT I:** **16** **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: **12** **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: **12** **Vectors and Coordinate Geometry:**Vectors algebra, Unit vectors, Components of a vector, Position vector, Dot and cross products. Projection of a vector on another. Distance between two points. Equations of a line, plane and sphere. Intersections, Distance between lines and planes.
	UNIT IV: **08** **Set Theory:** Introduction to the theory of sets; a combination of sets; power sets; finite and infinite sets; the principle of inclusion and exclusion.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: PHBB 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	**ENGINEERING PHYSICS**			
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.			
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	AnIntroductiontoMechanics
	Author	D.KleppnerandR.J.Kolenkow
	Publisher	TataMcGraw−Hill
3.		Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles
	Author	R.Eisberg and R. Resnick
	Publisher	John−Wiley
Reference Books:		
1.	Title	QuantumPhysics
	Author	S.Gasiorowicz
	Publisher	JohnWiley
2.	Title	Concepts of Modern Physics
	Author	A. Beiser
	Publisher	Tata McGraw-Hill Education

Content	**UNIT I: 06** **Coordinate Systems:** Orthogonal coordinate systems and frames of reference, conservative and nonconservative forces, work-energy theorem, potential energy and concept of equilibrium; Rotation about fixed axis, translational-rotational motion, vector nature of angular velocity, rigid body rotation and its applications, Euler's equations; Gyroscopic motion and its application; Accelerated frame of reference, centrifugal and Coriolis forces.
	UNIT II: 10 **Classical Mechanics**: Review of Newtoninan Mechanics in rectilinear coordinate system, motion in plane polar coordinates. Conservation Principles. Collision problems and centre of mass frame. Rotation about fixed axis. Non-inertial frames and pseudo forces, rigid bossy systems.
	UNIT III: 12 **Quantum Mechanics/ Physics:** Two−slit experiment. Dual nature of light; Compton Effect; De-Broglie hypothesis; 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; Normalization. Expectation values. Eigen values and eigen functions Stationary states, Bound states, Applications in one dimension: Particle in a box, 1-D Finite Potential well, Harmonic oscillator. Free-particle solution, 1-D infinite potential well, Expectation values and uncertainty relations;, Quantum mechanical tunneling and alpha-decay, Kronig-Penny model and emergence of bands.
	UNIT IV: 12 **Electrodynamics:** Ohm'slaw, Motional EMF, Faraday's law, Lenz's law,Self andMutual inductance, Energy stored in magnetic field, 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 Interference, Diffraction, and Polarization**:** Interference of EM waves**;** Division of amplitude: Uniform and wedge-shaped films; interferometers; Fresnel and Fraunhofer diffractions of EM waves;
	UNIT V: 08 **Magnetostatics:** Lorentz force, Bio-Savart and Ampere's Laws and their applications, Divergenceand Curl of Magnetostatic fields, Magnetic vector Potential, Force and torque on a magneticdipole, Magneticmaterials,Magnetization,Boundcurrents,Boundaryconditions.
	Tentative List of Experiments- Characteristics of PN junction, Zener, and Light emitting diodes Determination of semiconductor bandgap through thermal variation Determination of Planck's constant through LED Newton's rings apparatus experiment Malus' law verification for polarization Diffraction grating experiment
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 Code ECBB 101		**Semester: Odd (Odd/Even)**	
Course Name	**BASICS OF ELECTRONICS AND ELECTRICAL ENGINEERING**		
Credits	**4**	**Contact Hours**	3 (Theory) + 2 (Lab)
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		
Course Objectives	To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.		

Module No.	**Title of the Module**	**List of Topics**	
Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
Unit I	Semiconductors	Conductivity of insulators, metals, and semiconductors in terms of energy bands, the chemical bond in Si and Ge, conductivity of intrinsic semiconductors, extrinsic semiconductors: n-type and p-type semiconductors, Hall Effect in semiconductors, Mechanism in current flow: drift and diffusion, Einstein relation, semiconductor materials: Element semiconductor, II-VI compound, III-V compounds, ternary and quaternary compounds. V-I characteristics of PN-junction diode. Diode equivalent circuit, diode as a switch, diode testing.	15
Unit II	Diode Applications	Rectifiers: Half wave, center tapped and bridge full-wave, Zener diode regulator and voltage multiplier, clipping and clamping circuits.	07
Unit IV	Electrical Circuit Analysis	Voltage and current sources, dependent and independent sources, source conversion, DC circuit's analysis using mesh & nodal method, Thevenin's & superposition theorem, star-delta transformation. 1-phase AC circuits under sinusoidal steady-state, active, reactive, and apparent power, physical meaning of reactive power, power factor, 3-phase balanced and unbalanced supply, star and delta connections.	10
Unit V	Electrical Machines (Static & Dynamic)	Transformers: Magnetic Circuits: Review of laws of electromagnetism, Flux, MMF and their relation, analysis of the magnetic and electric circuit. Single-phase transformer: Basic concepts, constructional features, EMF equation, voltage, current, and impedance transformation, Equivalent circuits. 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, the concept of slip and torque–slip characteristics. Synchronous Machines: Constructional features, working principle and emf equation.	10
Total			42

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

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson, 11th Ed., 2017.
2.	Vincent Del Toro, Electrical Engineering Fundamentals, PHI Learning, 2nd Edition, 2015.
3.	Millman, Halkias & Parikh, Integrated Electronics - Analog and Digital Circuit and Systems , McGraw-Hill Education -, 2nd Edition, 2012.
4.	S. Ghosh, Fundamentals of Electrical and Electronics Engineering, 2nd Edition, PHI Learning Pvt. Ltd., 2007.
5.	I.J. Nagrath & D P Kothari, Basic Electrical Engineering, 3rd Edition TMH, 2009.

Tentative List of Experiments	
S. No.	**Experiments**
1.	Introduction to Breadboard and Electronics components/ Equipment Task
2.	Multimeter Operation, Color Coding of Resistance and capacitor coding Task
3.	Study of Cathode Ray Oscilloscope
4.	Light a bulb/LED and its brightness control
5.	Series/ Parallel Connection of resistors and Water Level detector
6.	Slow light up of LED - Series/ Parallel Connection of Capacitors and build your own battery
7.	One-way current using diode and One-way Light Bulbs LED's
8.	The Electronic Switch- using Transistor
9.	THE LIGHTHOUSE- LED blinking
10.	a) Breadboard to PCB – PCB Introduction b) To learn how to solder and de- solder
10	Study of Resonance in Parallel RLC Circuit and to find its resonance frequency**.**
11.	Study of Resonance in Series RLC Circuit and to find its resonance frequency**.**
12.	Study of characteristics of PN Junction diode a) Forward bias b) Reverse bias

Course no: HMBB 101	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	Y	No	No
Type of Course	Theory and practical			
Course Title	**THEORY AND PRACTICES OF HUMAN ETHICS**			
Course Coordinator				
Semester	**Autumn: Yes**		**Spring: Yes**	

Contact Hours	Lecture	Tutorial	Practical	Credits	Total Teaching Hours
Contact Hours	2	0	2	4	**4**

Pre-requisite : Nil

Detailed Syllabus:

Unit I **08**

Introduction: Organization and Organizational Behavior- Concept and significance, Organizational Structures, Individual & Group Behavior; Morals, Values and Ethics; Engineering Ethics- Need, Scope, and Approach; Personality- meaning and definition, Types of Personality; Personality Attributes; Determinants of Personality- Biographical and Personal factors, Environmental Factors, Psychological Factors; Big Five Personality traits.

Unit II **06**

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 **06**

Moral Development; Variety of Moral Issues; Moral Dilemma; Moral Autonomy; Theories of Moral Development- Cognitive Moral Development; Concept of moral Relativism and Moral Imperialism; Encouragement and Approaches to Ethical Behavior.

Unit IV **04**

Human Resource Policies& Procedures- Introduction, Importance of Policies, Policy Formation, Human Resources Planning. Decision-making & Ethics.

List of Experiments:

1. Management Activities and Games
2. Case Studies
3. Group Discussion
4. Debate
5. Presentation
6. Skit

Recommended Books	A.K. Chitale, R.P. Mohanty and N.R. Dubey, "Organizational Behaviour: Text and Cases", PHI Learning Private Limited, 2019. Ashwathappa, K., "Text & Cases in Human Resources Management", Tata McGraw Hill Bhattacharyya D.K., "Human Resource Planning", Excel Books India M. Govindarajan, S. Nataraja and V.S. SenthilKumar "Engineering Ethics includes Human Values" - PHI Learning Pvt. Ltd- 2011 M.W. Martin, R. Schinzinger, "Ethics in Engineering", McGraw-Hill Education, 2005 Mike W. Martin and Roland Schinzinger "Ethics in Engineering" Tata McGraw- Hill R.S. Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International Publishers. R.W. Griffin, G. Moorhead, "Organizational Behavior: Managing People and Organizations", Cengage Learning, 2013.
Course Assessment	Theory (60%): Continuous Evaluation 25%, Mid Semester 25% End Semester 50% Laboratory (40%): Continuous Evaluation 50%

Course no: CEPB 121	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	Y	No	No
Type of Course	**Practical**			
Course Title	**NATURE AND CARE**			
Course Coordinator				
Semester	**Autumn: Yes**		**Spring: Yes**	

Contact Hours	Lecture	Tutorial	Practical	Credits	Total Teaching Hours
Contact Hours	0	0	2	1	**24**

Pre-requisite	**:**	Nil

List of Experiments: 2 Practical hours per week

1. Identification of different plant species in NIT Delhi Campus and find its uses in daily life.
2. Best out of waste competition.
3. Poster and signs making competition to spread environmental awareness.
4. Recycling and environmental pollution article writing competition.
5. Use of environment friendly alternatives for daily life products.
6. Quiz activity on rising environmental concern.
7. Organising Zero-waste day.
8. Adopt a plant programme.
9. Digital Environmental awareness activity via various social media platforms.
10. Conducting digital survey to know environmental stress faced by people.
11. Calculate your carbon footprint.
12. Introduction to live Air Quality Index.
13. Virtual demonstration of different eco-friendly approaches for sustainable living.
14. Write a summary on any book related to environmental issues.
15. Field visit to zoological park/ Botanical garden/ Industry.

Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publicatio
1.	Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e	2008
2.	Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e	2007

3.	Peavy H. S., Rowe D.R. and Tchobanoglous G., "Environmental Engineering", McGraw Hill, New York	1986
4.	Mines R. O. and Lackey L. W. ""Introduction to Environmental Engineering", Prentice Hall, New Yark	2009
5.	Miheicic J. R. and Zimmerman J. B. " Environmental Engineering: Fundamentals, Sustainability, Design" John Wiley and Sons, Inc.	2010
Course Assessment	Continuous Evaluation 50% End Semester 50%	

Course no: HMPB 102	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	Y	No	No
Type of Course	**Practical**			
Course Title	**COMMUNICATION SKILLS**			
Course Coordinator				
Semester	**Autumn: Yes**		**Spring: Yes**	

Contact Hours	Lecture	Tutorial	Practical	Credits	Total Teaching Hours
Contact Hours	0	0	2	1	**28**

Pre-requisite	**:**	Nil

Practicals:

Unit I: WRITTEN COMMUNICATION **04**

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: ORGANISATIONAL COMMUNICATION **04**

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: PRESENTATION SKILLS **06**

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: Group Discussion Skills **06**

Techniques for Group Discussion Subject Knowledge, Communication Skills, Leadership Skills, Group Behaviour, Group 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 **08**

Pre-interview Presentation Techniques Self-Analysis, Research the Organisation Job Analysis, Revise your Subject Knowledge, Develop your Interview file. Interview questions: types, Answering Strategies.

Suggested Books:

S.No.	Name of Books / Authors/ Publishers	Year of Publication / Reprint
1.	Rizvi, M. A. Effective Technical Communication. New Delhi: McGraw Hills Education	2005
2.	Jones, L &R. Alexander. New International Business English. UK: CUP	2006
4.	Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. Orient Blackswan. Hyderabad.	2013
5.	Hewings, M. English Pronunciation in Use. Advanced. Cambridge: CUP	2009
6.	Marks, J.English Pronunciation in Use. Elementary. Cambridge: CUP	2009
7.	Nambiar, K.C. Speaking Accurately. A Course in International Communication. NewDelhi :Foundation	2011
8.	Soundararaj, Francis. Basics of Communication in English. New Delhi: Macmillan	2012

Course Code	**:**	**EAPB 101**				
Course Title	**:**	**Extra Academic Activity**				
Type of Course	**:**	**Practical**				
		Lecture	**Tutorial**	**Practical**	**Credits**	**Total Lab Hours**
Contact Hours		0	0	2	0	28 (P)
Pre-requisite	**:**	Nil				
Physical activities, Sports, Yoga, meditation, Indore and outdoor games, etc.						

Course no: MALB 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:	To learn the basics of matrix theory and linear algebra. To learn about vector analysis for functions of one and more than one variable. To learn the fundamentals of vectors and coordinate geometry. To learn about basic concepts of complex analysis, such as limit, continuity, differentiability and integration, and also related theorems. To provide students with the foundations of graph theory,			

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
3 33.	Title	Vectors and Geometry
	Author	G.S. Pandey, R.R. Sharma
	Publisher	New Age international
	Edition	2018
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
	UNIT I: **12** 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: **12** Vector Analysis: 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.	
	UNIT III: **12** 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.	
	UNIT IV: **12** Graph Theory: Path, cycles, handshaking theorem, bipartite graphs, sub-graphs, graph isomorphism, operations on graphs, Eulerian graphs and Hamiltonian graphs, planar graphs, Euler formula, traveling salesman problem, shortest path algorithms.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECLB 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	**BASICS COMMUNICATION SYSTEMS**			
Course Coordinator				
Course objectives:	• To understand the fundamentals of communication system • To understand the concept of analog communication including amplitude and angle modulation • To understand the fundamentals digital communication, basic advantage of digital modulations schemes over analog modulation • To understand the basic concepts and advantages of fiber optics communication. To understand the basic concept of wireless communication			
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	Wireless Communications principle and practice
	Author	Rappaport
	Publisher	pearson
	Edition	2rd ed. (2010)
2.	Title	Optical Fibre Communications
	Author	G. Keiser
	Publisher	3rd Edition Tata McGraw Hill, 2000
3.	Title	Modern Digital and Analog Communication Systems
	Author	B. P. Lathi and Z. Ding
	Publisher	4th edition, OXFORD
Reference Books:		
1.	Title	analog and digital communication
	Author	simonhaykin
	Publisher	2nd edition,

Content		**UNIT I:** **06** **Introduction:** Introduction of communication system, Block diagram, type of communication, modes of communication, signal bandwidth, channel bandwidth, frequency spectrum, Signal classification (continuous time signal, discrete time), Energy and power signal.

		UNIT II: **10** **Analog Communication**: Overview of Communication System; Need of Modulation and its Benefits, definition of amplitude modulation, demodulation, modulation index, efficiency, bandwidth requirement, advantage of angle modulation over amplitude modulation, Bandwidth comparison between amplitude and angle modulation.
		UNIT III: **12** **Digital Communication** Introduction of digital communication, advantage of digital communication over analog, Modulation Techniques: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying.
		UNIT IV: **12** **Advancement of communication system:** Introduction to optical communication systems, Advantage of optical communication, Signal propagation in optical fibre, TIR, refractive index, numerical aperature, relative refractive index, skew rays, classification of fibres, Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering, Signal fading, Scattering, Friss transmission equation.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: CSBB 181	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	NO
Type of course	**Elective**			
Course Title	**PROBLEM SOLVING AND COMPUTER PROGRAMMING**			
Course Coordinator				
Course objectives:	This course covers computer systems hardware organization and the programmer interface with the goal of improving students' abilities to reason about the execution of their programs, write system software, and enhance the performance of the programs they write. This course will also serve as a basis for other systems courses, such Operating Systems, Computer Networks or Computer Systems Organization. It will help the student to become a better programmer by teaching the basic concepts underlying all computer systems.			
POs				

Semester	**Autumn: Yes**		**Spring:**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3		2	4	36
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	Computer Systems: A Programmer's Perspective
	Author	Bryant and O'Hallaron
	Publisher	Pearson
	Edition	3
Reference Book:		
1.	Title	Advanced Programming in the Unix Environment
	Author	Richard Stevens
	Publisher	Addison-Wesley
	Edition	1992
Content	**UNIT I:** **03** Introduction to evolution of computers, computational Physics, transistors, photolithography, Moore's Law, bits, bytes, and logic, Introduction to CPU, Programming Languages	

	UNIT II: 15 Program Structure and Execution: Representing and manipulating information: information storage, integer representations, integer Arithmetic and floating points Machine- level representation of programs :A historical perspective, program encodings, data formats, accessing information, arithmetic and logical operations, control flow, procedures, array allocation and access, heterogeneous data structures. Processor Architecture: microarchitecture, X-86-64 Extending IA32 to 64 bits, instruction set architecture, logical design and hardware control language HCL,implementations Program Optimization: Capabilities of operating compilers, Expressing program performance, eliminating loop inefficiencies, reducing procedure calls, memory performance Memory Hierarchy : Storage technologies, locality, memory hierarchy, cache memories, impact of caches on program performance. **UNIT III 09** **Running programs on a system:** Linking: Compiler Drives, Static linking, object files, relocatable object files, symbols and symbol tables, symbol resolution, relocation, executable object files, loading executable object field, dynamic linking with shared libraries Exceptional Control flow: Exceptions, process, system call error handling , process control, signals Virtual memory : Physical and virtual addressing, addressing space, VM as a tool for caching, memory management, address translation, memory mapping, dynamic memory allocation, garbage collection, common memory related bugs. **UNIT IV 06** **Interaction and communication between programs:** System-level input output: Introduction to operating systems, types, Unix I/O, opening and closing files, reading and writing files, Reading file metadata, sharing files, I/O redirection, standard I/O, Networking Programming: Client server programming model, Networks, Global IP Internet, Sockets Interface, Web servers, Concurrency, Distributed Systems. **UNIT V 03** **Advance topics:** Introduction to AI, Security needs, Management Information System, Cloud and Quantum Computing ,etc
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: MEBB 162	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.			
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. **Laboratory**- 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	Continuous Evaluation 25%, Mid Semester 25% End Semester 50%

Course no: ECBB 152	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	Yes	No	No
Type of course	Theory			
Course Title	**DIGITAL ELECTRONICS AND LOGIC DESIGN**			
Course Coordinator				
Course objectives:	Through a series of intensive lectures and a hands-on project the course aims to: • To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. • Introduce the concept of digital and binary systems • Be able to design and analyze combinational logic circuits. • Be able to design and analyze sequential logic circuits.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 36 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					

Reference Books:		
1.	Title	Digital Design, Principles and Practices
	Author	J. F. Wakerly
	Publisher	Pearson Education
	Edition	4th, 2005
2.	Title	Digital Computer Fundamentals
	Author	T.C. Bratee
	Publisher	McGraw Hill.
	Edition	2001
3.	Title	Digital Logic & Computer Design
	Author	M Morris Mano
	Publisher	Pearson
	Edition	5th, 2011
4.	Title	Digital Principles and Applications
	Author	A.P. Malvino and B.P. Leach
	Publisher	McGraw Hill.
	Edition	4th
Text Book:		
1.	Title	Digital Electronics

	Author	WH Gothmann
	Publisher	PHI
	Edition	2nd Edn
Content	**Unit I** **10** Number System: Various number systems-decimal, Binary, Hex and Octal with mutual conversion, binary arithmetic in computers, addition, subtraction, multiplication and division. Binary Codes: Weighted, non-weighted codes, error detecting and correcting codes, alphanumeric codes, ASCII codes **Unit II : Boolean Algebra & Logic Hardware** **09** Boolean Algebra: AND, OR, NOT, NAND, NOR, EXOR, operations and gates, laws of Boolean algebra, reduction of Boolean expression, logic diagram, universal building blocks, negative logic. Logic hardware " Diode as switch, Bipolar transistor as switch FET as switch, MOSFET (Deplection and Enhancement mode) IC Technology, MSI, LSI, VLSI, logic specification, logic families (DTL, TTL, ECL, MOS, CMOS) **Unit III : Combinational circuits and system** **08** Combinational logic: Minterms and maxterms, Truth table and Karnaugh mapping, reduction of Boolean expression with SOP, POS and mixed terms, incompletely specified functions multiple output minimization, variable mapping, minimization by labular/ Quine Mc cluskey method. Encoders, Decoders, Multiplexers, Demultiplexers, code convertors, Binary address Digital comparator, parity checker/ generator, programming logic Array (PLA); **Unit IV : Sequential circuits system** **08** State tables and diagrams, flip flop and its various types- JK, RS, T, D, pulse and edge triggered flip flops transition and excitation tables, timing diagrams. Shift registers: Series and parallel data transfer, ripple counters, synchronous counters, Modulo N counter design, Up down counters, Ring **Unit V : Memory & A/D Conversion system** **07** Semiconductor ROM, Bipolar and MOS RAM, organization of RAM memory subsystem. Timing circuit, clock circuit and IC Timer. Analog/Digital conversion: Digital to analog conversion, dual slope integration successive approximation, parallel and parallel/ series conversion, converter specifications.
Tentative List of Experiments	Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates Construction of half and full adder using XOR and NAND gates and verification of its operation To Study and Verify Half and Full Subtractor Realization of logic functions with the help of Universal Gates (NAND, NOR) Construction of a NOR gate latch and verification of its operation Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers Implementation and verification of decoder or de-multiplexer and encoder using logic gates Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates

	Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop Verify Binary to Gray and Gray to Binary conversion using NAND gates only Verify the truth table of one bit and two bit comparator using logic Gates.
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: ECBB 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**			
Credits	**4**	**Contact Hours**	3 (Theory) + 2 (Lab)	
Course Coordinator				
Course objectives:	This course provides the detailed understanding of the physics, design, operation, and limitations of important solid state electronic and optoelectronic devices used by electrical and telecommunications engineers. Students equipped with the knowledge and training provided in the course will be able to participate in design and development, installation and operation of a wide spectrum of applications in the field of solid-state device. Solid state device is the basic fundamental of electronics industry. It is highly relevant for electrical engineers who intend to pursue further studies of integrated circuit design and/or microfabrication.			
Semester	**Autumn: Yes**		**Spring: No**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
	3	0	2	4	48
Prerequisite course code as per proposed course numbers	PHLB 100 EEBB 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

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
Unit I	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.	06
Unit II	Semiconductor under Equilibrium	Charge carriers in semiconductors, carrier concentrations, dopant atoms and energy levels, intrinsic and extrinsic semiconductors; charge neutrality, Fermi energy level.	06
Unit III	Semiconductor under Non-Equilibrium	Carrier transport, 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.	06
Unit IV	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.	06
Unit V	Bipolar Junction Transistors:	Fundamental operation, amplification with BJTs, generalized biasing and equivalent circuit models, non-ideal effects, Classification (CC, CB & CE), configurations, transistor as an amplifier, testing of transistor, load line analysis, biasing of the transistor, bias compensation, and transistor as a switch.	06
Unit VI	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.	06
Unit VII	Photonic Devices	Light emitting diodes, semiconductor lasers, photo detectors, solar cells, power devices etc.	06
Total			42

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

Tentative List of Experiments:

S. No.	Experiments
1.	To study Digital Storage Oscilloscope

2.	To study PN diode characteristics
3.	To study Zener diode characteristics
4.	To study half wave and full wave rectifier circuits
5.	To study Bridge wave rectifier circuit
6.	To study zener diode as a voltage regulator
7.	To study zener diode as a voltage regulator
8.	To study clipper and clamper circuits
9.	To study the characteristics of various transistor configurations
10.	To study the performance of CE amplifier
11.	To study the performance of CC amplifier
12.	To study the performance of CB amplifier

Course no: ECLB 202	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	Theory			
Course Title	**NETWORK ANALYSIS AND SYNTHESIS**			
Course Coordinator				
Course objectives:	To introduce the fundamentals of network analysis using matrices, two-port, and network synthesis.			

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	EEBB 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: ECLB 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 fundamentals of vector calculus, Electrostatics, Magneto statics, Maxwell's Equations.			
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	PHLB 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: ECBB 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			
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: ECLB 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	**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			
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	EELB-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.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: HMPB 103	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 REPORT WRITING**			
Course Coordinator				
Course objectives:	This course aims to prepare the students to understand how to place information appropriately in reports to match multiple audience needs. It employs efficient process of planning and organizing information. The course also focuses on preparation of visuals to supplement text, workplace communication, explanations of processes, and writing effective reports.			
Semester	**Autumn:** No		**Spring:** Yes	

VI	Lecture	Tutorial	Practical	Credits	Total Teaching Hours
Contact Hours	**0**	**0**	**2**	1	-
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				

Content

Unit I: STEPS TO EFFECTIVE REPORT WRITING

Introduction to Technical Report Writing, The optimal 6-step process for Business Writing

Unit II: REPORT PLANNING

Analyzing audience, Understanding Purpose before writing the report, framing a report and conveying technical information, including content and organization

Unit III: REPORT STRUCTURE

Report Organization, Assembling a Well Organized Report, Academic vs. Business Writing and Report Structure, Effective Collaborative Writing

Unit IV: EXECUTIVE SUMMARY AND TOOLS USED FOR REFORTS

Executive Summary Defined and Process Illustrated, When and How to Write the Executive Summary, Examples of Good and Bad Executive Summaries and Key Tips, Common Errors in Reports and Executive Summaries, Power point for Report, Excel for Reports, Word for Reports , Avoiding Writer's Block

	Unit V: PERSUATION AND CLARITY IN REPORT WRITING Engaging readers and highlighting recommendations, Ways of achieving the 7 Cs (Clear, Concise, Concrete, Correct, Coherent, Complete, Courteous) of communication in report writing, Eliminating grammar and punctuation errors, Proofreading .
Course Assessment	Laboratory: Continuous Evaluation 50% End Semester 50%

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Rizvi, M. A. Effective Technical Communication. New Delhi: McGraw Hills Education	2005
2.	Jones, L &R. Alexander. New International Business English. UK: CUP	2006
4.	Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. Orient Blackswan. Hyderabad.	2013
5.	Hewings, M. English Pronunciation in Use. Advanced. Cambridge: CUP	2009
6.	Marks, J.English Pronunciation in Use. Elementary. Cambridge: CUP	2009
7.	Nambiar, K.C. Speaking Accurately. A Course in International Communication. NewDelhi :Foundation	2011
8.	Soundararaj, Francis. Basics of Communication in English. New Delhi: Macmillan	2012

Course no: ECBB 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	**ANALOG ELECTRONICS**			
Course Coordinator				
Course objectives:	The goal of this course is to introduce and verify basic principles, operation and applications of the various analog electronic circuits made up of devices like: BJT and MOSFET for various engineering/ social applications. To make students understand and analyse the design and working of amplifiers and their configurations. This course is also intended to develop an understanding of small signal amplifier design using linear transistor models; and its analysis at low and high frequencies, including different feedback topologies and oscillators. The course also indulges power amplifiers, tuned amplifiers and behaviour of noise in an amplifier.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	2	4	**36**
Prerequisite course code as per proposed course numbers	**ECBB 201 (Solid State Devices)**				
Prerequisite Credits	4				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
Unit I	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.	06

Unit II	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	06
Unit III	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.	06
Unit IV	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.	06
Unit V	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.	06
Unit VI	Multistage Amplifiers and Power Supplies	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, Multivibration Circuits, 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.	06
Total			36

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

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Malvino, Electronics Principles, 3rd Edition, Tata McGraw Hills, New Delhi.

2.	Christos C. Halkias, Jacob Millman, Satyabrata Jit, Electronic Devices and Circuits, 4th Edition, McGraw Hill Education Pvt Ltd, 2015.
3.	Boylestead and Nashelski, Electronic Circuit Theory, 3rd Edition, Tata McGraw Hills, New Delhi.
4.	Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, International Student Edition, Oxford University Press, 2006.

Tentative List of Experiments:	
S. No.	**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.	Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip
12.	Construction of a simple function generator using IC
13.	Realization of a V-to-I & I-to-V converter using Op-Amps
14.	Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO). 15. Study of D.A.C & A.D.C
15.	RC-Coupled Amplifier
16.	Emitter Follower (Common Collector Amplifier), Common emitter amplifier and Differential Amplifier

Course no: ECBB 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 COMMUNICATION**			
Course Coordinator				
Course objectives:	To understand the basic concepts of Amplitude Modulation, Frequency modulation, Phase modulation techniques.			
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	ECBB-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
Reference Books:		
1.	Title	Introduction to Communication Systems
	Author	B. Carlson
	Publisher	McGraw-Hill

	Edition	4/e, 2009
2.	Title	Modern Communication Circuits
	Author	J. Smith
	Publisher	McGraw Hill
	Edition	2/e, 1997
3.	Title	Modern Electronic Communication
	Author	J. S. Beasley & G. M. Miler
	Publisher	Prentice Hall
	Edition	9/e, 2008
Content	**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.	
Course Assessment	Continuous Evaluation 25%, Mid Semester 25% End Semester 50%	

Course no: ECBB 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	**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.			
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	EEBB 100 EELB 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

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Transducers & Instrumentation</td></tr>
<tr><td>Author</td><td>D.U. S Murthy</td></tr>
<tr><td>Publisher</td><td>Prentice Hall of India</td></tr>
<tr><td>Edition</td><td>3rd</td></tr>
<tr><td>Content</td><td colspan="2">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.
UNITIII: 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.</td></tr>
</table>

	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: HMBB 251	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.			
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	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	McGraw Hills
	Edition	2004

UNIT I: **08**

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: **08** 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: **08** Writing Skills: Practice in Written Communication with a view to enabling independent, original and creative writing. Construction of Sentences and Paragraphs to write the Research paper, Correspondence (letters, memos, emails, and fax), , Professional Writing (Process Writing, Technical Description and Report Writing), Tips for making presentation, Curriculum Vitae etc.
	UNIT IV: *Laboratory Work-* **12** Speaking and Listening Skills- 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.
	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: CSBB 255	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	NO	NO	NO	NO
Type of course	**Core**			
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.			

Semester	**Autumn:**		**Spring: Yes**		
II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	48
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 Book:		
1	Title	Fundamentals of Data Structures
	Author	E. Horowitz, S. Sahni
	Publisher	Computer Science Press
	Edition	2nd Edition, 2008
2	Title	Data Structures Using C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	2013
3	Title	Data Structure and Program Design
	Author	R.L. Kruse
	Publisher	Prentice Hall
	Edition	2nd Edition, 1996
4	Title	Data Structures Using C
	Author	A. M. Tanenbaum, Y. Langsam, M. J. Augenstein
	Publisher	Pearson Education
	Edition	1990

Content	**Unit I:** **08** 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:** **08** 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:** **06** 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:** **06** 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: ECBB 301	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	**Yes**	**No**	**No**
Type of Course	Theory & Practical			
Course Title	**MICROPROCESOR AND MICROCONTROLLER**			
Course Coordinator				
Course objectives:	To study the architecture of 8085, 8086, 8051and ARM. To study the addressing modes and instruction set of 8085, 8086 8051and ARM. To explore the need and use of Peripherals and Interfacing. To develop skill to explore system design technique. To study introduce the programming language of 8086 and 8051. To develop skill in program writing for microprocessors and controllers. To introduce microprocessor and microcontroller-based system design. To impart knowledge on embedded S/W development.			

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	Microprocessor Architecture, Programming and Applications with 8085
	Author	Ramesh S. Gaonkar
	Publisher	Penram International Publishing reprint
	Edition	6th Edition, 2017
2.	Title	Microprocessor and Interfacing, Programming and Hardware
	Author	Douglas V. Hall,
	Publisher	Tata McGraw Hill

	Edition	Revised 2 nd Edition 2006, 11th reprint 2015
3.	Title	The 8051 Microcontroller and Embedded Systems
	Author	Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley
	Publisher	Pearson Education
4.	Edition	2nd Edition,12th impression 2018
5.	Title	Advanced Microprocessor and Peripherals
	Author	A.K. Ray, K.M. Bhurchandi
	Publisher	Tata McGraw-Hill
	Edition	2nd Edition, 2010
6.	Title	Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096
	Author	Krishna Kant
	Publisher	PHI
	Edition	2007, 7th Reprint, 2015
7.	Title	ARM System-on-Chip Architecture
	Author	Steve Furber
	Publisher	Pearson Education
	Edition	Second

Content

UNIT I: **09**

8085 Architecture, Instruction set, Addressing modes, Interrupts, Timing diagrams, Memory and I/O interfacing. 8086 Architecture, Instruction set and programming, Minimum and Maximum mode configurations.

UNIT II: **09**

Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC0808 and DAC0808 Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251).

UNIT III: **09**

8051 – Architecture, Special Function Registers (SFRs), Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers / counters, Interrupts and serial communication.

UNIT IV: **09**

Interfacing to: matrix display, (16x2) LCD, high power devices, optical motorshaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol.

UNIT V: **09**

RISC Vs CISC Architecture, ARM Processor Architecture, ARM Core data flow model, Barrel Shifter, ARM processor modes and families, pipelining , ARM instruction Set and its Programming.

List of Experiments

Assembly Language Programming of 8086:

1. Programs for 8 / 16 bit Arithmetic, Sorting, Searching and String operations.
2. Programs for Digital clock, Interfacing ADC and DAC.
3. Interfacing and programming 8279, 8259, and 8253.
4. Serial Communication between two microprocessors kits using 8251.
5. Interfacing Stepper Motor, Speed control of DC Motor
6. Parallel communication between two microprocessors kits using

	Mode 1 and Mode 2 of 8255. 7. Macro assembler Programming for 8086. **8051 based experiments using assembly language and C programming:** 8. Programming using Arithmetic, Logical and Bit Manipulation instructions of the 8051 microcontroller. 9. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller. 10. Interfacing – DAC and ADC and 8051 based temperature measurement 11. Interfacing – LED and LCD 12. Interfacing – Stepper motor and traffic light control system. 13. Communication between 8051 Microcontroller kit and PC. 14. Programming ARM processor using Embedded C.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECBB 302	**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.			

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	ECBB 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	**UNITI: 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) **UNITII: 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. **UNITIII: 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, Super netting, 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.	
	Tentative list of experiments- Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool. 2Study of Network Devices in Detail. 3Study of network IP. 4Connect the computers in Local Area Network. 5 Study of basic network command and Network configuration commands. 6Performing an Initial Switch Configuration 7Performing an Initial Router Configuration 8Configuring and Troubleshooting a Switched Network 9Connecting a Switch 10Configuring WEP on a Wireless Router	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ECBB 303	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of Course	Theory + Practical		Core Engineering Course	
Course Title	**DIGITAL COMMUNICATION**			
Course Coordinator				
Course objectives:	To understand the basic concepts of Digital Communication System, need of digital communication, Various Waveform Coding Techniques, Baseband line coding, Digital Modulation Techniques, Binary ASK, FSK, PSK, Multilevel modulation techniques like QPSK, CPFSK, MSK, QAM, Designing of Receivers, Matched Filters, Maximum Likelihood Receiver Structures, Inter symbol Interference and Eye Pattern.			
Semester	**Autumn: Yes**		**Spring: No**	

Contact Hours	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	4	4	**48**
Prerequisite course code as per proposed course numbers	ECBB-252				
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:		
1.	Title	Digital Communication
	Author	John G. Proakis
	Publisher	Tata McGraw
	Edition	4th
2.	Title	Communication Systems
	Author	Simon Haykins
	Publisher	John Wiley & Sons
Reference Books:		
1.	Title	Modern Digital & Analog Communication
	Author	B.P.Lathi
	Publisher	Oxford University Press
	Edition	3rd
2.	Title	Principles of Communication Systems
	Author	Taub Schilling
	Publisher	Tata McGraw Hill
	Edition	2nd

Content	**UNIT I:** **10** **Introduction:** Introduction to Digital Communication System, Basic block diagram of system, need of digital communication, Guided and unguided transmission media, concept of bandwidth, Electromagnetic spectrum and its usage, Review of Signal representation using Fourier Series & Transform, Review of Sampling Theorem. **Probability and Random Processes:** Basic introduction, Properties of probability, Random variables, CDF & PDF of random variables, Joint CDF & PDF,

	Marginal Densities, Statistical averages, Random processes, types of random processes **UNIT II: 10** **Line Coding:** Basic introduction, Need and properties of line coding techniques, NRZ, RZ, Manchester encoding, Differential Manchester Encoding, AMI coding, High density bipolar code, Binary with n-zero substitution codes **Waveform Coding:** Uniform and Non-uniform Quantization, Commanding, μ-Law and A-Law compressors, Concept & Analysis of PCM, DPSM, DM & ADM Modulators and demodulators, SNR for all techniques, Probability of error for PCM & other modulation techniques. **UNIT III: 08** **Digital Modulation Schemes:** Coherent Binary Schemes: ASK, FSK, PSK, QPSK, MSK. Coherent M-ary Schemes, Incoherent schemes DPSK, Calculation of Average Probability of Error for different Modulation Schemes, Power Spectra of Digitally modulated signals, Performance comparison of different digital modulation schemes. **UNIT IV: 10** **Designing of Receivers:** Analysis of Digital receivers, Error performance degradation in radio receivers, Demodulation and Detection, Maximum Likelihood Receiver structure, Design and Properties of Matched Filter, Coherent receiver Design, Inter Symbol Interference, Eye Pattern **Tentative List of Experiments:** 1. Write a program to generate a periodic as well as aperiodic signal. 2. Write a program to generate following line-coding techniques. (a) NRZ signal (b) RZ signal (c) Alternate Mark Inversion (d) Polar Quaternary (e) Manchester coding techniques (f) Write a code to generate the signal 1101001100 for all coding techniques. 3. Write a program to generate a sample signal along with its reconstruction that is from analog to sample and then reverse. 4. Write a program to study and calculate SNR of PCM using MATLAB 5. Write a program to study DPCM modulation and demodulation techniques using MATLAB. 6. Write a program to study Delta Modulation Technique using MATLAB. 7. Write a program to study Adaptive Delta Modulation techniques using MATLAB. 8. Write a program to study Amplitude Shift Keying (ASK) technique using MATLAB. 9. Write a program to study Frequency Shift Keying (FSK) technique using MATLAB. 10. Write a program to study Phase Shift Keying (PSK) technique using MATLAB. 11. Write a program to study Differential Phase Shift Keying (DPSK) technique using MATLAB. 12. Write a program to study Quadrature Phase Shift Keying (QPSK) technique using MATLAB. 13. Write a program to study Quadrature Amplitude Modulation (QAM) technique using MATLAB. 14. Review of one Latest Research Paper.
Course Assessment	Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%

Course no: ECLB 304	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	No	No
Type of Course	Theory			
Course Title	**IC APPLICATIONS**			
Course Coordinator				
Course objectives:	This course is aimed to cover OP AMP basic characteristics, AC and DC parameters. It also covers OP AMP linear as well as nonlinear applications.			
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	OP-AMP and linear integrated circuits
	Author	Ramakant A. Gayakwad
	Publisher	Pearson
	Edition	2rd ed.
2.	Title	Design with operation amplifiers and Analog Integrated circuits
	Author	Sergei Franco
	Publisher	John Wiley and Sons
Reference Books:		
1.	Title	Integrated Electronics: Analog and Digital circuits &system
	Author	Millman & Halkias
	Publisher	TMH

Content	**UNIT I:** **INTRODUCTION TO OPERATIONAL AMPLIFIERS:** The basic operational amplifier & its schematic symbol, Block diagram representation of OP-AMP, Power supply requirements of an OP-AMP, Evolution of OP-AMP., Specification of a typical OP-AMP (741).	**06**
	UNIT II: **THE PRACTICAL OP-AMP** Input offset voltage, input bias current, input offset current. Total output offset voltage, thermal drift, error voltage, variation of OP-AMP parameter with temperature & supply voltage. Supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters. Frequency response compensator networks. Frequency response of internally compensated OPAMP & non-compensated OP-AMP. High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency. Slew rate, causes of slew rates and its effects in application.	**06**

	UNIT III: **10** **OPERATIONAL AMPLIFIER CONFIGURATIONS & LINEARAPPLICATION:** Open loop OP-AMP configurations- The differential amplifier, inverting amplifier, noninverting amplifier, negative feedback configurations -inverting and non-inverting amplifiers, voltage followers & high input impedance configuration, differential amplifiers, closed loop frequency response& circuit stability, single supply operation of OP-AMP, summing, scaling and averaging amplifier, voltage to current & current to voltage converters, integrators & differentiators, logarithmic & anti logarithmic amplifiers.
	UNIT IV: **10** **ACTIVE FILTERS & OSCILLATORS:** Advantages of active filters, classification of filters, response characteristics of butter worth, 73 hebyshev, causal filters, first order and second order butter worth filter- low pass and high pass types. Band pass & band reject filters. Oscillator principles, types of oscillators – phase shift, wein bridge &quadrature. Square wave, triangular wave and saw tooth wave generators, voltage-controlled oscillator.
	UNIT V: **10** **COMPARATORS & CONVERTERS**: Basic comparator & its characteristics, zero crossing detector, voltage limiters, clippers & clampers, small signal half wave & full wave rectifiers, absolute value detectors, sample and hold circuit.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECLB 351	Open course (YES/NO)	HM Course(Y/N)	DC(Y/N)	DE(Y/N)
	No	**Yes**	**No**	**No**
Type of Course				
Course Title	**ANTENNAS AND WAVE PROPAGATION**			
Course Coordinator				
Course objectives:	**1.** Select the appropriate portion of electromagnetic theory and its application to antennas. **2.** Distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics. **3.** Assess the need for antenna arrays and mathematically analyze the types of antenna arrays. **4.** Distinguish primary from secondary antennas and analyze their characteristics by applying optics and acoustics principles. **5.** Outline the factors involved in the propagation of radio waves using practical antennas.			
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	Antennas and Radio Wave Propagation
	Author	R.E.Collin
	Publisher	McGraw – Hill
	Edition	1985
	Title	Antenna Theory and Design
	Author	W.L.Stutzman&G.A.Thiele

2	Publisher	Wiley
Reference Books:		
1.	Title	Principles of Antenna Theory
	Author	K.F.Lee
	Publisher	Wiley
	Edition	1984
2.	Title	Electronic Radio Engineering (4/e)
	Author	F.E. Terman
	Publisher	McGraw Hill.
3.	Title	Modern Antenna Handbook
	Author	C.A.Balanis,
	Publisher	Wiley India Pvt. Limited
Content	**UNIT I:** **12** **Introduction:** Radiation fundamentals. Potential theory. Helmholtz integrals. Radiation from a current element. Basic antenna parameters. Radiation field of an arbitrary current distribution. Small loop antennas. Receiving antenna. Reciprocity relations. Receiving cross section, and its relation to gain. Reception of completely polarized waves. Linear antennas. Current distribution. Radiation field of a thin dipole. Folded dipole. Feeding methods. Baluns.	
	UNIT II: **08** **Antenna Array:** Array factorization. Array parameters. Broad side and end fire arrays. Yagi-Uda arrays Log-periodic arrays.	
	UNIT III: **08** **Aperture Antenna:** Fields as sources of radiation. Horn antennas. Babinet's principle. Parabolic reflector antenna. Microstrip antennas.	
	UNIT IV: **12** **Wave Propagation:** Propagation in free space. Propagation around the earth, surface wave propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF. Fading, tropospheric propagation, Super refraction.	
Course Assessment	Mid sem Evaluation 25% Continuous Evaluation 25% EndSemester50%	

Course no: ECBB 352	**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.				
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	ECBB 201 ECBB 251				
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: ECBB 353	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 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				
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	**ECBB 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. **Tentative 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. • Classification, denoising of real time signals. • 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 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: ECBB 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			
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 Code	**:**	**HMLB 401**				
Course Title	**:**	**MANAGEMENT PRINCIPLES AND PRACTICES**				
Type of Course	**:**	Theory				
		Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours		3	0	0	3	36
Pre-requisite	**:**	Nil				

Detailed Syllabus:

Unit I Introduction **08**

Management Concept and Definition, Nature of Management, Objectives of Management, Significance of Management, Managerial Roles and Managerial Skills, Management and Administration, Levels of Management, Management Process and Functions, Functional Areas of Management, Management Principles- General and Scientific Management, Evolution of Management Thought, Approaches of Management Thought.

Unit II Planning and Decision **08**

Planning definition and nature, Importance of Planning, Planning Process, Need for Planning, Principles of Planning, Types of Planning, Advantages and Disadvantages of Planning; Decision making concept, Characteristics of Decision Making, Types of Decisions, Decision Making Process, Characteristics of Effective Decisions, Rationality in Decision Making.

Unit III Organizing **08**

Organizing definition. Organisation as a Process, Organisation Structure, Principles of Organisation, Importance of Organisation, Types of Organisation. Departmentation- Meaning, Need and Significance of Departments, Process involved in Departmentation, Methods or Basis of Departmentation; Span of Management; Centralization and Decentralisation; Delegation.

Unit IV Directing **06**

Directing concept, Nature and Characteristics of Directing, Principles of Directing; Motivation- Concept and Theories of motivation; Concept of Leadership- Theories and Styles; Communication Process, Channels and Barriers, Effective Communication.

Unit V Coordination and Controlling **06**

Coordination- Concept and Nature of Coordination, Need for coordinating; Importance, Principles and Techniques of Coordination; Process of Coordination. Controlling- Definitions, Characteristics of Controlling, Steps in Control Process, Types of Controlling, Control Techniques.

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

Recommended Books		Drucker, F. Peter, "Management-Tasks, Responsibilities & Practices" Dubey, C.H, "Organizational Behaviour" Prentice Hall in India (PHI) Edition 2015. Gupta C. B., "Human Resource Management" Sultan Chand & Sons New Delhi, Edition 2006. Koontz, Hand Weilhrich H, "Essentials of Management", 10th Edition, Tata McGraw Hill Prasad, L M, "Principles and Practices of Management", 6th Edition, Sultan Chand Robbins, Stephen P, Coutler, Mary, "Management" 8th Edition, Pearson Stoner, J A F, Freeman R E, Gilbert, D R, "Management" 6th Edition, Pearson

LIST OF ELECTIVES: BOUQUETS WITH SPECIALIZATIONS

SPECIALIZATIONS: PHOTONICS AND OPTICALCOMMUNICATION

Course no: ECLB 321	**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.			
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 Code	Course Name	Periods			Credits	Hours
		L	T	P		
ECLB 322	OPTICAL FIBRE COMMUNICATION	3	0	0	3	36
Pre- Requisite Courses:		Solid State Devices and Applications, Analog Electronics				
Course Objective		To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.				
Course Content		**Unit I:** **09** Optical processes in Semiconductors, Electron hole pair formation and recombination, Absorption and emission of light in semiconductors, Effect of electric field on Absorption, Franz-Keldysh and stark effects, Absorption in Quantum wells and Quantum confined stark effect, relation between Absorption and emission spectra, Stokes shift in optical transition, Deep level transitions, Quantum Structures, Materials for working at different wavelengths. **Unit II:** **09** Principles of light propagation through a fiber, Step index and graded index, mode theory. Fibre materials and their characteristics, Transmission characteristics of fibers. Attenuation in optical fibers absorption losses, scattering losses, Dispersion. Different types of modulators. Characteristic equation of step-index fibre, modes and their cut-off frequencies, single-mode fibres, weakly guiding fibres, Graded-index fibres - WKB and other analysis, propagation constant, leaky modes, power profiles, dispersions - material, modal & waveguide dispersions, impulse response. **Unit III:** **09** Optical fiber systems, modulation schemes, Digital and analog fiber communication system, system design consideration, wavelength conversion, switching and cross connect, Semiconductor Optical amplifier (SOA), characteristics, advantages and drawback of SOA , Raman amplifier, erbium doped fiber amplifier, Brillouin fiber amplifier, Noise characteristics, amplifier spontaneous emission, Noise amplifier, Noise figure. Various receiver configurations, noise sources in optical communication, nonlinear effects in fiber optics, direct detection receiver, optimum gain in APD, signal- to-noise ratio (SNR) calculations, Optimization of SNR. **Unit IV:** **09** Introduction to optical communications, Optical signaling schemes viz., IM, PL, PCM, PCM/PL, digital PPM, PRM, PFM etc., electro-optic modulators, optical preamplifier design, Optical line coding schemes, performance evaluation of various optical				

	receivers and their comparative study, Applications of optical amplifier in the system. Optical fiber, link design- power budget, time budget and maximum link length calculation, hybrid fiber co-axial/microwave links, sub-carrier multiplexing, WDM Systems.
Book	John. M. Senior, Optical fiber communications: principles and practice, Prentice Hall of India. Gerd Keiser, Optical fiber communications, McGraw Hill, 3rd edition. Fiber Optic Communication Systems: G.P Agrawal, Johannian and Sons.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECLB 371	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.			
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: ECLB 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	**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.			
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: ECLB 421	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.			
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, fiberpigtailing, 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: ECLB 422	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.			
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	Optical Networks
	Author	R. Ramaswami and K. Sivarajan
	Publisher	Â Morgan Kaufmann Publishers, 2002
	Edition	Second
2.	Title	Optical Switching Networks
	Author	Mayer & Martin
	Publisher	Cambridge University Press, 2008
Content	**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** **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.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ECLB 423	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: ECLB 424	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			
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%	

SPECIALIZATION: CIRCUIT DESIGN AND NETWORKS

Course no: ECLB 323	**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.			
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: ECLB 324	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.			
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: ECLB 373	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.			
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: ECLB 374	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.			

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: ECLB 425	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			
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: ECLB 426	**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.			
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: ECLB 427	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.			
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%

SPECIALIZATION: MICROPROCESSOR AND VLSI

Course no: ECLB 325	**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			
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: ECLB 326	**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.				
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: ECLB 375	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.				
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, Interpolation 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: ECLB 376	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.				
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: ECLB 428	**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.			
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: ECLB 429	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.			
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: ECLB 430	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.			
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	
Reference Book:		
1.	Title	Introduction to VLSI Circuits and Systems
	Author	John P. Uymera,
	Publisher	Wiley Student Edition
	Edition	
2.	Title	CMOS Digital Integrated Circuits-Analysis and Design
	Author	S.M. Kang and L. Yusuf
	Publisher	Tata Mc-Graw Hill (TMH)
	Edition	3rd Edition

Content	**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.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

SPECIALIZATION: RF AND MICROWAVE ENGINEERING

Course no: ECLB 327	**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, signalling. 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.			
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: ECLB 328	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.			
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: ECLB 377	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.			
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; Friistransmission 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: ECLB 431	**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.			
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: ECLB 432	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.			
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: ECLB 433	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			
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%

SPECIALIZATION: EMBEDDED SYSTEM DESIGN

Course no: ECLB 329	**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.				
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: ECLB 378	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.				
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			
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: ECLB 434	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.				
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: ECLB 435	**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.				
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: ECLB 436	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.			
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%	

SPECIALIZATION: COMMUNICATION AND SIGNAL PROCESSING

Course no: ECLB 330	**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.				
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: ECLB 331	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.			
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, VeliSahin
	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: ECLB 379	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 PROCESSING**			
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.			
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: ECLB 380	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.				
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: ECLB 437	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.			

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: ECLB 438	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.			
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
Reference Books:		
3.	Title	Mobile Adhoc Networking
	Author	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic
	Publisher	Wiley-IEEE press
	Edition	2004
4.	Title	Cross Layer Design Optimization in Wireless Protocol Stacks
	Author	V.T. Raisinhani and S. Iyer
	Publisher	Comp. Communication
	Edition	Vol. 27 no. 8, 2004

Content

UNIT I: **06**

Introduction to adhoc networks – definition, characteristics features, applications.Characteristics of Wireless channel, Adhoc Mobility Models: - Indoor and outdoormodels.

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

Course no: ECLB 439	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.				
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, SugandaJutamulia
	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: ECLB 440	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.			
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: ECLB 441	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.			
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%

SPECIALIZAION: ANTENNA THEORY

Course no: ECLB 332	**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**.**			
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: ECLB 381	**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.				
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: ECLB 382	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).			
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: ECLB 442	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			
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: ECLB 443	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.			
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: 05** 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: ECLB 444	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.			
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	Modern Radar System Analysis
	Author	David Barton. K
	Publisher	Artech House
	Edition	1988
2.	Title	Radar Design Principles Signal Processing and The Environment
	Author	Fred Nathanson E,
	Publisher	McGraw Hill
	Edition	1969
3.	Title	Radar Signals
	Author	Cook CE. Bernfield. M
	Publisher	Academic Press
	Edition	1967
4.	Title	Introduction to radar systems
	Author	Skolnik
	Publisher	McGraw hill

	Edition	2nd Edition 2003
Content	**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.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

SPECIALIZATION: MACHINE LEARNING AND INTERNET-ON-THINGS

Course no: ECLB 333	**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.				
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: ECLB 383	**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.				
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: theApri-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: ECLB 384	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.			
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: ECLB 445	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				
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: ECLB 446	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 NETWORKS**			
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.			

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%

LIST OF OPEN ELECTIVES TO BE OFFERED TO OTHER DEPARTMENTS

Course Code	**ECLB 385**	**Semester: Even (specify Odd/Even)**	**Semester: Session** Month from:
Course Name	**INTRODUCTION TO NANO SCIENCE AND NANO TECHNOLOGY**		
Credits	**3**	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		
Course Objectives	Introduction to the underlying principles and applications of the emerging field of Nanotechnology and Nanoscience. Discusses current and future nanotechnology applications in engineering, materials, physics, chemistry, biology, electronics, and energy		
Module No.	**Title of the Module**	**List of Topics**	
Unit I	Background to Nanoscience	Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.	
Unit II	Types of nanostructure and properties of nanomaterials	One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.	
Unit III	Application of Nanomaterial	Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.	
Unit IV	Recent special nanomaterials	Carbon based nanomaterials – CNT- graphene- core-shell structures- Micro and Mesopores Materials- Organic-Inorganic Hybrids- ZnO- Silicon -- DNA- RNA- Nanoproducts	
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 the laboratory for overall grading		

Recommended Reading material:

1.	Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2.	Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3.	Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831, Cambridge University Press.
4.	Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

Course no: ECLB 386	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.			

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: ECLB 387	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			

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 Code	**ECLB 388**	**Semester: Even (specify Odd/Even)**	**Semester: Session** Month from:
Course Name	**ELECTRONIC MATERIALS AND THEIR APPLICATIONS**		
Credits	**3**	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		
Course Objectives	Understanding the various materials and its properties contribution towards electrical and electronics field.		
Module No.	**Title of the Module**	**List of Topics**	
Unit I	Introduction	Structure: atomic structures and bonding, types of bonding, band formation. Defects and imperfections in solids: Point, Line and Planer defects; Interfacial defects and volume defects. Classification of materials based on bonding: conductors, semiconductors and insulators.	
Unit II	Conducting materials	Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantin, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.	
Unit III	Semiconducting and magnetic materials	Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.	
Unit IV	Dielectric and insulating materials	Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.	

Unit V	Optoelectronic and nano electronic materials	Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photodetectors, solar cells. Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.
Course Assessment	Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%	
Recommended Reading material:		
1.	S.O. Kasap "Principles of Electronic Materials and Devices", 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.	
2.	W D Callister, "Materials Science & Engineering – An Introduction", Jr., John Willey & Sons, Inc, New York, 7th edition, 2007.	
3.	B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.	
4.	Eugene A. Irene, Electronic Materials Science, Wiley, 2005	

Course no: ECLB 389	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	NO	NO
Type of Course	Elective			
Course Title Code	**OPTIMIZATION TECHNIQUES**			
Course Coordinator				
Course objectives:	1. To cover the concepts of optimization methods and algorithms developed for solving various types of optimization Problems. 2. To apply the mathematical results and numerical techniques of optimization theory to various Engineering and Analytics problems.			

Semester	**Autumn:**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3			3	32
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	An Introduction to Optimization
	Author	Edwin K.P. Chong, Stanislaw H. Zak,
	Publisher	Wiley
	Edition	

2.	Title	Convex Optimization
	Author	Stephen Boyd and Lieven Vandenberghe
	Publisher	Cambridge University Press
	Edition	
3.	Title	Modern Optimization with R (Use R)
	Author	Paulo Cortez
	Publisher	Springer
	Edition	20104

Content

Unit I: **05**

Preliminaries: Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry, Elements of Calculus.

Unit II: **07**

Unconstrained Optimization: Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b

Unit III: **08**

Linear Programming: Introduction to Linear Programming, Simplex Method, Duality

Unit IV: **08**

Nonlinear Constrained Optimization: Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems,

Unit V: **08**

Algorithms for Constrained Optimization: Projections, Project gradient methods,
Penalty methods.

Course Assessment-

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

Course no: ECLB 448	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.			

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	ReactionsRashmiSanghi 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%

Course no: ECLB 449	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of Course	Theory and Laboratory			
Course Title	**MACHINE LEARNING AND PATTERN RECOGNITION**			
Course Coordinator				
Course objectives:	To understand the basics of the machine learning and pattern recognition. To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning and pattern recognition To introduce dimensionality reduction techniques To enable the students to know deep learning techniques to support real-time applications To understand the need for machine learning for various problem solving			
Semester	**Autumn:**		**Spring:**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3			3	36
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	NIL				
proposed course numbers					

Text Books:		
1.	Title	Machine Learning,
	Author	Tom M. Mitchell
	Publisher	McGraw-Hill Education (India) Private Limited,

	Edition	2013
2.	Title	Pattern Recognition and Machine Learning
	Author	Bishop, C.
	Publisher	Springer
	Edition	2006
3.	Title	Introduction to Machine Learning
	Author	Alpaydin,E.
	Publisher	MIT Press
	Edition	2004
Reference Books:		
1.	Title	Machine Learning: An Algorithmic Perspective
	Author	Stephen Marsland
	Publisher	CRC Press
	Edition	2009
2.	Title	Pattern Classification, 2nd edt.
	Author	R. O. Duda, P. E. Hart and D. G. Stork
	Publisher	Wiley India
	Edition	2007
Content	**Unit I**: **06** Basic definition: Machine Learning, Pattern, and Pattern Recognition. Feature vector and Feature space, Features of pattern recognition, Classifier and Decision Boundry, Phases of pattern recognition, its advantage and disadvantage, Design Principles of Pattern Recognition: Statistical and Structural approach. Feature Extraction: different shape and region based methods, Overfitting and Underfitting. **Unit II**: **8** Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks. Bayes Decision Theory : Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces; Normal density and discriminant functions. Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Principle component analysis, Linear Discriminant Analysis (LDA), KL expansion. Regression: Linear Regression and Logistic Regression. **Unit III**: **06** SUPPORT VECTOR MACHINE: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel,and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM. DECISION TREE LEARNING - Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. **Unit IV**: **08** INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning. Clustering approach: K-means, GMM. REINFORCEMENT LEARNING–Introduction to Reinforcement Learning ,	

	Learning Task,Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process , Q Learning - Q Learning function, Q Learning Algorithm), Application of Reinforcement Learning,Introduction to Deep Q Learning. Bootstrapping, Boosting, Bagging and and Combining Classifiers **Unit V**: **08** ARTIFICIAL NEURAL NETWORKS – Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant. DEEP LEARNING - Introduction,concept of convolutional neural network , Types of layers (Convolutional Layers , Activation function , pooling , fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.
Course Assessment	**Continuous Evaluation 25%** **Mid Semester 25%** **End Semester 50%**

Course no: ECLB 450	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
	No	No	Yes	No
Type of course	**Elective Course**			
Course Title	**WIREIRELESS COMMUNICATION AND SENSOR NETWORKS**			
Course Coordinator				
Course objectives:	To make students understand the basics of Wireless sensor Networks. To familiarize with learning of the Architecture of WSN. To understand the concepts of Networking and Networking in WSN. To study the design considerations of topology control and solution to the various problems. To introduce the hardware and software platforms and tool in WSN.			
Semester	**Autumn: No**		**Spring: Yes**	

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 48 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	Protocols and Architectures for Wireless Sensor Networks
	Author	Holger Karl & Andreas Willig
	Publisher	John Wiley
	Edition	5th Edition, 2005
2.	Title	Fundamentals of Wireless Sensor Networks - Theory and Practice
	Author	Waltenegus Dargie, Christian Poellabauer
	Publisher	John Wiley & Sons Publications
	Edition	5th Edition, 2011
3.	Title	Wireless Sensor Networks-Technology, Protocols, and Applications
	Author	Kazem Sohraby, Daniel Minoli, & Taieb Znati,
	Publisher	John Wiley
	Edition	5th Edition, 2007

Content	**UNIT – I: OVERVIEW OF WIRELESS SENSOR NETWORKS** **08** SingleNode Architecture Hardware Components Network Characteristics unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks Types of wireless sensor networks. **UNIT – II: ARCHITECTURES** **07** Network Architecture Sensor NetworksScenarios Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments introduction to Tiny OS and nesC Internet to WSN Communication. **UNIT – III: NETWORKING SENSORS** **08** MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols EnergyEfficient Routing, Geographic Routing. **UNIT – IV: INFRASTRUCTURE ESTABLISHMENT** **07** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. **UNIT – V: SENSOR NETWORK PLATFORMS AND TOOLS** **06** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Nodelevel software platforms, Node level Simulators, Statecentric programming.
Course Assessment	Continuous Evaluation 25%, Mid Semester 25%, End Semester 50%

Evaluation Criteria Components

Midterm	25%
End Semester Examination	50%
continuous Evaluation:	25%

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2.	Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3.	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks - Theory and Practice”, John Wiley & Sons Publications, 2011
4.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
5.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

Course Code	**ECLB 451**	**Semester - Even**		**Semester - Session** 2022-2023 Month from Jan to June	
Course Name	**DATA COMMUNICATION AND NETWORKING**				
Credits	3		**Contact Hours**	36	
Faculty (Names)	**Coordinator(s)**				
	Teacher(s) (Alphabetically)				

Course no: ECLB 451	**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 Coordinator	
Course objectives:	To Focus on information sharing and networks. • To Introduce flow of data, categories of network, and different topologies. • To Focus on different coding schemes. To build a strong understanding of the fundamental concepts of computer networking. Brief the students regarding protocols and standards. • To give a clear idea of signals, transmission media, errors in data communications and their correction, networks classes and devices ,etc.. Modern routing algorithms are introduced in this course. Deep understanding of Data links, Networks and Transport Layers ECB providing more focus on Internet and network performance.
Semester	**Autumn: No** **Spring: Yes**

	Lecture	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours 48 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	Data and Computer Communications
	Author	William Stallings
	Publisher	Pearson
	Edition	TENTH EDITION

2.	Title	Computer Networks
	Author	AS Tanenbaum, DJ Wetherall
	Publisher	Prentice-Hall
	Edition	5th Edition, 2010
3.	Title	Data Communication and Network
	Author	Behrouz A. Forouzan
	Publisher	McGraw Hill
	Edition	5th Edition, 2012
Content	**UNIT I:** **08** Introduction to data communication and networking: Why study data communication? Data Communication, Networks, Protocols and Standards, Standards Organizations. Line Configuration, Topology, Transmission Modes, Categories of Networks Internet works, 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** Study of Signals: Analog and Digital, Periodic and Aperiodic Signals, Analog Signals, Time and Frequency Domains , Composite Signals , Digital Signals, Physical layer: line encoding, block encoding, scrambling, and 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** Guided Media, Unguided Media, Transmission Impairments, Performance Wavelength , Shannon Capacity , Media Comparison, PSTN , Switching, 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 IV:** **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** Introduction to networks and devices: Network classes,Repeaters, Hub, Bridges , Switches, Routers, Gateways Brouters Routing Algorithms, Distance Vector Routing , Link State Routing, 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%	

Evaluation Criteria Components

Midterm	25%
End Semester Examination	50%
continuous Evaluation:	25%

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2.	Data Communication & Networking by Forouzan, Tata McGraw Hill
3.	Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
4.	Computer Network, 4e, by Andrew S. Tenenbaum, Pearson Education/ PHI.

Course No.: ECLB 452	Open Course (Yes/No)	HM Course (Yes/No)	DC (Y/N)	DE (Y/N)	
Type of Course	Theory				
Course Title	**MICROELECTRONICS AND VLSI TECHNOLOGY**				
Course Coordinator					
Course Objectives:	1. To learn the concepts of clean room environment for Fabrication of integrated circuits and understand the theory and concept of cleaning process for silicon and other wafers for IC fabrication 2. To develop skills for simulating the various fabrication processes. 3. To understand the process integration flow for different IC fabrication technologies. 4. Advance the knowledge and understanding of current developments in VLSI technology				
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	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	VLSI Technology
	Author	S M Sze
	Publisher	McGrawHill
	Edition	2nd Edition
2.	Title	Modern VLSI Design Systems on Silicon
	Author	Wayne Wolf
	Publisher	Pearson Education Asia
	Edition	2nd Edition
3.	Title	CMOS Digital Integrated circuits- Analysis and design
	Author	Sung- Mo Kang and Yusuf Leblenici
	Publisher	McGrawHill
	Edition	2nd Edition
4.	Title	Digital Integreted Circuits-(A design perspective)
	Author	Jan M. Rabaey
	Publisher	P.M.I

	Edition	2nd Edition
	Contents	
	Unit I CleanRoom Technology, Clean Room Classifications, Design concepts, Clean Room Installations and Operations, Automation related facility systems, future trends. Wafer Cleaning Technology - Basic Concepts, Wet cleaning, Dry cleaning, Epitaxy, Fundamental Aspects, Conventional silicon epitaxy, low temperature, Epitaxy of silicon, selective epitaxial growth of Si, Characterization of epitaxial films.	
	Unit II Process simulation, Introduction, Ion-implantation, Monte Carlo method, Diffusion and Oxidation, two-dimensional LOCOS simulation example, Epitaxy, Epitaxial doping model, Lithography, Optical projection lithography, Electron-beam lithography, Etching and deposition, future trends.	
	Unit III: Transistors and layouts - Transistors, Wires and Vias, Design Rules, Layout Design and Stick Diagrams - example, Logic Gate – Pseudo NMOS, DCVS, Domino. Delay through Resistive Interconnect. CMOS Inverter: Basic Circuit and DC Operation – DC Characteristics.	
	Unit IV Inverter Switching Characteristics- Static behavior– Switching threshold, Noise Margin, CMOS Inverter Dynamic Behavior- capacitances, propagation delay - High-to-Low time, Low to High time, Sources of Power Consumption, Power Consumption Static and dynamic. Logic Gate - Switch Logic.	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	