B.Tech ECE Syllabus IIIT Nagpur

IIIT Nagpur
Scheme for B.Tech ECE

Year	Semester	Course Code	Course Name	Type	L	T	P	Credits
FIRST YEAR								
1ST	1ST	MAL 101	Mathematics-I	BS	3	1	0	4
1ST	1ST	BEL 102	Elements of Electrical Engineering	ES	3	0	2	4
1ST	1ST	BEL 101	Mechanics & Graphics	ES	3	0	2	4
1ST	1ST	CSL 101	Computer Programming	DC	3	0	2	4
1ST	1ST	ECL 101	Analog Electronics	DC	3	0	2	4
1ST	1ST	HUL 101	Communication Skills	HU	2	0	2	3
1ST	1ST	SAP 101	Health, Sports & Safety	HU	0	0	2	0
Sub Total					**17**	**1**	**12**	**23**
1ST	2nd	MAL 102	Mathematics-II	BS	3	1	0	4
1ST	2nd	BSL 101	Applied Sciences	BS	3	0	2	4
1ST	2nd	ECL 102	Digital Electronics	DC	3	0	2	4
1ST	2nd	CSL 102	Data Structures	DC	3	0	2	4
1ST	2nd	HUL 102	Environmental Studies	HU	2	0	0	2
1ST	2nd	CSL 103	Application Programming	DC	3	0	2	4
Sub Total					**17**	**1**	**8**	**22**
Total								**45**
SECOND YEAR								
2nd	3rd	MAL 201	Mathematics-III	BS	3	1	0	4
2nd	3rd	ECL 201	Signals and Systems	DC	3	0	0	3
2nd	3rd	ECL 202	Microprocessors & Interfacing	DC	3	0	2	4
2nd	3rd	ECL 203	Analog ICs	DC	3	0	2	4
2nd	3rd	ECL 204	Network Theory	DC	3	0	2	4
2nd	3rd	ECL 205	Electronic Engineering Materials	DC	3	0	0	3
2nd	3rd		Open Course - I	OC	3	0	0	3
Sub Total					**21**	**1**	**6**	**25**
2nd	4th	ECL 301	Digital Signal Processing	DC	3	0	2	4
2nd	4th	ECL 302	Analog Communication	DC	3	0	2	4
2nd	4th	ECL 303	Hardware description languages	DC	3	0	2	4
2nd	4th	ECL 304	Control Systems	DC	3	0	2	4
2nd	4th	ECL 305	Electromagnetics	DC	3	0	0	3
2nd	4th		Computer Architecture &Organisation	DC	3	0	0	3
2nd	4th		Open Course - II	OC	3	0	0	3
Sub Total					**21**	**0**	**8**	**25**
Total					**42**	**1**	**14**	**50**

Year	Semester	Course Code	Course Name	Type	L	T	P	Credits
THIRD YEAR								
3rd	5th	ECL 306	Digital Communication	DC	3	0	2	4
3rd	5th	ECL 307	Waveguides & Antennas	DC	3	0	0	3
3rd	5th	ECL 308	Embedded Systems	DC	3	0	2	4
3rd	5th	ECL 309	Electronic Instrumentation	DC	3	0	0	3
3rd	5th	ECL 310	Devices & Modelling	DC	3	0	0	3
3rd	5th		Elective - I	DE	3	0	0	3
3rd	5th		Elective - II	DE	3	0	0	3
Sub Total					**21**	**0**	**4**	**23**
3rd	6th	ECL 311	Wireless Digital Communication	DC	3	0	0	3
3rd	6th	ECL 312	Electronic System Design	DC	3	0	2	4
3rd	6th		Elective - III	DE	3	0	2	4
3rd	6th		Elective - IV	DE	3	0	2	4
3rd	6th		Elective - V	DE	3	0	0	3
3rd	6th		Elective – VI	DE	3	0	0	3
3rd	6th		Elective – VII	DE	3	0	0	3
Sub Total					**21**	**0**	**6**	**24**
Total					**42**	**0**	**10**	**48**
FINAL YEAR								
4th	7th		Elective - VIII	DE	3	0	2	4
4th	7th		Elective – IX	DE	3	0	2	4
4th	7th		Elective - X	DE	3	0	0	3
4th	7th		Elective – XI	DE	3	0	0	3
4th	7th	ECL 401	In – House Project	DE	0	0	4	8
4th	7th	**OR**						
4th	7th	ECL 402	Industry Internship Project	DE	0	0	0	6
Sub Total					**12**	**0**	**8**	**22/6 ***
4th	8th	ECL 402	Industry Internship Project	DE	0	0	0	6
4th	8th	**OR**						
4th	8th		Elective - VIII	DE	3	0	2	4
4th	8th		Elective – IX	DE	3	0	2	4
4th	8th		Elective - X	DE	3	0	0	3
4th	8th		Elective – XI	DE	3	0	0	3
4th	8th	ECL 401	In – House Project	DE	0	0	4	8
Sub Total					**12**	**0**	**8**	**6/22 ***
Total								**28**
GRAND TOTAL								**170**

* Same choice cannot be repeated for 7th& 8th Semester.

Type	Credits
BS	**16**
ES	**08**
HU	**05**
C	**06**
DC	**84**
DE	**51**
TOTAL	**170**

FINAL YEAR								
4th	7th		Elective-V	DE	3	0	2	4
4th	7th		Elective-VI	DE	3	0	2	4
4th	7th		Elective-VII	DE	3	0	2	4
4th	7th		Elective-VIII	DE	3	0	2	4
4th	7th		Elective-IX	DE	3	0	0	3
Subtotal					**15**	**0**	**8**	**19**
4th	8th		Industry Internship Project / In- house Project (Full Semester)	DE	-	-	-	14
Subtotal					-	-	-	**14**
Total								**33**
GRAND TOTAL								**170**

<table>
<tr><td>Course Code:</td><td>MAL 101</td><td>Course Title:</td><td colspan="4">Mathematics-I</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Basic Science</td></tr>
<tr><td colspan="7">Course Outcomes:
1) To understand importance of calculus infinite series and matrix theory.
2) Applications of calculus infinite series and matrices.
3) Derivation and application of theorems of matrices.</td></tr>
<tr><td colspan="7">Course Contents:
Differential Calculus: Functions of single variable: Limit, continuity and differentiability. Mean value theorems: Rolle’s theorem, Lagrange’s theorem, Cauchy’s theorem, Taylor’s theorem with remainders, indeterminate forms, curvature, curve tracing.

Integral Calculus: Fundamental theorem of Integral calculus, mean value theorems, evaluation of definite integrals, Applications in Area, length, volumes and surface of solids of revolutions, Improper integrals: Beta and Gamma functions, differentiation under integral sign.

Infinite series: Sequences, Infinite series of real and complex numbers, Cauchy criterion, tests of convergence, absolute and conditional convergence, improper integrals, improper integrals depending on a parameter, uniform convergence, power series, radius of convergence.

Matrices: Rank of matrix, consistency of a system of equations, linear dependence and independence, linear and orthogonal transformations, Eigen values and eigen vectors, Cayley – Hamilton theorem, reduction to diagonal form, Hermitian and skew Hermitian matrices, Quadratic forms.</td></tr>
<tr><td colspan="7">Text:
1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons
2. Piskunov, N., Differential and Integral calculus, Mir publishers Moscow (Vol. 1, Vol. 2)</td></tr>
<tr><td colspan="7">Reference:
1. Thomas, G.B. and Finney, R.L, Calculus and Analytic Geometry, Addison Wesley Longman
2. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education Pvt. Ltd
3. Jain R.K., Iyengar S.R.K, Advanced Engineering Mathematics, Narosa Publishers</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)
1)
2)</td></tr>
</table>

Course	BEL 102	**Course Title:**	Elements of Electrical

Code:			Engineering			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Basic Engineering			

Course Outcomes:

1. To enable the students understand the basic ideas and principles of Electrical Engineering.
2.To impart knowledge for understanding the details of electrical power systems, transformers, generators, motors etc.

Course Contents:

Electrical Circuit: Circuit Elements Resistance, Inductance & Capacitance, Kirchhoff's Laws, Voltage Source (Definition, Characteristics of Practical Source, and Equivalent Current Source), and Star-Delta Transformation.

Magnetic Circuit, Flux, MMF, Reluctance, Analogy with Electric Circuits. Simple Calculations for Composite Magnetic Circuits

AC Circuits: Periodic Function, Average & R.M.S., Values, Steady State Behavior With Sinusoidal Excitation, Phasor Representation, Reactance & Impedance, Series & Parallel Circuit, Power Factor, Principle of Generation of Single Phase & Three Phase Voltages, Power in Balanced Three Phase AC System

Electrical Measurements : Definition, Indicating, Integrating & Recording Instruments, Deflecting Controlling & Damping Mechanisms, Ammeter & Voltmeters, P.M.M.C. Type & Moving Iron Type, Electrodynamometer Type Wattmeters, Induction Type Single Phase Energy Meter

Transformers : Introduction, Basic Principles, Construction, Phasor Diagram for Transformer under No Load Condition Transformer On Load, Balance of MMF on Sides, Phasor Diagram, Equivalent Circuit, Open Circuit & Short Circuit Test, Voltage Regulation and Efficiency

Power Systems : Elementary Idea about Power Generation, Transmission and Distribution

Electric Machines :DC Shunt and Series Motor – Construction, Principle of Working, Characteristics, Speed Control and Applications

Induction Motors – Construction, Principle of Working of Single Phase and 3-Phase Motors. Torque Slip Characteristics

Text:

1. Hughes, Electrical Technology, Pearson Publishers
2. Theraja B.L., Electrical Technology, S. Chand Publishers

Reference:

3. Kothari D.P. and NagrathI.J.,Theory And Problems Of Basic Electrical Engineering, Prentice Hall India
4. Kulshresta D.C., Basic Electrical Engineering, TMH India
5. Mittle and Mittal, Basic Electrical Engineering, TMH, 2005

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

1. Study and verification of Kirchhoff's laws applied to DC circuits
2. Study of AC series R-L-C circuits
3. Determination of B-H curve of a magnetic material

4. Study of AC parallel R-L-C circuits

5. Study of balanced 3-phase circuits

6. Determination of voltage regulation and efficiency of a single-phase transformer by direct loading

7. Study of speed control of a DC motor by field current control and by armature voltage control

8. Study of reversal of direction of rotation of a 3-phase induction motor

Course Code:	BEL 101	**Course Title:**	Mechanics and Graphics			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Basic Science			

Course Outcomes:

1. To enable the students understand the basic concepts of mechanics such as force, equilibrium, moment etc and to analyze simple determinate structures like beam, truss and frame.
2. To impart and include proper understanding of the theory of projection. Improve the visualization skills.
3. To enable the students with various concepts like dimensioning, conventions and standards related to working drawing in order to become professionally efficient.
4. To impart the knowledge on understanding and drawing of simple residential/ office building.

Course Contents:

Use of various drawing instruments, Concept of scales, Representative factor and dimensioning, Orthographic projections of points, lines, plane on principle planes/ Profile plane/ Auxiliary planes. Projection of right regular solids inclined to both the planes. Projection of right regular solids inclined to both the planes. Drawing isometric views from orthographic projection orthographic views.

Principles ofVector representation of force system, Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force – a couple Wrench**,** Free Body Diagram, Reactions at supports, Equilibrium of Planar (including friction) and Spatial force system,

Internal forces in member:Determination of variation of Axial force (Axial Force Diagram), Shear force (Shear Force Diagram), Bending moment (Bending Moment Diagram) and twisting moment (Torque diagram)

Concept of stress and strain:Normal and shear stress and strain, State of stress at a point, Stress strain curve, Hook's law, Modulus of elasticity, Poisson's ratio, Modulus of rigidity, Bulk modulus, Transformation of stress.

Text:

1. Singer F.L. and Andrew Pytel, Strength of Material, Harper and Row Publishers, New York.

2. Bhatt N.D. and Panchal V.M., Elementary Engineering Drawing, Charotar Publishing House, 43rd edition.

Reference:

1. Hibbler, Engineering Mechanics, Pearson Education, Asia Pvt Ltd.

2. Beer F.P. and Johnston E.R., Vector Mechanics for Engineers: Statics and Dynamics, Tata McGraw-Hill

3. Irving H. Shames, Engineering Mechanics: Static and Dynamics, Pearson Education, Asia Pvt Ltd.

4. Meriam J.L. and Kraige L.G., Engineering Mechanics, John Wiley and Sons.

5. Stephen Timoshenko, Strength of Materials, Part -1, CBS Publishers and Distributors,

New Delhi.
6. Popov E.P., Mechanics of deformable bodies, Prentice-Hall
7. Beer F.P. and Johnston E.R., Mechanics of materials, McGraw-Hill International

8. JolheDhananjay ,Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Co.Ltd., 1st edition.
9. BIS-SP-46-1988, Handbook BIS SP -46-1988, BIS

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

1. Verification of equilibrium equation for coplanar forces.
2. Verification of Lami's theorem.
3. Verification of Law of parallelogram of forces.
4. Verification of Law of polygon of forces.
5. Verification of equilibrium equation for spatial forces.
6. Determination of coefficient of friction.
7. Analysis of truss (Analytical / Graphical method).
8. Determination of modulus of elasticity for copper wire.
9. Determination of modus of rigidity of material.
10. Flexural test on beam.

Projection of points and lines
Projections of planes
Projections of lines and planes using Auxiliary planes
Projections of solids
Isometric views

<table>
<tr><td>Course Code:</td><td>CSL 101</td><td>Course Title:</td><td colspan="4">Computer Programming</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1) To understand importance of calculus infinite series and matrix theory.
2) Applications of calculus infinite series and matrices.
3) Derivation and application of theorems of matrices.</td></tr>
<tr><td colspan="7">Course Contents:

Introduction: Flow charts, data types and storage classes, scope of variables, arithmetic operators, assignment, conditional, arithmetic expressions, enumerated data types, decision making, branching, looping, Switch concept, function and parameter passing, recursive functions, macros.
Basic programming algorithms: Programs to illustrate basic language constructs in C like - Factorial, Sine/cosine and other mathematical series, Fibonacci series, calculating square-root of a number, calculating GCD of 2 integers (Euclid’s method and otherwise), Calculating LCM of 2 integers and similar such programs.
Arrays and applications: Introduction to one dimensional and 2-D array with examples. Representing a polynomial using 1-D array and polynomial operations, Use of 2-D array to represent a matrix and matrix operations. Character arrays (strings): String related functions (strlen, strcpy, strcat, strcmp, atoi, itoa, reverse, strstretc) and their function definitions. Searching and Sorting methods: Selection sort, Bubble sort, Insertion sort, Linear and binary search, partitioning an array, merging of 2 sorted arrays. Introduction to “Divide and Conquer” via Mergesort and Quicksort.
Structures and Unions: Basic concept, array of structures and its applications.

Pointers: Introduction (declaration and initialization), pointers and arrays, concept of dynamic memory allocation, use of pointers to represent variable-sized 1-D and 2-D arrays, pointers to structures.
File Management in C: Open, close, read and write operations, Sequential and text files.</td></tr>
<tr><td colspan="7">Text:
1. Kerninghan; Ritchie, “C programming Language”, PHI
2. Balguruswamy, “Programming in ANSI C”, Tata Mcgraw Hill Publishing</td></tr>
<tr><td colspan="7">Reference:
3. Kakde and Deshpande, “C and data Structure”, Charles River Media Publisher
4. Dromey R G, “How to Solve it by Computer”, PHI
5. Y. Kanetkar, “Let us C ”.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)
1) Programs based on Conditional statements – eg. Maximum of two numbers, 2nd max, Roots of Quadratic Equations.
2) Program based on loops- GCD, LCM , Sine Series, Finding square root
3) Program based on Arrays – Finding max, Search of an element, Removal of duplicates etc.
4) Programs on sorting – Selection sort, Bubble sort, Insertion sort.</td></tr>
</table>

5) Program Files-Text and Binary files, searching in files.
6) Program on Strings – Concatenation, Substring, String Compare

Code:						
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Basic Science			

Course Outcomes:

1. This course introduces the fundamentals of semiconductor devices, such as diode, BJT, DIAC, LED, UJT etc.
2. To study the V-I characteristics, biasing, small signal analysis, etc. for various electronic devices.
3. The student will be able to apply various devices into electroniccircuits and can compute various parameters.
4. At the end student will be able to study and design various power devices including applications of these devices in to power amplifications.

Course Contents:

P &N Type Semiconductors, Diodes and Power Supplies, Theory of P-N Junction Diode, Junction Capacitance,
Halfwave & Fullwave, Rectifiers, Filters, Ripple-Factor,
Characteristics & Applications of Following Diodes, Zener as Regulators, Schottkey, Photodiode, LED, LCD, Varactor Diode &Tunnel Diode
Junction Transistors Theory of Operation, Static Characteristics , Break Down Voltages, Current Voltage Power Limitations, Biasing of BJT Different Biasing Arrangements, Stability Factor, Thermal Runaway, Power Transistors
Small Signal Analysis & High Frequency Analysis of BJT CE, CB, CC Amplifiers and Comparison High Frequency Analysis Calculation of Frequency Response, Gain Bandwidth Product
Power Amplifiers Classification A, B, AB, C Classes, Efficiency, Push Pull Configuration, Complimentary Symmetry, Second Harmonic & Cross Over Distortion. Positive and Negative Feedback Amplifiers Classification, Practical Circuits, Applications, Advantages. Oscillators Stability, Barkhausen Criteria, RC, LC & Crystal Oscillators
Field Effect Transistor & MOSFET, Principle of Operation & Characteristic, Biasing Arrangement, Small Signal Analysis of CG, CD & CS, High Frequency

Text:

1)Milman and Halkias, "Integrated Electronics", Second Edition, 2011, McGraw Hill.
2)Boylestad and Nashelsky, "Electronic Devices & Circuit theory",2011, Tenth Edition,

Reference:

1) David A. Bell, "Electronic Devices and Circuits"
2)Milman and Halkias, "Electronic Devices and Circuits", Second Edition, 2011, McGraw Hill.

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

1)Study of characteristics PN-junction and Zenerdiodes
2) Study of PN-junction diode as full-wave and half wave rectifier
3) Study of Zener Diode as regulator
4) Input and output characteristics of NPN transistor under different configurations.
5)

<table>
<tr><td>Course Code:</td><td>HUL 101</td><td>Course Title:</td><td colspan="4">Communication Skills</td></tr>
<tr><td>Category:</td><td>Core</td><td>Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Humanities</td></tr>
<tr><td colspan="7">Course Outcomes:
1. To impart to the students the skills that they need in their academic, and later in their professional pursuit.
2. To train the students to adopt an innovative approach to English language teaching and learning.</td></tr>
<tr><td colspan="7">Course Contents:

Importance of Effective Communication; Reading, writing and oral communication skills; Methods/Modes of communication, choice ofmedia; Barriers to communication. Basics of Technical report Writing, Referencing methods, Visual communication and its impact, Hands-on-experiences and Case studies</td></tr>
<tr><td colspan="7">Text:
1. Orient Longman , A Textbook of English for Engineers and Technologists.</td></tr>
<tr><td colspan="7">Reference:
1. Quirk R.andGreenbaum S., A University Grammar of English.
2. Krishnaswamy N., English Grammar (Longman Publication) (Macmillan India Ltd)</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)
1. Presenting a book chapter using powerpoint slides
2. Data Analysis: Maintaining multiple results obtained over time and reporting them using charts and graphs
3. Technical Documentation – Requirement/specification documentation, Design documentation, Test-cases documentation, Use-cases documentation
4. Writing an installation/instruction manual
5. Writing an abstract of a technical article – summarizing an article in 300 words
6. Summarizing 3 papers into a report and its presentation</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>SAP 101</td><td>Course Title:</td><td colspan="4">Health, Sports & Safety</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Basic Science</td></tr>
<tr><td colspan="7">Course Outcomes:
1. To provide physical fitness and good health.
2. Create awareness among the students about their health status by conducting various tests and measurements and suggest them suitable remedial physical fitness program so that they can improve physical and physiological health status.
3. To improve productivity, foster social harmony, inculcate sense of discipline and dedication in general life, develop the spirit of team work, through various sports activities.</td></tr>
<tr><td colspan="7">Course Contents:

Development of components of fitness through conditioning exercises:
Strength: (Strength Endurance, Maximum Strength, explosive strength), Endurance: (aerobic endurance, anaerobic endurance, speed endurance and strength endurance), Speed, Co-coordinative ability, Flexibility
Physical Efficiency Test Level 1(Testing and Evaluation of Physical Fitness):
Cooper Test 12 minute run or walk test, Sit and reach test, 100 meter run, one minute sit up test, Push up/Bent knee push up test,
Teaching and development of sports skills: Cognitive, Perceptual, Motor, Perceptual motor.
First Aid training:
Intramural phase 1: Identification of sports talent through exposing students to inter-section tournament. Football, Volleyball, throw ball, table tennis & Chess.

Yoga, Meditation and Personal Safety.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)
1) Physical Efficiency Test(Testing and Evaluation of Physical Fitness):1500 meter run, shuttle run, standing broad jump, one minute sit up test, flexibility test
Testing and assessment of selected Physiological parameters through Sports Medicine Research Lab: Total body fat analysis, Harvard step test, BMI, WHR, Back strength, Leg strength, grip strength, resting pulse rate, and resting respiratory rate.
Intramural phase 2: Badminton, Basketball, Cricket, Kho-Kho, etc.
Yoga and Meditation.
2)Personal Safety Skill Demonstration</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>MAL 102</td><td>Course Title:</td><td colspan="4">Mathematics-II</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>MAL 101</td><td>Type of Course</td><td colspan="4">Basic Science</td></tr>
<tr><td colspan="7">Course Outcomes:
To make students understand the basic importance of multi variable calculus (Differential calculus & Integral calculus), Vector calculus and ordinary differential equations in engineering.</td></tr>
<tr><td colspan="7">Course Contents:

Calculus of Functions of Several Variables: Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, Tangent plane and normal line. Euler’s theorem on homogeneous functions, Total differentiation, chain rules, Jacobian, Taylor’s formula, maxima and minima, Lagrange’s method of undetermined multipliers.
Multiple Integrals: Double and triple integrals, change of order of integration, change of variables, application to area, volumes, Mass, Centre of gravity.
Vector Calculus: Scalar and vector fields, gradient of scalar point function, directional derivatives, divergence and curl of vector point function, solenoidal and irrotational motion. Vector integration: line, surface and volume integrals, Green’s theorem, Stoke’s theorem and Gauss divergence theorem (without proof).
Ordinary Differential Equations: First order differential equations: Exact equation, Integrating factors, Reducible to exact differential equations, Linear and Bernoulli’s form, orthogonal trajectories, Existence and Uniqueness of solutions. Picard’s theorem, Picard’s iteration method of
solution (Statements only). Solutions of second and higher order linear equation with constant coefficients, Linear independence and dependence, Method of variation of parameters, Solution of Cauchy’s equation, simultaneous linear equations</td></tr>
<tr><td colspan="7">Text:
1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons
2. Piskunov, N., Differential and Integral calculus, Mir publishers Moscow (Vol. 1, Vol. 2)
3. Thomas, G.B. and Finney, R.L, Calculus and Analytic Geometry, Addison Wesley Longman.</td></tr>
<tr><td colspan="7">Reference:
1. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education Pvt. Ltd
2. Jain R.K., Iyengar S.R.K, Advanced Engineering Mathematics, Narosa Publishers.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)
1)
2)</td></tr>
</table>

Course Code:	BSL 101	Course Title:	Applied Sciences			
Category:	Core	Credit Assigned	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	Type of Course	Basic Science			

Course Outcomes:

1) To understand the fundamentals of Quantum Mechanics
2) To understand the structure and properties of materials.
3) To know current trends and advances in NEMS and MEMS

Course Contents:

Quantum Mechanics-I: Dual nature of matter, de-Broglie Hypothesis, phase velocity and group velocity, their relations, wave function & its physical significance, probability density, Schrodinger's wave equation, eigen values &eigen functions, applications. Electronic conduction in solids: Drude-Lorentz Theory, Drift velocity, relaxation time, mean collision time, mean free path, Electrical conductivity, Quantum free electron theory, density of energy states, Fermi energy, thermionic emission.

Structure of materials, Properties of materials, Transforming materials, Structure and transformation of materials, Electronic properties of materials, Mechanical properties, Engineering applications of materials.

Current trends in Engineering. applications : Quantum information & quantum computing, evolution of quantum theory, quantum computer, nanoscale systems and nanotechnology, nanoscience and technology, composite materials, smart materials and structures, nano and micromechanical systems (NEMS and MEMS).

Text:

1. Resnick, Walker and Halliday, Fundamental of Physics, John Willey and Sons. Inc, 6th Edition, 2005.
2. Streetman B. G., Solid State Electronics, Prentice Hall India (2nd Edition) 1986.
3. Avadhanulu M. N. and P.G. Kshirsagar, A text Book of Engineering Physics, (7th Edition) 2004.
4. Dekkar A.J.; Electrical Engineering Materials; Prentice Hall og India Publication, 1992.
5. Kenneth Krane; Modern Physics; (2 nd Edition); John Wiley Eastern, 1998.
6. Pillai S. O., Solid State Physics, New Age International Publishers, 3 rd edition, 1999.

Reference:

1) John A. Pelesko, David H. Bernstein, "Modeling MEMS and NEMS" CRC Press, 2002

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

1. To study the characteristics of Photocell and to determine the work function of the cathode material.
2. To calibrate an electromagnet and to study the dependence of Hall voltage on magnetic field and current through the sample.
3. To study the I/P, O/P and transfer characteristics and to determine 'á' of transistor in common base mode.
4. To study the forward and reverse characteristics of semiconductor diode.
5. To determine the band-gap in a semiconductor using reverse biased p-n junction diode.

6. To determine e/m for an electron by Thomson's method.
7. To calibrate an audio frequency oscillator and to determine the unknown frequency and phase of RC network by using single trace CRO.
8. To determine the radius of curvature of a plano- convex lens using Newton's Rings.
9. To determine the wavelength of sodium vapour lamp by plane transmission grating.

<table>
<tr><td>Course Code:</td><td>ECL 102</td><td>Course Title:</td><td colspan="4">Digital Electronics</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1) To understand the fundamentals of digital logic design
2) Applications of combinational and sequentional logic circuits
3) To learn the HDL programming</td></tr>
<tr><td colspan="7">Course Contents:

NUMBER SYSTEMS: Representations, signed, 1's complement, 2's complement, saturation and overflow in fixed point arithmetic.

BOOLEAN ALGEBRA: Axioms and theorems, DeMorgan’s law, universal gate, duality, expression manipulation using axioms and theorems.

COMBINATIONAL LOGIC: Introduction to switching algebra, canonical forms, two-level simplification, boolean cube, logic minimization using K-map method, QuineMcCluskey tabular method, minimization for product-of-sum form, minimization for sum-of-product form, multiplexers, demultiplexers, decoders, encoders, hazard free synthesis, Arithmetic circuits, adders, half adder, full adder, BCD adder, ripple carry adder, carry-lookahead adder, combinational multiplier.

SEQUENTIAL LOGIC: Simple circuits with feedback, basic latches, clocks, R-S latch, master-slave latch, J-K flip flop, T flip-flop, D flip-flop, storage registers, shift register, ripple counter, synchronous counters, Finite State Machine (Moore/Mealy Machines), FSM with single/multiple inputs and single/multiple outputs etc.

CONTROLLER DESIGN: Based on minimum number of flip-flops and shift register method. Multiple command responsing register design. Conditional response controller design.

HARDWARE DESCRIPTION LANGUAGE: Programming and simulation, structural specification,
behavioral specification, dataflow modelling, testbench, testing using test vectors, testing using waveforms, design of basic blocks to build larger circuits, case studies, adder, ALU, counters, shift registers, register bank, FSM design example etc.</td></tr>
<tr><td colspan="7">Text:
1. Digital Design, Morris Mano, Prentice Hall, 2002
2. Digital Fundamentals,10th Ed, Floyd T L, Prentice Hall, 2009.</td></tr>
<tr><td colspan="7">Reference:
1. Digital Design-Principles and Practices, 4th Ed, J F Wakerly, Prentice Hall, 2006.
2. Fundamentals of Digital Logic with Verilog Design, 2nd Ed, S. Brown and Z. Vrsaniec, McGraw Hill, 2007</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>CSL 102</td><td>Course Title:</td><td colspan="4">Data Structures</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>CSL 101 (Computer Programming)</td><td>Type of Course</td><td colspan="4">Computer Science</td></tr>
<tr><td colspan="7">Course Outcomes:
• Appreciation and practice of structured programming
• Ability to formulate the problem, devise an algorithm and transform into code
• Understanding different programing techniques and make an informed choice amongst them
• Understanding different sorting algorithms, their advantages and disadvantages,
• Appreciation of concept of dynamic memory allocation and its utilization, dynamic data structures and implementation
• Understanding of concept of Abstract Data Type and implementations.</td></tr>
<tr><td colspan="7">Course Contents:

Types and operations, Iterative constructs and loop invariants, Quantifiers and loops, Structured programming and modular design, Illustrative examples, Scope rules, parameter passing mechanisms, recursion, program stack and function invocations including recursion, Overview of arrays and array based algorithms - searching and sorting, Mergesort, Quicksort, Binary search, Introduction to Program complexity (Big Oh notation), Sparse matrices.
Structures (Records) and array of structures (records). Database implementation using array of records. Dynamic memory allocation and deallocation. Dynamically allocated single and multi-dimensional arrays.
Concept of an Abstract Data Type (ADT), Lists as dynamic structures, operations on lists, implementation of linked list using arrays and its operations. Introduction to linked list implementation using self-referential-structures/pointers.
Stack, Queues and its operations. Implementation of stacks and queues using both array-based and pointer-based structures. Uses of stacks in simulating recursive procedures/ functions. Applications of stacks and queues.
Lists - Singly-linked lists, doubly linked lists and circular linked lists. List traversal, insertion, deletion at different positions in the linked lists, concatenation, list-reversal etc. Mergesort for linked lists.</td></tr>
<tr><td colspan="7">Text:
1) Data Structures & Program Design in C: Robert Kruse, G. L. Tondo and B. Leung PHI-EEE.
2) Fundamentals of Data Structures in C : E. Horowitz, S. Sahni, and S. Anderson-Freed, University Press</td></tr>
<tr><td colspan="7">Reference:
1) Aho, Hopcroft and Ullmann, —Data Structures and Algorithms,‖ Addison Wesley, 1983.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment</td></tr>
</table>

should be based (If Any)

1) Implementation of Binary search, Quick Sort, Merge Sort
2)Implementation of linked lists, insertion, deletion, finding an element.
3) Implementation of Sparse matrices, ADT and its Operation.
4) Implementation of Queue and its operations.
5) Implementation of Stacks and its operation.
6) Implementation of Priority Queues and its operations.

<table>
<tr><td>Course Code:</td><td>HUL 102</td><td>Course Title:</td><td colspan="4">Environmental Studies</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Basic Science</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Introduce to various natural resources, their importance and status.
2. Introduce to the concepts of ecosystem, their structure and functions.
3. Introduce to the concept of biodiversity conservation.
4. Introduce to possible causes of various forms of environmental pollution and their consequences, methods of prevention.
5. Introduce to various social and climatic changes due to pollution.</td></tr>
<tr><td colspan="7">Course Contents:
Natural resources: Forest resources, Water resources, Mineral resources, Food resources, Energy
resources, Land resources.
Ecosystem: Concept of an ecosystem, Structure and functions of an ecosystem, Producers, consumers and
decomposers, Ecological succession, Food chain, food webs and pyramids.
Biodiversity and its conservation: Introduction, definitions: genetics, species and diversity, Value of
biodiversity, Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of
biodiversity, Threat to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Conservation
of biodiversity: in-situ and ex-situ conservation.
Environmental pollution: Definition, Causes, effects and control measures of: Air pollution, Water
pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid
waste management: Causes, effects and control measures of urban and industrial wastes.
Social issues and environment: Sustainable development, Water conservation, Rain water harvesting,
Watershed management, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear
accident, Holocaust, Environmental rules and regulations.
Human population and environment: Population growth, Environment and human health, Human rights,
Value education, Role of information technology in environment and human health.</td></tr>
<tr><td colspan="7">Text:
1. Rajgopalan R., Environmental Studies.</td></tr>
<tr><td colspan="7">Reference:
1. Benny Joseph, Environmental Studies, McGraw Hill.
2. ErachBarucha Environmental Studies University press (UGC).</td></tr>
</table>

Course Code:	CSL 103	**Course Title:**	Application Programming			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	CSL 101 (Computer Programming)	**Type of Course**	Computer Science			

Course Outcomes:

- Aware about different tools for Web Programming.
- Background of working on web.
- Construct efficient web pages with CSS and Javascript.
- Demonstrate competency in the use of common HTML code.
- Able to design efficient client as well as server side scripts.

Course Contents:

Internet fundamentals, LAN, WAN, Introduction to common Internet terms, www.

Basics of networking, DNS, URL, firewall, proxy, Web protocols – http and https.

Designing web pages: HTML, forms, DHTML, XML, CSS. Extensible Hypertext Mark up Language (XHTML): XHTML syntax, headings, linking, images, special characters and horizontal rules, lists, tables, forms, internal linking, meta elements.

Introduction to Web Server – Setting up and configuration of Apache Tomcat server, Accessing pages from another machine.

Server Side Programming: Introduction to web programming with PHP.

Client side programming with Javascript

Introduction to Python - Statements and Control Flow, Expressions, Methods, Typing, Libraries and Developmental Environment, Web Programming using Python.

Text:

1)Deitel H.M. and P. J. Deitel, Internet & World Wide Web - How to Program, Prentice-Hall.
2) Goodman D, Morrison M., JavaScript Bible; Wiley India
3) Lutz, Mark, Learning Python (4th ed.). O'Reilly Media

Reference:

1)Garfinkle S., Spafford G; Web Security, Privacy and Commerce; O'Reilly, 2002.
2) Atkinson L., Core PHP Programming, Prentice Hall.
3) N.P.Gopalan, Akilandeswari, Web Technology, Prentice-Hall.

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

1) Creating an HTML Web page, forms.
2)Creating Home Page using HTML
3) Creating XHTML and CSS and understanding its use in creating Web pages.
4)Setting up and configuration of Apache Tomcat server.
5) Understanding modification of Web.XML
6) Creating Websites using PHP.
7) Understanding Javascript
8) Creating a Web page with back end in PHP and front end in Javascript and hosting it on Apache Tomcat Server.
9) Writing and understanding program in Python.
10) Use Python Libraries like Maths statistics to create programs for Scientific Computations.

<table>
<tr><td>Course Code:</td><td>MAL 201</td><td>Course Title:</td><td colspan="4">Mathematics-III</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">Course Contents:</td></tr>
<tr><td colspan="7">Text:</td></tr>
<tr><td colspan="7">Reference:</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 201</td><td>Course Title:</td><td colspan="4">Signals and Systems</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
At the end of the course, the students are expected to
1. Understand various properties of continuous time signals
2. Analyze the frequency spectrum of continuous time signals
3. Describe a LTI system by impulse/frequency response
4. Analyze magnitude/phase response of various LTI systems
5. Analyze systems commonly used in Communications, Control, and Signal Processing</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to Signals and Systems: The unit impulse and unit step functions, Continuous-time signals, Transformations of the independent variables, Exponential and Sinusoidal signals, Continuous-time systems and basic system properties.
Linear Time-invariant Systems: Continuous-time Linear Time-invariant (LTI) system, Discrete-time LTI system, Properties of LTI systems, System representation through linear constant coefficient differential equations.
Fourier Series Representation of Periodic Signals: Fourier series representation of continuous-time periodic signals, Convergence of the Fourier series, Properties of continuous-time Fourier series, Fourier series and LTI systems, Filtering, Examples of continuous-time filters described by differential equations.
The Continuous-time Fourier Transform: Representation of aperiodic signals, The Fourier transform for periodic signals, Properties of the continuous-time Fourier transform, Convolution and multiplication properties and their effect in the frequency domain, magnitude and phase response.
The Laplace Transform: The Laplace transform for continuous-time signals and systems, the notion of Eigen value and Eigen functions of LTI systems, Region of convergence, System functions, Poles and zeros of system functions and signals, Properties of the Laplace transform, Analysis and characterization of LTI systems using the Laplace transform, The unilateral Laplace transform. Applications of signals and systems theory.</td></tr>
<tr><td colspan="7">Text:
1. A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, ¯Signals and Systems,‖ 2nd Edition, Prentice Hall, 2003.
2. Proakis and Manolakis, “Digital Signal Processing”, Pearson International.</td></tr>
<tr><td colspan="7">Reference:
1. S. Haykin and B. V. Veen, ¯Signals and Systems‖ 2nd Edition, Wiley, 2007.
2. B.P. Lathi, ¯Principles of Linear Systems and Signals,‖ Oxford University Press, 2nd Edition, 2009.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 202</td><td>Course Title:</td><td colspan="4">Microprocessors & Interfacing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Through this course the students will be able to identify the internal registers and memory organization for assembly language programming.
2. They are able to design interface circuits for microprocessors and also interface controlling devices and data acquisition systems.
3. This course helps the students to develop assembly language codes for microprocessor-based systems.</td></tr>
<tr><td colspan="7">Course Contents:
Architecture of Intel's 8085 microprocessor, Addressing modes of 8085 and its timing diagrams, Machine cycle, T-states, Bus structure. Instruction set of 8085, Grouping of instructions, Instruction cycle and their timing diagrams, Assembly language programming. Stacks and sub routines, related instructions, Interrupts and associated instructions, Expanding interrupts, ALP for stacks and interrupt service routines. Memory Interfacing, I/O mapped and memory mapped modes, interfacing of input and output devices, Multiplexed and matrix interfacing. Study and Interfacing of (at least four of the following) peripherals with 8085: Peripherals: 8255, 8254, 8251, 8259, 8257/37, and 8279.</td></tr>
<tr><td colspan="7">Text:
1. "Microprocessors Architecture, Programming and applications with 8085", Gaonkar R.S, Penram Publishing, Edition</td></tr>
<tr><td colspan="7">Reference:
1. Microprocessors and Microcontrollers, Uffenbeck J, Prentice Hall of India Edition
2. K M Bhurchandi, A K Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 2012, 3rd ed</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 203</td><td>Course Title:</td><td colspan="4">Analog ICs</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Through the course student is able to do the Analysis, design, and applications of modern analog circuits
2. Demonstrate the use of analog circuit analysis to analyze the operation and behavior of various modern analog integrated circuits</td></tr>
<tr><td colspan="7">Course Contents:
Architecture of Intel's 8085 microprocessor, Addressing modes of 8085 and its timing diagrams, Machine cycle, T-states, Bus structure. Instruction set of 8085, Grouping of instructions, Instruction cycle and their timing diagrams, Assembly language programming. Stacks and sub routines, related instructions, Interrupts and associated instructions, Expanding interrupts, ALP for stacks and interrupt service routines. Memory Interfacing, I/O mapped and memory mapped modes, interfacing of input and output devices, Multiplexed and matrix interfacing. Study and Interfacing of (at least four of the following) peripherals with 8085: Peripherals: 8255, 8254, 8251, 8259, 8257/37, and
8279.</td></tr>
<tr><td colspan="7">Text:
1. Operational amplifiers, Design and applications","Tobey, Graeme,
Huelsman", McGraw Hills, Edition
2. Operational Amplifiers and Linear Integrated Circuits,Gaikwad R.A, PHI
1990 Edition</td></tr>
<tr><td colspan="7">Reference:
1. Design with OPAMPS and Analog Ics,FransisS.,"McGraw Hills,
1998.",Second Edition
2. OPAMPS and Linear Ics,"Fiore J.M., delmer-Thomson",USA 2001.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 204</td><td>Course Title:</td><td colspan="4">Network Theory</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course introduces the fundamentals of network analysis andsynthesis.
2.This covers the concept of circuit elements, lumped circuits, circuit lawsand reduction and Analyse AC steady-state responses and transient response of resistance, inductance and capacitance in terms of impedance.
3.At the end students will be able to understand the transient response ofseries and parallel A.C. circuits and concept of coupled circuits and two port networks.</td></tr>
<tr><td colspan="7">Course Contents:
Node and Mesh Analysis: Node and mesh equation, matrix approach of complicated network containing voltage and current sources, and reactances, source transformation and duality.
Network theorem: Superposition, reciprocity, Thevenin's, Nortons, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.
First order circuits: RC, RL, and RLC networks with and without initial conditions, with Laplace transforms evaluation of initial conditions.
AC Power Analysis: Instantaneous and average power, RMS value, apparent power and power factor,
two port network and interconnections, Behaviour of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.
Transient behaviour, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero integral solutions.
locations, convolution theorem and Two port network and interconnections, Behaviour of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.</td></tr>
<tr><td colspan="7">Text:
1. Van, Valkenburg.; Network analysis; Prentice hall of India, 2000
2. Jack Kemmerly and William H. Hayt, “Engineering Circuit Analysis”; TataMcgraw-Hill New Delhi, 1994</td></tr>
<tr><td colspan="7">Reference:
1. Sudhakar, A., Shyammohan, S. P.; Circuits and Network; TataMcgraw-Hill New Delhi, 1994
2. Charles Alexander and Mathew Sadiku, “Fundamentals of Electric Circuits”, TMH, 2008</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 205</td><td>Course Title:</td><td colspan="4">Electronic Engineering Materials</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course introduces the fundamentals of various material used for makingelectronic devices.
2.This covers the concept of various properties of the material and their applicationsin designing electronic devices and components.
3.At the end students will be able to understand the behavior of various materialstowards developing various sensors, conducting materials, semiconducting materials, magnetic materials etc..</td></tr>
<tr><td colspan="7">Course Contents:
Dielectric properties of insulators in static fields, Polarization, Dielectric constant, Dielectric behavior of materials, Ferroelectric, Piezoelectric and Pyroelectric materials, Dielectric properties of insulators in alternating fields, Complex dielectric constant, Dipolar relaxation, Dielectric loss, Loss tangent, Dielectric break down, different types of capacitor, multilayer capacitors, Ferroelectric polymers. Conductivity of pure metals and alloys, Temperature coefficient of resistivity, High conductivity materials, Fixed and variable resistors, Resistors used in electronic circuits, Magnetic materials classification, Soft and Hard magnetic materials, Ferrites, Magnetic cores of transformers, Relays, memory elements, Magnetic resistors and Magnetic tapes mutliferroic materials Superconductivity,Type-I and Type-II superconductors, High temperature superconductivity,Applications of superconductivity.</td></tr>
<tr><td colspan="7">Text:
1. DekkarA.J.;Electrical Engineering Materials; Prentice Hall of IndiaPublications, 1992
2. Seth S.P.; A course in Electrcal Engineering Materials; (Third edition)Dhanpatrai Publications, 2003</td></tr>
<tr><td colspan="7">Reference:
1.Joshi M.A.; Electronic components and materials; SPD Publications
2.Pillai S.O.; Solid State Physics; New Age Publication, 1999
3.Kasap S.O.; Principles of Electronic Materials and Devices; Tata-Mcgraw-Hill, 2002</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 301</td><td>Course Title:</td><td colspan="4">Digital Signal Processing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.</td></tr>
<tr><td colspan="7">Course Contents:
DSP Preliminaries Sampling, DT signals, sampling theorem in time domain, sampling of analog signals, recovery of analog signals, and analytical treatment with examples, mapping between analog frequencies to digital frequency, representation of signals as vectors, concept of Basis function and orthogonality. Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.
Discrete Fourier Transform DTFT, Definition, Frequency domain sampling , DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Linear filtering using overlap add and overlap save method, Introduction to Discrete Cosine Transform.
Z transform Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.
IIR Filter Design Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by approximation of derivatives, , IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Characteristics of Butterworth filters, Chebyshev filters and elliptic filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Finite word length effect in IIR filter design
FIR Filter Design Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form, Finite word length effect in FIR filter design.
Multirate DSP and Introduction to DSP Processor Concept of Multirate DSP, Sampling rate conversion by a non-integer factor, Design of two stage sampling rate converter, General Architecture of DSP, Case Study of TMS320C67XX, Introduction to Code composer studio. Application of DSP to Voice Processing, Music processing, Image processing and Radar processing.</td></tr>
<tr><td colspan="7">Text:
1. Discrete Time Signal Processing,Oppenheim& Schafer, PHI Ltd, Third Edition
2. Digital Signal Processing: Principles Algorithms and Applications,Proakis John and ManolakisD.G.Prentice Hall 1992.Edition</td></tr>
<tr><td colspan="7">Reference:
1. Digital Signal Processing A Computer -Based Approach, MitraS.K,Tata McGraw- Hill</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment</td></tr>
</table>

should be based (If Any)

Course Code:	ECL 302	**Course Title:**	Analog Communication			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

The course is designed to cover the fundamentals, principles, concepts, and techniques of analog and digital communication systems like various modulation techniques, digital data transmission, communication technologies, time-domain and frequency domain multiplexing techniques, noise analysis, information theory and various channel coding

Course Contents:

Review of Signal Analysis using Fourier series representation of periodic signals, Fourier transform, Properties of Fourier transform, Convolution, Analysis of Linear time invariant systems. Transmission of signals through systems: Criteria for distortion less transmission, ideal filters, distortions in practical systems, power and energy of signals. Amplitude modulation: Need of modulation, AM DSB-SC, SSB-SC and vestigial side band modulation and demodulation, AM transmitter (broadcast and low power), FDM, Noise in AM systems. Angle modulation: FM and PM, reactance FET modulator Armstrong method, Foster-Seely discriminator, PLL detector, Stereophonic FM, Spectrum of FM, Narrow band and wide band FM, FM transmitter (broadcast and low power). Noise in FM systems. Radio receivers: TRF and super- heterodyne receiver, AGC, FM receiver, sensitivity, selectivity, image frequency rejection measurements, communication receiver and its special features. Transceivers for wireless mobile communication devices. Analog pulse modulation: Sampling theorem, PAM, PWM, PPM, generation & Detection of these pulse modulated signals, TDM

Text:

1. “Introduction to Analog & Digital Communication Systems”, “Haykin Simon”, John Wile
2. “Modern Analog & Digital Communication Systems”, “Lathi B.P”, John Wiley

Reference:

1.“Electronic Communication Systems”, “Kennedy”, TMH
2.“Communication Electronics Principles and Applications”, “Frenzel”, TMH, 3rd Edition
3.“Electronic Communication Modulation and Transmission”, “Schoenbeck”, PHI

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 303</td><td>Course Title:</td><td colspan="4">Hardware description languages</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
The course is designed to cover the fundamentals, principles, concepts, and techniques of analog and digital communication systems like various modulation techniques, digital data transmission, communication technologies, time-domain and frequency domain multiplexing techniques, noise analysis, information theory and various channel coding</td></tr>
<tr><td colspan="7">Course Contents:
Modeling digital systems, Hardware design environment, Design Flow, Hardware description languages, Various design styles. Introduction to VHDL, Elements of VHDL, Basic concepts in VHDL, Simulation, Synthesis. Dataflow modeling, Concurrent signal assignment, delays, Behavioral modeling, processes. Design organization, Structural specification of hardware, parameterization, hierarchy, abstraction, configurations, utilities. Subprogram, packages, libraries, Basic I/O, Programming mechanics Synthesis, RTL description, constraints attributes, FPGA, CPLD structure, technology libraries.
Introduction to Verilog Programming</td></tr>
<tr><td colspan="7">Text:
1. Jayaram .Bhaskar, “VHDL programming”, TMH.
2. Perry Douglus, “VHDL”, TMH.</td></tr>
<tr><td colspan="7">Reference:
1. “VHDL”, “Nawabi Z”, PHI.
2. “Principles of CMOS VLSI design. A systems perspective”, “Eshraghian K, NHE Weste”, Addison Wesley
3. Basic VLSI Design”, “Pucknell D.A., Eshraghian K”</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 304</td><td>Course Title:</td><td colspan="4">Control Systems</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Students will learn the modelling of linear dynamic systems via differential equations and transfer functions utilizing state-space and input- output representations.
2. They can analysis of control systems in the time and frequency domains and using transfer function and state-space methods.
3. Through the successful completion of the course, the student will be able to:
a. Learn various systems exhibiting control mechanisms and understand their operation,
b. Represent Mathematical model of Feedback Control Systems.
c. Evaluate the concept and significance of a Control System model and its applicability.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to need for automation and automatic control. Use of Feedback, Broad spectrum of system application. Mathematical modelling, Diff. Equations, transfer functions, block diagram, signal flow graphs, Application to elementary system simplifications, Effect of feedback on parameter variation, disturbance signal, servomechanisms and regulators. Control system components, Electrical, Electromechanical, hydraulic, pneumatic and other components. Their functional analysis and input output representation.Time response of systems, First order and second order system, standard inputs concept of gain and time constants. Steady state error, type of control system, approximate methods for higher order system.Root location and its effect on time response, Elementary idea of Root Locus, effect of adding pole and zero in proximity of imaginary axis.Stability control systems , conditions of stability, characteristic equation, Routh Hurwitz criterion, special cases for determining relative stability.Frequency response method of analysing linear system. Nyquist and Bode plots stability and accuracy analysis from frequency responses, open loop and close loop frequency response. Nyquist criterion, Effect of variation of gain and addition of pole and zero on response plot, stability margins in frequency response.State variable method of analysis, characteristic of system state, choice of state representation in vector matrix, different standard form, relation between transfer function and state variable.</td></tr>
<tr><td colspan="7">Text:
1. Nagrath&Gopal ; Control System Analysis
2. D'AzzoHoupis; Linear System Analysis; 1975.Huelsoman, McGraw Hill, Logakusha.</td></tr>
<tr><td colspan="7">Reference:
1. Kuo. B. C.; Automatic Control Systems; Prentice Hall, 1991.
2. NomanNise; Control System Engineering; John Wiley &Sons,INC 2000.
3. Gopal M.; Control Systems : Principle of Design.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 305</td><td>Course Title:</td><td colspan="4">Electromagnetics</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. The students will learn to define electric and magnetic fields, calculate electric and magnetic fields from stationary and dynamic charge and current distributions,
2. Solve simple electrostatic boundary problems, describe simple models for electromagnetic interaction with media,
3. Be able to choose adequate models and solution methods for specific problems, solve problems analytically and numerically.</td></tr>
<tr><td colspan="7">Course Contents:
Vector calculus: Cartesian, Cylindrical and spherical co-ordinate systems, differential lengths, surfaces and volumes, Electrostatics: Coulomb's law, Electric field, intensity, electric flux density, Gauss's law and applications, divergence and divergence theorem, potential difference and potential gradient, Electric dipole and dipole moment, Energy in electric field. Steady magnetic fields: BiotSavart's law, Amperes circuital law and application, Curl and Stroke's theorems, Magnetic flux density and magnetic flux, scalar and vector magnetic potentials, Maxwell's equations and time varying fields, Faraday's law, displacement current, Maxwell's Equations in point & integral form, Retarded potentials. Uniform Plane waves: Maxwell's equation in phasor form, wave equation in general medium and perfect dielectric mediums, Solution of wave equations, intrinsic impedance, velocity and wavelength, conductors and dielectrics, depth of penetration, Poynting's vector theorem. Reflection of Electromagnetic Waves: Reflection of Electromagnetic waves: Normal incidence, standing waves, laws of reflection, reflection of obliquely incident waves, Brewsters angle.</td></tr>
<tr><td colspan="7">Text:
1. Engineering Electromagnetics, HaytJr.,Tata McGraw Hill Edition
2. Electromagnetic Fields & Radiating Systems,Jorden&Ballman, PHIEdition</td></tr>
<tr><td colspan="7">Reference:
1. Elements of Electromagnetics, Sadiku,Oxford publications Edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 306</td><td>Course Title:</td><td colspan="4">Computer Architecture &Organisation</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. This course helps to learn:
a. How computers work, basic principles,
b. How to analyse their performance,
c. How computers are designed and built.
d. It gives understanding of issues affecting modern processors (caches, pipelines etc.).</td></tr>
<tr><td colspan="7">Course Contents:
Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.
Processor organisation, Information representation, number formats. multiplication & division ALU design, Floating Point arithmetic, IEEE 754 floating point formats
Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit
Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory,. System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces
Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network</td></tr>
<tr><td colspan="7">Text:
1 . Computer Organization, V. Carl Hammacher, Fifth Edition .
2. Structured Computer Organisation, A.S.Tanenbum, PHI,Third edition</td></tr>
<tr><td colspan="7">Reference:
1. Computer Organisation and Microprogramming, Y.Chu, II, Englewood Chiffs, N.J.", Prentice Hall, Edition
2. Computer System Architecture, M.M.Mano,Edition
3. Computer Organisation and Programming, C.W.Gear,"McGraw Hill, N.V",Edition
4. Computer Architecture and Organisation, Hayes J.P,PHI,Second edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 307</td><td>Course Title:</td><td colspan="4">Digital Communication</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course is useful to present the basic principles that underline theanalysis and design of digital communication systems.
2.The subject of digital communication involves the transmission ofinformation in digital form from a generating source to one or more destinations.
3.The course also covers the analysis and design of communicationsystems are affected by the characteristics of the physical channels through which the information is transmitted.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to digital communication. Comparison of analog and digital communication. Advantages and disadvantages of digital communication. Source Coding of Analog Sources: PCM-TDM, Practical PCM-30 system, Delta modulation, Adaptive DM, DPCM, ADPCM. Source coding of digital sources: Information, entropy, Shannon's source coding theorem, Huffman algorithm, prefix codes. Generalized digital communication system, geometric interpretation of signals, performance of matched filter receiver and correlator receive in the presence of white noise. Threshold setting and error probability. Base band transmission: Line coding fundamentals, transmission formats, spectral requirements. Media used for digital communication; storage and transmission, guided and unguided. types of noise and other impairments. Inter-symbol interference, Nyquist's results for ISI, Eye pattern and adaptive equalization. Pass-band transmission methods: Binary ASK, PSK and FSK, Quadrature multiplexing, QPSK and QAM methods. Geometric interpretation of signals, performance of matched filter receiver and correlator receive in the presence of white noise. Spread spectrum methods: Properties of PN sequences, DSSS system, slow and fast FHSS. Block diagrams and performance analysis, carrier and symbol synchronization. Case studies of transmission methods in telecommunications and computer networking. For example ISDN, XDSL, 802.3 LANs, WiFi LANs, GSM and CDMA mobile wireless networks. Error control coding: Shannon's channel capacity theorem, significance of the theorem. Linear block codes generation and decoding, Hamming distance considerations, Cyclic codes and their applications, Convolutional codes and Viterbi decoding algorithm.
Data link layer protocols; ARQ and sliding window protocols; flow control methods; elementary analysis of protocol correctness and performance; Case studies of HDLC and PPP.</td></tr>
<tr><td colspan="7">Text:
1.Introduction to Analog & Digital Communication Systems;HaykinSimon;JohnWiley,Edition
2.Modern Analog & Digital Communication Systems; LathiB.P,JohnWileyEdition</td></tr>
<tr><td colspan="7">Reference:
1.Digital communication ,HaykinSimon,WileyEdition
2.Communication systems ,"Haykin, Simon",Wiley,(4e)
3.Digital communication,"Proakis, John",Tata- McGraw-Hill,(3e)</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment</td></tr>
</table>

should be based (If Any)

Course Code:	ECL 308	**Course Title:**	Waveguides & Antennas			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

1.The course provides students an introduction to radiation theory, antennas,radiation fields, radiation resistance and gain.

2.It helps to understand transmitting arrays, plane-wave approximation ofradiation fields, plane-wave propagation, reflection, and transmission.

3.It introduces Doppler Effect, evanescent waves and tunnelling,dispersion, phase and group velocities, waveguides and resonant cavities, antenna reception and link budgets.

Course Contents:

Revision of Maxwell's equations for time varying fields and physical significance of Curl, Divergence and Gradient. Waves between parallel planes, TE, TM,& TEM and their characteristics. Attenuation in parallel plane guides wave impedances. TE, TM waves and impossibility of TEM mode in Rectangular waveguide. Different characteristics like group velocity, phase velocity, guide wavelength and wave impedances. Transmission line equations and their solutions. Transmission line parameters, Characteristic impedances, Propagation constant, Attenuation constant, Phase constant, Waveform distortion, Distortion less transmission lines, Loading of transmission lines, Reflection coefficient and VSWR. Equivalent circuits of transmission lines, Transmission lines at radio frequency. Open circuited and Short circuited lines, Smith Chart, Stub matching. Scalar and vector potentials related potentials, field due to a current element, power radiated and radiation resistance for field due to a dipole, power radiated and radiated resistance. Reciprocity theorem applied to antennas. Antenna terminology: Gain, Aperture, Radiation intensity, Directivity, Directive gain, Beam width, Radiation patterns, FBR, Antenna bandwidth etc. Concept of antenna arrays, Two element arrays and their directional characteristics, Linear array analysis, Broadside and end fire arrays, Principles of pattern multiplication & their application. Polynomial representation, Binomial arrays, Design of broadcast array for a specific pattern, Chebyshev array synthesis. Analysis of power patterns of various antennas like Parabolic reflectors, Lens antenna, folded dipole, Turnstile antenna, Yagi antenna, Log-periodic antenna, Horn antenna
& feeding, Traveling wave antenna, Printed antennas, Case grain antenna, Patch & Micro strip antennas, Superconducting antenna, Rhombic, Helical, Open ended waveguide radiator, Small design problems & applications. Signal processing antennas or smart antenna, DOA, Principle beam formation
& Digital beam formatting, Switched beam systems, Adaptive antennas, introduction to concepts of various signal processing algorithms, Principle of special filtering, Antenna diversity, TRB, SRB and Nulling of interference. Introduction to antenna measurement methods: measurement of Gain, Radiation pattern, Time domain gating, Antenna noise temperature & G/T, Impedance & Bandwidth. Introduction to measurement of cellular radio handset antenna.

Text:

1.“Antennas and Wave Propagation”, K.D.Prasad, Khanna or SatyaPublications

2.“Electromagnetic waves and radiating systems”, Jhordan&Balmin,Pearson
Reference: 1.“Electromagnetic field theory and transmission lines”, Raju, Pearson 2.“Antennas and wave propagation”, Raju, Pearson 3.“Antennas for all applications”, Kraus,TMH 4.“Elements of electromagnetism”, Sadiku, Oxford 5.“Electromagnetic Waves”, Shevgaonkar,TMH
List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 309</td><td>Course Title:</td><td colspan="4">Embedded Systems</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.The aim of this course is to provide the student with a detailed understanding of Microcontrollers and Embedded systems.
2.The course covers fundamentals of Architecture, Assembly Language Programming, Instruction set, Serial Communication and Interfacing techniques of 8051 Microcontroller.
3.By the end of course, students are able to design an application specific embedded system.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to embedded systems, microcontrollers 8051 family, architecture, register set, instruction set, programming, interrupts, stack, timers on-chip and off chip peripherals interfacing and programming, Keys, keyboards, LEDs, 7Seg multiplexed display interfacing, ADC,DAC, Stepper motor LCD dot matrix interfacing, Serial communication, sensors and actuators, instrumentation amplifier, Design examples , introduction to ARM, features, architecture, instruction set features, Concepts of RTOS.</td></tr>
<tr><td colspan="7">Text:
1.M A Mazidi, J G Mazidi, R D McKinley, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson/Prentice Hall, 2ndEd 2.Kenneth Ayala, The 8051 Microcontroller, Cengage learning, India, 2004 3rd Ed</td></tr>
<tr><td colspan="7">Reference:
1.Lyla B Das; Embedded Systems and Integrated Approach,Pearson, India, 2013, first edition,
2.K M Bhurchandi, A K Ray, Advanced microprocessors and
Peripherals, McGraw Hill Education India, 2012, 3rd ed
3.Rajkamal, Microcontrollers, Archi, Progr, interfacing and Sys design, Pearson, India, 2nd ed, 2012
4.K V Shibu, Introduction to Embedded Systems, Tata McGraw-Hill Education, India, 2009</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 310</td><td>Course Title:</td><td colspan="4">Electronic Instrumentation</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
The students are expected to learn:
1. How to get an accurate measurement any physical quantity using various calibration methods.
2. The fundamentals of measuring systems including the particular limitations and capabilities of a number of specific measuring devices (pressure transducers, strain gages, thermocouples, etc.) and equipment (oscilloscope, data acquisition card, etc.).
3. The experimental process applied in the laboratory for different physical quantity measurement.</td></tr>
<tr><td colspan="7">Course Contents:
Accuracy and precision, Significant figures, Types of errors, statistical, Probability of errors, Limiting errors. Functional elements of an instrument, Active and Passive transducers, Analog and Digital mode of operation, Null deflection methods, Input and output configuration of measuring instrument and instrument system. Wheat stone bridge : Basic operation, measurement errors, Thevenin's equivalent circuit, Guarded Wheat-stone bridge, Kelvin bridge: Effects of connecting leads, Kelvin double Bridge. AC Bridges and their application: Condition and application of the balance equation. Maxwell's bridge, Hay Bridge, Schering Bridge, Wein Bridge unbalanced condition. PMMC galvanometer, DC ammeters , Ohmmeter: Series and shunt type, VOM, watt hour meter, instrument transformers power factor meter, Q- meter. Transducers as input elements to instrumentation system. Basic methods of Force measurement, Torque measurement of rotating shafts, shaft power measurement (Dynamometers) Pressure and Sound Measurement : Standards and calibration, Basic methods of pressure measurement, high pressure and low-pressure measurement, sound measurement. Temperature and Heat Measurement: Standards and calibration, Thermal expansion methods, Thermocouples (Thermoelectric sensors), Resistance thermometers Junction semiconductors sensors, Digital thermometers. Heat-flux sensors, Radiation types. Strain Measurement: Bonded and un-bonded electrical strain gauges, gauge factor, temperature compensation methods. Introduction, Amplified DC meter, AC voltmeter using rectifiers, Electronic multi-meter, Digital voltmeters, Q meter. Oscilloscope : Introduction, Oscilloscope block Diagram, Cathode Ray tube (CRT), CRT circuits, Deflection systems, Delay line. Multiple trace , Simple frequency counters. Strip XY recorder, CRO, signal conditioning Techniques used in various transducers, Gain clipping, filtering, amplification, data logger. IEEE 488 Bus: Principles of operation, protocols.</td></tr>
<tr><td colspan="7">Text:
1. Electronic instrumentation & Measurement techniques,"Cooper , Helfrick",Prentice Hall India
2. Measurement System : Application &design,DoelbinE.D,McGrawHill,Edition</td></tr>
<tr><td colspan="7">Reference:
1. Electronic Instrumentation,Kogalsusha. Terman, Petil Edition</td></tr>
</table>

2. Electronic Instrumentation, Kalsi, Tata Mc-Grawhill Edition
3. Electronic Measurement &Instrumentation,Oliver,TataMc-Grawhill Edition Electronic Measurement and Measuring Instruments, Sawhney A.K

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

Course Code:	ECL 311	**Course Title:**	Devices & Modelling			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

1. This course offers an introduction to numerical modelling of semiconductor devices and to deal with advanced concepts in semiconductor electronic devices.
2. Through the course, student will understand the physical, electrical, and optical properties of semiconductor materials and their use in microelectronic circuits.
3. Course enables students to analyze the relation of atomic and physical properties of semiconductor materials to device and circuit performance issues.
4. By the end of course, student understand the connection between device- level and circuit-level performance of microelectronic systems.
5. Students can perform analysis of device structures and behaviours using modelling software.

Course Contents:

Introduction to SPICE Simulation, Analysis of complex electronic circuits, simulation and analysis using SPICE, AC/DC operation, DC sweep transfer function, frequency response, feedback control analysis, transient response, device models, simulation and analysis of electronic circuits and systems. Review of semiconductor physics, The pn junction, , The built-in voltage, Depletion width and junction capacitance, Diode current/voltage characteristic, Minority carrier charge storageMOS transistors, Threshold voltage and the body effect, Current/voltage characteristics, Subthreshold current, Short channel effect and narrow width effect, Drain induced barrier lowering Channel length modulation, Hot carrier effects, Effective mobility and velocity saturation SPICE models, MOS inverter circuits Bipolar transistors, Current gain, Gummel plots and output characteristics, Recombination in the emitter/base depletion region, Charge storage and forward transit time, Cut-off frequency, TTL gates. Basic SPICE Models, Ebers-Moll and basic Gummel-Poon model, Small-signal model, Parameter extraction.

Text:

1. “Solid State Electronic Devices”, “B.G.Streetman and S.Banerjee”, Prentice Hall India
2. “Analysis and Design of Digital Integrated circuits”, “D.A.Hodges, and H.G.Jackson” , McGrraw-Hill International

Reference:

1.“Introduction to VLSI circuit and systems”, “J.P.Uyemura”, John Wiley and Sons
2.“Fundamentals of Modern VLSI devices”, “Y.Taur, T.H.Ning”, Cambridge University Press
“Principles of CMOS VLSI design , A systems perspective”, “Eshraghian K”, Addison Wesley.

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 312</td><td>Course Title:</td><td colspan="4">Wireless Digital Communication</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course provides the students deep knowledge in modern digitalcommunication systems at the theoretical & practical level and introduces the most advanced standards, the future of digital wireless communication systems & networks.
2.The course will focus on modern digital wireless communicationsystems including the cellular concept, mobile radio environment, signals generation, modulation & processing.
3.At the end of course, students will should able to work in thecommunication industry & in mobile communication networks.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to wireless digital communication systems; block diagram of a typical RF transceiver, radio propagation and cellular engineering concepts; frequency reuse, frequency management and channel assignment, handoff and handoff strategies, trunking theory, coverage and capacity improvements, medium access techniques, FDMA, TDMA, CDMA, SDMA. Modulation methods: Basic digital modulation methods; ASK, PSK and FSK; Quadrature multiplexing and its applications; advanced modulation methods QPSK, QAM, MSK, GMSK, applications of differential coding, OFDM, MIMO. Spread Spectrum methods: basics; generation and properties ofPN sequences, DS-SS system analysis; slow and fast FH-SS system; performance analysis. Interference measurement and reduction, co-channel and other interference, Diversity methods for Mobile Wireless Radio Systems, concepts of diversity branch and signal paths, combining and switching methods, C/N and C/I ratio improvements, average Pe improvements</td></tr>
<tr><td colspan="7">Text:
1.Wireless Communication: Principles and Practices ,Theodore Rappaport,
Pearson Education 2nd edition
2.Wireless Digital Communication, Feher, PHI</td></tr>
<tr><td colspan="7">Reference:
1.Digital communication, John Proakis, Tata- McGraw-Hill, 3rd edition
2.Digital communication, Simon Haykin ,Wiley
3.Communication systems, Simon Haykin ,Wiley, 4th edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 313</td><td>Course Title:</td><td colspan="4">Electronic System Design</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">Course Contents:
Passive components: Understanding and interpreting data sheets and specifications of various passive and active components, non-ideal behavior of passive components,. Op amps: DC performance of op amps: Bias, offset and drift. AC Performance of operational amplifiers: band width, slew rate and noise. Properties of a high quality instrumentation amplifier. Design issues affecting dc accuracy & error budget analysis in instrumentation amplifier applications. Isolation amplifier basics. Active filers: design of low pass, high pass and band pass filters. ADCs and DACs: Characteristics, interfacing to microcontrollers. Selecting an ADC. Power supplies: Characteristics, design of full wave bridge regulated power supply. Circuit layout and grounding in mixed signal system.
Understanding and interpreting data sheets & specifications of various CMOS&BiCMOS family Logic devices. Electrical behavior (steady state & dynamic) of CMOS &BiCMOS family logic devices. Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies. CMOS/TTL Interfacing Basic design considerations for live insertion. JTAG/IEEE 1149.1 design considerations. Design for testability, Estimating digital system reliability. Digital circuit layout and grounding. PCB design guidelines for reduced EMI.
Cabling of Electronic Systems: Capacitive coupling, effect of shield on capacitive coupling, inductive coupling, effect of shield on inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, coaxial cable versus shielded twisted pair, ribbon cables. Grounding of Electronic Systems: Safety grounds, signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields, ground loops, shield grounding at high frequencies.
Balancing & Filtering in Electronic Systems: Balancing, power line filtering, power supply decoupling, decoupling filters, high frequency filtering, system bandwidth. Protection Against Electrostatic Discharges (ESD): Static generation, human body model, static discharge, ESD protection in equipment design, software and ESD protection, ESD versus EMC. Packaging & Enclosures of Electronic System: Effect of environmental factors on electronic system (environmental specifications), nature of environment and safety measures. Packaging's influence and its factors. Cooling in/of Electronic System: Heat transfer, approach to thermal management, mechanisms for cooling, operating range, basic thermal calculations, cooling choices, heat sink selection</td></tr>
<tr><td colspan="7">Text:
1. Electronic Instrument Design, 1st edition; by: Kim R.Fowler; Oxford University Press.
2. Noise Reduction Techniques in Electronic Systems, 2nd edition; by: Henry W.Ott; John</td></tr>
</table>

Wiley & Sons. 3. Digital Design Principles& Practices, 3rd edition by: John F. Wakerly; Prentice Hall International, Inc. 4. Operational Amplifiers and linear integrated circuits, 3rd edition by: Robert F. Coughlin; Prentice Hall International, Inc 5. Intuitive Analog circuit design by: Mark.T Thompson; Published by Elsevier
Reference: 1. Printed Circuit Boards - Design & Technology, 1st edition; by: W Bosshart; Tata McGraw Hill.
List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 410</td><td>Course Title:</td><td colspan="4">Computer Communication Networks</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course provides students with an overview of the concepts andfundamentals of data communication and computer networks.
2.Through the course, students will be able to understand the fundamentalconcepts of computer networking and familiar with the basic taxonomy and terminology of the computer networking area.
3.The course introduces the student about to advanced networking conceptsand gain expertise in some specific areas of networking such as the design and maintenance of individual networks.</td></tr>
<tr><td colspan="7">Course Contents:
Networks and services; network topologies; switching methods; network evolution; concept of layered architecture; the OSI model; the TCP/IP model; standardization and standards organizations. Study of telephone network; PCM-TDM based IDN; circuit switching; space and time division switching; signaling methods; store-and-forward switching. ISDN fundamentals; SS#7; Frame relay and ATM networks; SONET and SDH; LANs and MAC protocols; ALOHA, slotted ALOHA, CSMA and CSMA-CD protocols; IEEE 802.3 protocol and MAC frame format. Details of 802.3 hardware options; 100 Mbps and 1000 Mbps Ethernet LANs, switches, bridges and VPN; Wireless LANs; LAN applications; client-server architecture; Network Layer: services offered to the transport layer, internal organization as datagram or virtual circuit subnets; routing algorithms; congestion control; internetworking; Study of IPv4 and IP v6, DNS and Internet routing protocols. Transport Layer: Design issues; study of TCP; connection setup and removal; flow control; reliable and efficient delivery, timer management. The TCP/IP protocol stack: ICMP, IGMP, UDP, BOOTP, DHCP etc. Network applications: World Wide Web and HTTP; Web servers and browsers, Content Engines; FTP and TFTP; SMTP and MIME; DNS; multimedia networking; streaming stored audio and video; Internet audio and video communications. Network Security: Principles of cryptography; authentication; integrity, key distribution and certification; secure e-mail; Fire-walls Network management: issues in network management; infrastructure for NM, MIB, SNMP, RMON, ASN1</td></tr>
<tr><td colspan="7">Text:
1. Computer Networks Tanenbaum A. S.; PHI. 4th edition
2. Data Comuncation and Networking B. Forouzan TMH 4th edition Data
and Computer Communication</td></tr>
<tr><td colspan="7">Reference:
1. Stallings William PHI 6th edition Computer Networking, a top-down approach featuring the Internet;
2. Kurose and Ross ; Addison Wesley (Low Price Edition) Computer Communications and Networking Technologies- Gallo and Hancock ;Thomson Learning 2nd edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment</td></tr>
</table>

should be based (If Any)

Course Code:	ECL 411	**Course Title:**	Advanced Digital signal processing – Wavelets and Multirate			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

Course Contents:

1. Introduction Origin of Wavelets Haar Wavelet Dyadic Wavelet Dilates and Translates of Haar Wavelets L2 norm of a function
2. Equivalence of functions & sequences Angle between Functions & their Decomposition Additional Information on Direct-Sum Introduction to Filter Bank Haar Analysis Filter Bank in Z-domain Haar Synthesis Filter Bank in Z-domain
3. Moving from Z-domain to frequency domain Frequency Response of Haar Analysis Low pass Filter bank Frequency Response of Haar Analysis High pass Filter bank Ideal Two-band 4. Filter bank Disqualification of Ideal Filter bank Realizable Two-band Filter bank Demonstration: DWT of images
5. Relation Fourier transform of Scaling function to filter bank, Fourier transform of scaling function, Construction of Scaling and Wavelet function, Demonstration of scaling and wavelet functions
6. Applications: Speech, audio, image, and video compression, Signal denoising, Feature extraction, Inverse problems

Text:

1. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding," Prentice Hall, 1995; downloadable from http://www.waveletsandsubbandcoding.orgResearch papers.

2. S. Mallat, "A Wavelet Tour of Signal Processing," Academic Press, Second Edition, 1999.G. Strang and T. Q. Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press, Revised Edition, 1998.I. Daubechies, "Ten Lectures on Wavelets," SIAM, 1992.

3. P. P. Vaidyanathan, "Multirate Systems and Filter Banks," Prentice Hall, 1993.

Reference:

1. M. Vetterli, J. Kovacevic, and V. K. Goyal, "The World of Fourier and Wavelets: Theory, Algorithms and Applications,"

2. Barbara Burke Hubbard,"The Worldaccording to Wavelets - A Story of aMathematical Technique in themaking",Second edition, UniversitiesPress (Private) India Limited 2003.

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

Course Code:	ECL 412	Course Title:	CMOS Design			
Category:	Core	Credit Assigned	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	Type of Course	Core Engineering			

Course Outcomes:

1. The course offer the students is to introduce the fundamental principles of VLSI (Very Large Scale Integrated) circuit design and layout, to cover the basic building blocks of large-scale CMOS digital integrated circuits, and to provide hands-on design experience using a professional IC design platform.
2. The course help the students to provides an overview of CMOS fabrication technologies, physical VLSI design issues (bottom-up design), basic CMOS logic gates, architectural building blocks and system design (top-down design), with a stronger emphasis on physical design principles.

Course Contents:

CMOS Design Introduction:
Flow of circuit design, Fabrication Process Flow: Basic Steps, Layout Design Rules
CMOS Digital Circuits:
Inverters, Static logic gates, Transmission gates and Flip-Flops, Dynamic logic Gate. Memory Circuits.
CMOS Analog Circuits:
MOS Analog models, Current Sources and sinks, References, amplifiers, Differential Amplifiers, Operational Amplifiers.
CMOS Mixed- Signal Circuits:
Data converter:
Fundamentals and Converter architectures.

Text:

1. BehzadRazavi. 2000. Design of Analog CMOS Integrated Circuits (1 ed.). McGraw-Hill, Inc., New York, NY, USA.
2. "CMOS Circuit design, Layout and Simulation", R. J. Baker, H W Li, D. E. Boyce, PHI EEE
3. "Principles of CMOS VLSI Design", Neil H. E. Weste, Kamran Eshraghian, Addison Wesley

Reference:

1. BehzadRazavi, "Fundamentals of Microelectronics", 2nd Edition, March 2014.
2. "Basics of CMOS Cell Design", Etienne Sicard
3. "CIRCUIT DESIGN for CMOS VLSI", John P. Uyemura
4. "CMOS Digital Integrated Circuits: Analysis and Design," Sung-Mo Kang And Yusuf Leblebici

ONLINE VIDEOS:

1. "Analog IC Design" by Dr. NagendraKrishnapura, Department of Electronics & Communication Engineering, IIT Madras
https://www.youtube.com/playlist?list=PLbMVogVj5nJRlMz5diOg9wBizaU6-egJc

2. “CMOS Circuit Design, Layout, and Simulation” by R. Jacob Baker www.cmosedu.com/videos/
List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

Course Code:	ECL 413	**Course Title:**	Radio Frequency Circuit Design			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

3. 1.This course covers the analysis, design and simulation of radio frequency(RF) circuits and components for communication systems and industrial applications.
4. 2.This course is useful to students for understanding fundamental RFcircuit and system design skills and it introduces students the basic RF electronics utilized in the industry and how to build up a complex RF system from basis.

Course Contents:

Characteristics of passive components for RF circuits. Passive RLC networks. Transmission lines. Two-port network modeling. S-parameter model. The Smith Chart and its applications.Active devices for RF circuits: SiGe MOSFET, GaAspHEMT, HBT and MESFET. PIN diode. Device parameters and their impact on circuit performance. RF Amplifier design: single and multi-stage amplifiers. Review of analog filter design. Low-pass, high-pass, band-pass and band-reject filters. Bandwidth estimation methods. Voltage references and biasing.Low Noise Amplifier design: noise types and their characterization, LNA topologies, power match vs noise match. Linearity and large-signal performance.RF Power amplifiers: General properties. Class A, AB and C PAs. Class D, E and F amplifiers. Modulation of power amplifiers.Analog communication circuits: Mixers, phase-locked loops, oscillators and synthesizers.Design and performance characterization. Transreceiver design

Text:

1. BehzadRazavi. 2000. Design of Analog CMOS Integrated Circuits (1 ed.). McGraw-Hill, Inc., New York, NY, USA.

Reference:

1. The Design of CMOS Radio Frequency Integrated Circuits,LeeThomasH,Cambridge University Press.
2. VLSI for wireless communication,BoscoLeung,Pearson Education

ONLINE VIDEOS:

1. “Analog IC Design” by Dr. NagendraKrishnapura, Department of Electronics & Communication Engineering, IIT Madras https://www.youtube.com/playlist?list=PLbMVogVj5nJRlMz5diOg9wBizaU6-egJc
2. “CMOS Circuit Design, Layout, and Simulation” by R. Jacob Baker www.cmosedu.com/videos/

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 414</td><td>Course Title:</td><td colspan="4">Adaptive Signal Processing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. The primary objective of this course is to develop the ideas of optimality and adaptation in signal processing.
2. The students will discuss the design, analysis, and implementation of digital signal processing systems that can be considered optimal in some sense.
3. Through this course students will be able to understand why adaptation is required if a system is to remain optimal in a continually changing environment and why an emphasis is placed on developing adaptive algorithms with applications to specific engineering problems.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction to Adaptive Filters: Adaptive filters, filter structures, cost functions, applications etc.Stationary Processes and Models: Mean Ergodic theorem, correlation matrix and its properties, stochastic models, the eigenanalysis.Wiener Filters: Principle of orthogonality, minimum mean-squared error (MMSE), Wiener-Hopf equations, MMSE cost function, linearly constrained minimum variance filter.Linear Prediction: Forward and backward linear prediction, Levinson algorithm, lattice filters and their properties, joint process estimation.Stochastic Methods: Steepest-descent algorithm, its stability and transient behavior, Least Mean Square (LMS) algorithm, properties of LMS, Eigen System decomposition. Gradient search technique,Recursive LMS (RLMS) algorithm.Least Square Methods: Least squares and orthogonality, Recursive least squares (RLS) algorithms, properties of RLS.</td></tr>
<tr><td colspan="7">Text:
1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall,1984.</td></tr>
<tr><td colspan="7">Reference:
1.Widrow B., Stearns S.D.; Adaptive Signal processing; Prentice Hall, 1984
2.Treichler J.R.; Theory and Design of adaptive filters ; PHI, 2002</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 415</td><td>Course Title:</td><td colspan="4">Image Processing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course offers fundamentals of digital imageprocessing and algorithms that are used.
2.At the end of the course the student should have a clear impression of thebreadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
3. Students will learn to implement selected algorithms in MATLAB or C-language.</td></tr>
<tr><td colspan="7">Course Contents:
Elements of visual perception, Digital Image fundamentals, Basic image processing steps, Image Transforms, Image enhancement in spatial and frequency domain, linear gray level transformations, Histogram equalization and specification, smoothing & sharpening spatial filters. Image degradation models, image restoration, inverse filtering, Wiener filtering. Image reconstructions from projections, radon transform, projection theorem of computerized tomography. Morphological image processing, dilation, erosion, Basic morphological algorithms, thinning algorithms. Edge detection, Edge linking & Boundary Detection, watershed segmentation algorithm , Introduction to object recognition., color image processing ,RGB and HSI color models, Gray level to color transformation.</td></tr>
<tr><td colspan="7">Text:
1.Digital Image Processing,Gonzalez R.C. and WoodsR.E,Pearson,Second
2.Fundamentals of Digital Image Processing,A.K.Jain,PHI</td></tr>
<tr><td colspan="7">Reference:
1. Digital Image Processing, Pratt W.K.,Wiley, Third Edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 416</td><td>Course Title:</td><td colspan="4">Image and Video Communication</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. This course intends to give students the fundamentals of image and video processing and communications.
2. Students would learn various standard image and video codecs
3. Students would have learn the architectures of the state-of-the-art image and video codecs
4. Students will learn to implement selected algorithms in MATLAB or C-language.</td></tr>
<tr><td colspan="7">Course Contents:
Fundamentals of image and video processing, including color image capture and representation; color coordinate conversion; contrast enhancement; spatial domain filtering (linear convolution, median and morphological filtering); two-dimensional (2D) Fourier transform and frequency domain interpretation of linear convolution; 2D Discrete Fourier Transform (DFT) and DFT domain filtering; image sampling and resizing; geometric transformation and image registration; video motion characterization and estimation; video stabilization and panoramic view generation; basic compression techniques (entropy coding, vector quantization, predictive coding, transform coding); JPEG image compression standard; wavelet transform and JPEG2000 standard; video compression using adaptive spatial and temporal prediction; video coding standards (MPEGx/H26x); Stereo and multi-view image and video processing (depth from disparity, disparity estimation, video synthesis, compression).</td></tr>
<tr><td colspan="7">Text:
1. Y. Wang, J. Ostermann, and Y.Q.Zhang, Video Processing and Communications. Prentice Hall, 2002.
2. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Prentice Hall, (3rd Edition) 2008. ISBN number 9780131687288.</td></tr>
<tr><td colspan="7">Reference:
1. J. W. Woods, “Multidimensional signal, image and video processing and coding,” Academic Press / Elsevier, 2nd ed, 2012.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 439</td><td>Course Title:</td><td colspan="4">Coding Techniques</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
After successful completion of this course, students will be able to practice biomedical engineering to serve state and regional industries, hospitals, government agencies, ornational and international industries and work independently in particular areas such as biomedical electronics, medical instrumentation, medical imaging, biomedical signal processing, rehabilitation engineering, and neuro engineering</td></tr>
<tr><td colspan="7">Course Contents:
Information Theory and Source Coding 7L Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, The Lempel Ziv algorithm, Run Length Encoding, Discrete memory less channel, Mutual information, Examples of Source coding-Audio and Video Compression. Case Study: Huffmans coding in image compression/Detail overview of JPEG.
Information Capacity and Channel Coding 8L Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem, Linear Block Codes:Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding, Encoding and decoding circuit, Single parity check codes, Repetition codes and dual codes, Hamming code, Golay Code, Interleaved code. Case Study: Shannon’s Publications on information theory.
Cyclic Codes 8L Galois field, Primitive element & Primitive polynomial, Minimal polynomial and generator polynomial, Description of Cyclic Codes, Generator matrix for systematic cyclic code, Encoding for cyclic code, Syndrome decoding of cyclic codes, Circuit implementation of cyclic code.
BCH and RS Codes 7L Binary BCH code,Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes, Cyclic Hamming code and Golay code, CRC code, FEC and ARQ systems. Case Study: RS Coding in CD recording. Case Study: CRC used in Ethernet LAN.
Convolutional Codes 7L Introduction of convolution code, State diagram, Polynomial description of convolution code, Generator matrix of convolution code, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding, Known good convolution code, Introduction to LDPC and Turbo codes.
Coding and Modulation 8L Goals of a communication System designer, Error Probability plane, Nyquist minimum bandwidth, Shannon Hartley theorem, Bandwidth efficiency plane, Modulation and coding tradeoffs, Defining, designing and evaluating digital communication system.Trellis Coded Modulation:Concept of TCM and Euclidean distance, Asymptotic coding gain, Mapping by set partitioning, Ungerboeck’s TCM design rule. Case Study : TCM used in MODEMs</td></tr>
<tr><td colspan="7">Text:
1. Ranjan Bose, “Information Theory coding and Cryptography”, McGraw-Hill Publication,</td></tr>
</table>

2nd Edition

2. J C Moreira, P G Farrell, “Essentials of Error-Control Coding”, Wiley Student Edition..

Reference:

1. BernadSklar, “Digital Communication Fundamentals & applications”, Pearson Education. Second Edition.
2. Simon Haykin, “Communication Systems”, John Wiley & Sons, Fourth Edition.
3. Shulin and Daniel j, Cistellojr., “Error control Coding” Pearson, 2nd Edition.
4. Todd Moon, “Error Correction Coding : Mathematical Methods and Algorithms”, Wiley Publication
5. Khalid Sayood, “Introduction to Data compression”, Morgan Kaufmann Publishers

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

Course Code:	ECL 418	**Course Title:**	Neuro Fuzzy Techniques			
Category:	Core	**Credit Assigned**	L	T	P	C
			3	0	2	4
Pre-Requisite (if Any)	Nil	**Type of Course**	Core Engineering			

Course Outcomes:

1. This course intends to give students the fundamentals of image and video processing and communications.
2. Students would learn various standard image and video codecs
3. Students would have learn the architectures of the state-of-the-art image and video codecs

Course Contents:

Neural Networks: History, overview of biological neuro-system, mathematical models of neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, Learning Tasks, ANN training Algorithms-Single layer perceptron, multi-layer perceptron, Self-organizing Map, Applications of Artificial Neural Networks.

Introduction to fuzzy set, Operations on fuzzy sets, Fuzzy relation, Fuzzy implication, approximate reasoning, Fuzzy rule-based systems, Fuzzy reasoning schemes, Fuzzy logic controller.

Implementing fuzzy IF-THEN rules by trainable neural nets. Fuzzy neurons, Hybrid neural networks, Neuro-fuzzy classifiers.

Text:

1. Fuzzy Logic with Engineering Applications; Timothy Ross, McGraw-Hill.
2. Neural Network: A Comprehensive Foundation; Simon Haykin, PHI.

Reference:

1. Neuro-Fuzzy and Soft Computing: A computational Approach to Learning & Machine Intelligence; Roger Jang, Tsai Sun, EijiMizutani, PHI.
2. Soft Computing and Its Applications : R.A. Aliev, R.R. Aliev
3. Elements of artificial Neural Networks; KishanMehtrotra, S. Ranka, Penram International Publishing (India).
4. Neural Networks and Fuzzy Systems: Bar Kosko , PHI.

List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

<table>
<tr><td>Course Code:</td><td>ECL 419</td><td>Course Title:</td><td colspan="4">Android Application Development</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Experience in Object Oriented programming language
Knowledge in XML format</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
This course introduces mobile application development for the Android platform. Students will learn skills for creating and deploying Android applications, with particular emphasis on software engineering topics including software architecture, software process, usability, and deployment.</td></tr>
<tr><td colspan="7">Course Contents:
About Android
Smartphones future, Installing and preparing the development environment, Choosing which Android version to use, Android Stack, Android applications structure , Creating a project ,Working with the AndroidManifest.xml, Using the log system Activities , Application context, Intents, Activity life cycle, Supporting multiple screen sizes , Text controls, Button controls, Toggle buttons, Images Parameters on Intents, Pending intents, Status bar notifications, Toast notifications , Localization, Options menu, Context menu, Alert dialog, Custom dialog, Dialog as Activity, Using string arrays, Creating lists, Custom lists, Shared preferences, Preferences activity, Files access , SQLite database Using GPS to find current location, Google maps Web Services, HTTP Client, XML and JSON, Service lifecycle, Foreground service Creating custom components, Passing parameters to custom components Working with colors and pictures formats Introduction to Canvas, Drawing with primitives , Working with touch/multi-touch events, Working with accelerometer, Game design basics, Working with SurfaceView , Game Architecture, AndEngine example, Scaling the canvas Preparing for publishing , Signing and preparing the graphics, Publishing to the Android Market</td></tr>
<tr><td colspan="7">Text:
1. Reto Meir, Professional Android Application 4 Application Development.
2. Wallace Jackson, "Learn Android App Development", 2013</td></tr>
<tr><td colspan="7">Reference:
1. Wei-Meng Lee Beginning Android 4 Application Development, Wiley, 2012</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 430</td><td>Course Title:</td><td colspan="4">Statistical Signal Analysis</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">Course Contents:
Review of probability, Sample space, Algebra and random variable, Distribution and densities, Characteristics functions and moment generating functions, Transformation (function) of random variables; Conditional expectation; Sequences of random variables: convergence of sequences of random variables.
Statistical Independence, Uncorrelation of Random Variables, Joint and Marginal Densities Function of random variables, Stochastic processes: wide sense stationary processes, orthogonal increment processes, Wiener process, Ergodicity.
Mean square continuity, Stochastic Calculus: mean square derivative and mean square integral of stochastic processes.
Stochastic systems: response of linear dynamic systems to stochastic inputs correlation function; power spectral density function; introduction to linear least square estimation. Least square and mean square error.</td></tr>
<tr><td colspan="7">Text:
1. A.Papoulis, Probability Random Variables and stochastic Processes, 2nd Ed Mc Graw Hill
2. Alberto leon Gracia, Probability and Random Processes for Electrical Engineer, 2nd Ed PE India</td></tr>
<tr><td colspan="7">Reference:
1. A. Larson and B.O. Schubert, Stochastic Processes, Vol.I and II, Holden-Day</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 439</td><td>Course Title:</td><td colspan="4">Biomedical Engineering</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
After successful completion of this course, students will be able to practice biomedical engineering to serve state and regional industries, hospitals, government agencies, ornational and international industries and work independently in particular areas such as biomedical electronics, medical instrumentation, medical imaging, biomedical signal processing, rehabilitation engineering, and neuro engineering</td></tr>
<tr><td colspan="7">Course Contents:
Human body, physiology and sub system, Biochemistry Measurement of Electrical Activities in Human body, Electrocardiography, Electroanephalography, Electromygraphy and interpretation of records. Measurement of non-electrical quantity in human body, Measurement of blood flow respiration rate and depth heart rate, blood pressure, temperature, pH impedance of various CSR. Biotelemetry X Ray and Radio isotrope instruments, A scan, B scan, fital monitoring, X ray component Tomography. Cardiac pacemaker. Defibrillator, Neuropathophysiology of the Nervous System, Detection and treatment of nervous system disorder. Detection & treatment of nerway system disorders. Prosynthesis for hearing, visual, limb impairments students design & test a nueroprosthesis. Non inveasive diagnosis instrumentation. Blood pump Respiration controller. Latest trends in Biomedical Instrumentation. Electrical safety & Laser-Tissue interaction (</td></tr>
<tr><td colspan="7">Text:
1.“Biomedical Inst. & Measurement”, Cromwell, McGraw Hill
2.“Biomedical Engg. System”, Cromwell, McGraw HILL.</td></tr>
<tr><td colspan="7">Reference:
1.“Biomedical Phenomenon”, Plonsay Robert, McGraw Hill
2.“Biomedical Engg”, Khandpur, Tata McGraw Hill</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 432</td><td>Course Title:</td><td colspan="4">Wireless Sensor Networks</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1) This course provides an introduction to wireless sensors which have applications in many fields.
2) Students will be able to design wireless sensor networks for an application after completion of the course.
3) Students can know about emerging research areas in the field of sensor networks after successful completion of this course.</td></tr>
<tr><td colspan="7">Course Contents:
Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile AdhocNETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks: routing protocols; MAC protocols; Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE
802.15.4 standard and ZigBee, Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. Design Principles for WSNs ,Gateway Concepts Need for gateway ,WSN to Internet Communication, Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.</td></tr>
<tr><td colspan="7">Text:
1. Fundamentals Of Wireless Sensor Networks Theory And Practice ByWaltenegusDargie , Christian Poellabauer. John Wiley & Sons Publications
2. Tinyos Programming By Philip Levis, And David Gay. CambridgeUniversity Press.</td></tr>
<tr><td colspan="7">Reference:
1. Sensors Handbook by SabrieSoloman - McGraw Hill publication.
2. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks, ElsevierPublications.
3. KazemSohrby, Daniel Minoli, Wireless Sensor Networks: Technology,Protocols and Applications, Wiley- Interscience</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 433</td><td>Course Title:</td><td colspan="4">Satellite Communication</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.This course presents the fundamentals of satellite communications linkdesign and provides an overview of practical considerations.
2.Existing systems are described and analyzed, including direct broadcastsatellites, VSAT links, and Earth-orbiting and deep space spacecraft.
3.Topics include satellite orbits, link analysis, antenna and payload design,interference and propagation effects, modulation techniques, coding, multiple access, and Earth station design.</td></tr>
<tr><td colspan="7">Course Contents:
Orbital aspects of satellite communication, Orbit mechanisms, Equation of orbit, Locating satellite in orbit, Orbital elements, Orbital area coverage, Look angles, Slant range,
Space craft subsystems, Attitude and orbit control system, Telemetry tracking and command system (TTC), Power subsystems, Antennas, Reliability Satellite link design, System noise temperature, G/T ratio, Down link design, Uplink design, Link for specified (C/N) base-band noise signal.
Digital Satellite Links, Frequencies and channel allocations, Modulation techniques, QPSK, QAM, BER analysis, medium access methods for satellite communication.
Earth station technology, Earth station design for low system noise temperature. Equipment for earth stations, LNA and HPA.
VSAT systems- overview of VSAT systems, Access control protocols, multiple access selection, modulation, coding and interference issues</td></tr>
<tr><td colspan="7">Text:
1. Satellite communication, "Timothy Pratt, Charles Bostian, Jeremy Allnut",John Willey and Sons Inc, 2nd edition
2. Satellite Communication Systems Engineering,"W. L. Pritchard, H.G. Suyderhoud, R.A. Nelson, ",Pearson Education, 2nd edition</td></tr>
<tr><td colspan="7">Reference:
1.Advanced Electronic communications, Wayne Tomasi, Prentice Hall of India Pvt. Ltd, 5th edition
2.Electronic Communication Systems, Frank.R. Dungan, International Thomson Publishing Company, 3rd edition
3.Satellite Communication,Roddy, 2nd edition
4.Satellite Communication Technology, Dr. K. Miya, 2nd edition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 434</td><td>Course Title:</td><td colspan="4">RADAR Engineering</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1.Through this course students are able to learn the fundamental issuesinvolved in radar signal processing, the frequency and time domain methods of power and velocity measurements and algorithms for the enhancement of radar performance.
2.The course also provides how a Doppler radar can be used forprecipitation measurements, study the statistical properties of the various algorithms used with Doppler radars.</td></tr>
<tr><td colspan="7">Course Contents:
Radar range equation, CW and EM modulated radar. Moving target, Indicated and pulse dupler radar, Tracking radar. Transmitters, Magnetron Oscillator, Modulators, Line Pulsing modulator. Radar receiver, Receiver nise, Extraction of information from radar. Radar Antennas, Parabolic reflector, Scanning feed, Reflector cassegrain, Lens Antennas. Radar Clutter and interference-Radar Indicators.</td></tr>
<tr><td colspan="7">Text:
1. Introduction to Radar System,Skolink,McGrawHillEdition
2. Principles of Radar,Heities&Coates,McGrawHillEdition</td></tr>
<tr><td colspan="7">Reference:
1. Introduction to Radar System,Kingsley,McGrawHillEdition</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
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<table>
<tr><td>Course Code:</td><td>ECL 435</td><td>Course Title:</td><td colspan="4">Applied Linear Algebra</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">Course Contents:
Matrices: Review of Matrix Algebra; Rank of matrix; Row reduced Echelon form; Determinants and their properties; Solution of the matrix Equation Ax = b; Gauss elimination method,
Vector Space; Subspaces; Linear Dependence/Independence; Basis; Dimension; Linear transformation; Range Space and Rank; Null Space and Nullity; Rank nullity theorem, , Matrix Representation of a lineartransformation; Linear Operators on Rn and their representation as square matrices; Invertible linear operators; Inverse of a non-singularmatrix.
Eigenvalues and eigenvectors of a linear operator; properties of eigenvalues and eigenvectorsof Hermitian, skew-Hermitian, Unitary, and Normal matrices (including symmetric, skew-symmetric, and orthogonal matrices); Characteristic Equation; Bounds on eigenvalues;Cayley Hamilton theorem, Diagonalizability of a linear operator.
Inner Product Spaces, Norm; Orthonormal Sets, Gram Schmidt orthogonalisation process; projectionsand least squares approximation.
Optimization: Modeling and formulation of optimization problems; Least cost and Covex domain; Linear programming and Simplex Algorithm (Big M and Two Phase Method); Duality and the primal dual method.
Some Practical Applications</td></tr>
<tr><td colspan="7">Text:
1. Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi
2. Gilbert Strang : Linear Algebra And Its Applications (Paperback) , Nelson Engineering (2007)</td></tr>
<tr><td colspan="7">Reference:
1. V. Krishnamoorthy et al : An introduction to linear algebra , Affiliated East West Press, New Delhi P.G. Bhattacharya, S.K. Jain and S.R.
2. Nagpaul : First course in Linear Algebra, Wiley Eastern Ltd., New Delhi
3. K.B.Datta : Matrix and Linear Algebra, Prentice Hall of India, New Delhi</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 436</td><td>Course Title:</td><td colspan="4">Optical Communication</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Enable students to develop a full understanding ofthe components and the design and operation of optical fibre communication systems and introduces the principles of wavelength division multiplexed (WDM) systems, RF photonic systems and passive optical networks (PONs).
2.Students are able to understand the characteristics and limitations ofsystem components like laser diodes, external modulators, optical fibre, and optical amplifiers.
3.By the end of this course students will be able to analyze the performanceof both analog and digital optical fibre systems and calculate the system bandwidth, noise, probability of error and maximum usable bit rate of a digital fibre system.</td></tr>
<tr><td colspan="7">Course Contents:
Optical Fibre: Basic concepts of optical communication. The nature of light. Light as an Electromagnetic Wave, Polarisation, Interference. Transmitting light on a Fibre Refractive index, Fibre refractive index profiles, Modes of propagation. Light Propagation in Multimode Fibre, Snell's Law Critical Angle, Numerical aperture.
Optical Sources: Light Emitting Diodes (LEDS), The Semiconductor Junction Diode, Construction and Operation of LED's , Heterojunctions (Practical LED's) , Characteristics of LED'S, Lasers, Principle of the LASER, Semiconductor Laser Diodes
Optical Detectors: Photoconductors, Photodiodes, P-N Diodes, P-I-N Diodes, Schottky-Barrier Photodiodes, Avalanche Photodiodes (APDS), Hetero-interface photodetectors, Travelling wave photodetectors , Phototransistors
Optical Communication Systems: Point-to-point Transmission Systems, Modulation techniques, On-off key, Multi state coding, Forward Error correction, Receiving the signal, Timing recovery, Bandwidth Occupancy</td></tr>
<tr><td colspan="7">Text:
1.“Optical Fibre Communication Practice and Principles”, Senior
2.“Optical Communication”, Keiser</td></tr>
<tr><td colspan="7">Reference:
1.“Fibre Optic Communication”, D. C. Agrawal</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
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<table>
<tr><td>Course Code:</td><td>ECL 437</td><td>Course Title:</td><td colspan="4">Patents, Copyrights, and the Law of Intellectual Property</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Get aware of intricacies of Patents, Copyrights, and the Laws of Intellectual Property
2. Get aware of patent filing procedure and legal fundamentals</td></tr>
<tr><td colspan="7">Course Contents:

Historical and philosophical background of patents and other intellectual property. The U.S. and Indian Patent System: the Constitution, Congress, Patent Office (PTO), and courts Analyzing and understanding judicial opinions Legal fundamentals of patent protection for useful inventions. Design and plant patents Legal fundamentals of copyright protection. Similarity and access, Expression vs. ideas and information, merger. Fair use of copyrighted works (e.g., for classroom use), Contributory copyright infringement, Critical differences between patent and copyright protection. Copyright infringement distinguished from plagiarism. Legal fundamentals of trade-secret protection. Legal fundamentals of trademark protection. The legal requirement of novelty. First to invent vs. first inventor to file
The legal requirement of non-obviousness. Statutory subject matter and judicial exceptions: Patentability of algorithms, software, and business methods
Statutory subject matter and judicial exceptions: Patentability of medical treatments and human genes. Anatomy of a patent application Adequate disclosure The art of drafting patent claims. Patent searching: Purposes and techniques, On-line tools. Interpretation of claims. Doctrine of equivalents: Product testing as a possibly infringing use. Doctrine of exhaustion. Legal and equitable remedies for infringement
Anatomy of patent litigation.
Rights and obligations among co-inventors, co-authors, employers, and licensees</td></tr>
<tr><td colspan="7">Text:
1. Rines, Robert H. 1964. Create or Perish: The Case for Inventions and Patents (PDF - 1.0MB). Acropolis.</td></tr>
<tr><td colspan="7">Reference:
1. "Introduction to the Patent System," FJC #4342-V/02, Oct. 2002.
2. Bagley, and Dauchy. Chapter 14 in The Entrepreneur's Guide to Business Law. Cengage Learning, 2011, pp. 529–42. ISBN: 9780538466462.</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
</table>

<table>
<tr><td>Course Code:</td><td>ECL 438</td><td>Course Title:</td><td colspan="4">Introduction to Parallel Computing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Nil</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">Course Contents:
Introduction, Parallel Programming Paradigms, Parallel Architecture, Open MP Open MP&PRAM Model of Computation, PRAM, Models of Parallel Computation, Complexity Memory Consistency & Performance Issues, Parallel Program Design, Shared Memory & Message Passing, MPI, Algorithmic Techniques, CUDA, Algorithms,Merging & Sorting, Lower Bounds Lock Free Synchronization,Load Stealing, Lock Free Synchronization,Graph Algorithms</td></tr>
<tr><td colspan="7">Text:
1. Parallel Programming in C with MPI and OpenMP by M J Quinn
2. Introduction to Parallel Computing by Ananth Grama, George Karypis,Vipin Kumar, and Anshul Gupta.
3. Programming Massively Parallel Processors by D.Kirk and W. Hwu</td></tr>
<tr><td colspan="7">Reference:
1. "Using OpenMP" by B. Chapman, G. Jost, A.R.van der Pas, The MIT Press
2. "Introduction to Parallel Algorithms and Architectures" by F.T. Leighton, Morgan Kaufmann</td></tr>
<tr><td colspan="7">List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)</td></tr>
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<table>
<tr><td>Course Code:</td><td>ECL 439</td><td>Course Title:</td><td colspan="4">Biomedical Signal Processing</td></tr>
<tr><td rowspan="2">Category:</td><td rowspan="2">Core</td><td rowspan="2">Credit Assigned</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-Requisite (if Any)</td><td>Signals and Systems</td><td>Type of Course</td><td colspan="4">Core Engineering</td></tr>
<tr><td colspan="7">Course Outcomes:
1. Presents the fundamentals of digital signal processing with particular emphasis on problems in biomedical research and clinical medicine.
2. Covers principles and algorithms for processing both deterministic and random signals.</td></tr>
<tr><td colspan="7">Course Contents:
Biomedical Signals and Images:
ECG: Cardiac electrophysiology, relation of electrocardiogram (ECG) components to cardiac events, clinical applications. Guest lecture. Speech Signals: The source-filter model of speech production, spectrographic analysis of speech. Speech Coding: Analysis-synthesis systems, channel vocoders, linear prediction of speech, linear prediction vocoders. Imaging Modalities: Survey of major modalities for medical imaging: ultrasound, X-ray, CT, MRI, PET, and SPECT. MRI: Physics and signal processing for magnetic resonance imaging. Surgical Applications: A survey of surgical applications of medical image processing.

Fundamentals of Deterministic Signal and Image Processing:
Data Acquisition: Sampling in time, aliasing, interpolation, and quantization.
Digital Filtering: Difference equations, FIR and IIR filters, basic properties of discrete-time systems, convolution. DTFT: The discrete-time Fourier transform and its properties. FIR filter design using windows. DFT: The discrete Fourier transform and its properties, the fast Fourier transform (FFT), the overlap-save algorithm, digital filtering of continuous-time signals. Sampling Revisited: Sampling and aliasing in time and frequency, spectral analysis. Image processing I: Extension of filtering and Fourier methods to 2-D signals and systems. Image processing II: Interpolation, noise reduction methods, edge detection, homomorphic filtering.

Probability and Random Signals:
PDFs: Introduction to random variables and probability density functions (PDFs). Classification: Bayes' rule, detection, statistical classification. Estimating PDFs: Practical techniques for estimating PDFs from real data. Random signals I: Time averages, ensemble averages, autocorrelation functions, crosscorrelation functions. Random signals II: Random signals and linear systems, power spectra, cross spectra, Wiener filters. Blind source separation: Use of principal component analysis (PCA) and independent component analysis (ICA) for filtering.

Image Segmentation and Registration:
Image Segmentation: statistical classification, morphological operators, connected</td></tr>
</table>

components. Image Registration I: Rigid and non-rigid transformations, objective functions. Image Registration II: Joint entropy, optimization methods.
Text: 1. Bruce, "Biomedical Signal Processing and Signal Modelling", Wiley, 2006 2. Kayvan Najarian, Robert Splinter, "Biomedical Signal and Image Processing" 2e, CRC Press, 2012
Reference: 1. Reddy, Biomedical Signal Processing: Principles and Techniques, TMH, 2006
List of Lab Assignments / Experiments OR List of Tools on which the lab assignment should be based (If Any)

List of Elective Courses

Course Name	Type	L	T	P	Credits
Soft Computing	DE	3	0	2	4
Artificial Intelligence	DE	3	0	2	4
Machine Learning	DE	3	0	2	4
Pattern Recognition	DE	3	0	2	4
Distributed Systems	DE	3	0	2	4
Real Time Systems	DE	3	0	2	4
Mobile Computing	DE	3	0	0	3
Wireless Networks	DE	3	0	0	3
Cloud Computing	DE	3	0	0	3
Software Architecture	DE	3	0	0	3
Software Project Management	DE	3	0	0	3
Software testing and Evaluation	DE	3	0	0	3
Digital Image Processing	DE	3	0	0	3
Signals and Systems	DE	3	0	0	3
Digital Signal Processing	DE	3	0	0	3
Advanced Computer Architecture	DE	3	0	0	3
Embedded System	DE	3	0	2	4
Computer Graphics	DE	3	0	0	3
Human Computer Interaction	DE	3	0	0	3
Natural Language Processing	DE	3	0	0	3
Randomized Algorithms	DE	3	0	2	4
Parallel Algorithms	DE	3	0	2	4
Data Mining and Warehousing	DE	3	0	2	4
Bioinformatics	DE	3	0	2	4
Information Retrieval	DE	3	0	2	4
Business Intelligence	DE	3	0	2	4
Advance Compilers	DE	3	0	0	3
Paradigms Programming Languages	DE	3	0	2	4
Operation Research	DE	3	1	0	4
Introduction to GIS	DE	3	0	0	3
Introduction to Remote Sensing	DE	3	0	0	3

Big Data and Analytics	**DE**	**3**	**0**	**2**	**4**