NOIDA INTERNATIONAL UNIVERSITY

EVALUATION SCHEME & SYLLABUS

For

UNDERGRADUATE DEGREE COURSE

IN

ELECTRONICS & COMMUNICATION ENGINEERING

(Effective from the Session: 2020-21)

B. Tech in Electronics and Communication Engineering

Program Educational Objectives (PEOs)

The Department of Electronics and Communication Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of E&C Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Program outcomes (POs)

Engineering Graduates will be able to:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B.Tech. ECE program, graduates will be able to:
PSO1.
To identify the engineering problems and develop solutions in the area of communication, signal processing, VLSI and embedded systems.
PSO2.
To demonstrate proficiency in utilization of software and hardware tools along with analytical skills to arrive at appropriate solutions
PSO3.
Incorporate the socio-responsible electronics and communication engineer with leadership, teamwork skills and exhibit a commitment to the lifelong learning.

Credit Distribution

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 1 Hours Practical(Lab)/week	0.5 credits 1 credit

Range of credits:

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honors, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

Course code and definition

Course code	Definitions
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
MC	Mandatory Course
OE	Open Elective
EC	Program Core
ECEL	Program Elective

Structure of Undergraduate Engineering program:

S.no	Category	Credits
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	26
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	20
4	Professional core courses	51
5	Professional Elective courses relevant to chosen specialization/branch	21
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	14
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	Non-credit
Total		**156**

FIRST SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC103	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC102	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC101	English	2	0	0	20	20	40	60	100	2
4	ESC103	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5		Induction Program									0
1	BSC102P	Chemistry-1 Lab	0	0	3	-	-	40	60	100	1.5
2	ESC103P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	HSMC101P	English Lab	0	0	2	20	20	40	60	100	1
4	ESC102P	Engineering Graphics & Design Lab	1	0	4	-	-	40	60	100	3
Total											**20.5**

SECOND SEMESTER											
S.No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**End Exams**	**Subject Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
1	BSC101	Physics	3	1	0	20	20	40	60	100	4
2	BSC104	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
4	AECC01	Environmental Studies (MC)	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC101P	Basic Electrical Engineering Lab	0	0	2	20	20	40	60	100	1
3	ESC104P	Workshop Practices / Manufacturing Processes Lab	1	0	4	20	20	40	60	100	3
Total											**17.5**

THIRD SEMESTER											
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credit**
						Sessional Exam			**End Exams**	**Sub total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
1	EC01	Electronic Devices	3	0	0	20	20	40	60	100	3
2	EC03	Digital System Design	3	0	0	20	20	40	60	100	3
3	EC05	Signals & Systems	3	0	0	20	20	40	60	100	3
4	EC06	Network Theory	3	0	0	20	20	40	60	100	3
5	BSC201	Mathematics -III	3	1	0	20	20	40	60	100	4
6	ESC201	Engineering Mechanics	3	1	0	20	20	40	60	100	4
7	HSMC201	Human Psychology	3	0	0	20	20	40	60	100	3
8		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC02	Electronic Devices Lab	0	0	2	20	20	40	60	100	1
2	EC04	Digital System Design Lab	0	0	2	20	20	40	60	100	1
Total											**25**

FORTH SEMESTER											
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**ESE**	**Sub Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
THEORY											
1	EC07	Analog and Digital Communication	3	0	0	20	20	40	60	100	3
2	EC09	Analog Electronics	3	0	0	20	20	40	60	100	3
3	EC11	Microcontrollers	3	0	0	20	20	40	60	100	3
4	BSC202	Biology-I	3	0	0	20	20	40	60	100	3
5	HSMC202	Human values	3	0	0	20	20	40	60	100	3
6	MC02	Python	3	0	2	20	20	40	60	100	0
7		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC08	Analog and Digital Communication Lab	0	0	2	0	0	40	60	100	1
2	EC10	Analog Electronics lab	0	0	2	0	0	40	60	100	1
3	EC12	Microcontrollers Lab	0	0	2	0	0	40	60	100	1
Total											**18**

FIFTH SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
THEORY											
1	EC13	Electronic Measurements and Instruments	3	0	0	20	20	40	60	100	3
2	EC15	Computer Architecture	3	0	0	20	20	40	60	100	3
3	EC16	Probability Theory and Stochastic Processes	3	0	0	20	20	40	60	100	3
4	EC17	Digital Signal Processing	3	0	0	20	20	40	60	100	3
5	ECEL*	Program Elective – 1	3	0	0	20	20	40	60	100	3
6	HSMC 501	Management-I (Organizational Behavior)	3	0	0	20	20	40	60	100	3
7		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC14	Electronic Measurements & Instrument s Lab	0	0	2	0	0	40	60	100	1
2	EC18	Digital Signal Processing Lab	0	0	2	0	0	40	60	100	1
Total											**20**

SIXTH SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
THEORY											
1	EC19	Control Systems	3	0	0	20	20	40	60	100	3
2	EC20	Computer Network	3	0	0	20	20	40	60	100	3
3	ECEL*	Program Elective – 2	3	0	0	20	20	40	60	100	3
4	ECEL*	Program Elective – 3	3	0	0	20	20	40	60	100	3
5		Open Elective-1	3	0	0	20	20	40	60	100	3
6	MC02	Constitution of India	3	0	0	20	20	40	60	100	0
7		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC21	Computer Networks Lab	0	0	4	-	-	40	60	100	2
2	EC22	Control Systems Lab	0	0	2	-	-	40	60	100	1
2	EC23	Mini Project/Electronic Design workshop	0	0	4	-	-	40	60	100	2
Total											**20**

SEVENTH SEMESTER											
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**End Exams**	**Subject Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
1	ECEL*	Program Elective – 4	3	0	0	20	20	40	60	100	3
2	ECEL*	Program Elective – 5	3	0	0	20	20	40	60	100	3
3	ECEL*	Program Elective – 6	3	0	0	20	20	40	60	100	3
4		Open Elective-2	3	0	0	20	20	40	60	100	3
5		Online Course, NPTEL for Honors degree									
PRACTICALS											
1	ECP1	Project Stage-I	0	0	10	-	-	40	60	100	5
Total											**17**

EIGTHTH SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	ECEL*	Program Elective –7	3	0	0	20	20	40	60	100	3
2		Open Elective-3	3	0	0	20	20	40	60	100	3
3		Open Elective-4	3	0	0	20	20	40	60	100	3
4		Online Course, NPTEL for Honors degree NPTEL									
PROJECT											
1	ECP2	Project Stage-II	0	0	18			200	400	600	9
Total											**18**

Total Credits ---- 156

Program Elective Courses:

S.N	Course Code	Course Title	Preferred Semester
1	ECEL1	Bio-Medical Electronics	V
2	ECEL2	CMOS Design	V
3	ECEL3	Information Theory and Coding	V
4	ECEL4	Introduction to MEMS	VI
5	ECEL5	Electro Magnetic Waves	VI
6	ECEL6	Speech and Audio Processing	VI
7	ECEL7	Power Electronics	VI
8	ECEL8	Nano electronics	VI
9	ECEL9	Scientific computing	VI
10	ECEL10	Adaptive Signal Processing	VII
11	ECEL11	Antennas and Propagation	VII
12	ECEL12	Digital Image & Video Processing	VII
13	ECEL13	Mobile Communication and Networks	VII
14	ECEL14	Mixed Signal Design	VII
15	ECEL15	Microwave Theory and Techniques	VII
16	ECEL16	Fiber Optic Communications	VII
17	ECEL 17	RADAR and Satellite Communication	VII
18	ECEL18	High Speed Electronics	VII
19	ECEL19	Wavelets	VII
20	ECEL20	Wireless Sensor Networks	VIII
21	ECEL21	Embedded systems	VIII
22	ECEL22	Error correcting codes	VIII

OPEN ELECTIVES

1. Non-Conventional Energy Resources(7^{th})
2. Quality Management (6^{th})
3. Operations Research
4. Introduction to Biotechnology
5. Nonlinear Dynamic Systems
6. Product Development
7. Automation & Robotics
8. Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)
9. Nano Sciences
10. Laser Systems and Applications
11. Space Sciences
12. Polymer Science & Technology
13. Nuclear Science
14. Material Science
15. Finance & Accounting
16. Human Resource Development (7^{th})
17. Cyber Law & Ethics (8^{th})
18. Introduction to Philosophical Thoughts
19. Comparative Study of Literature
20. Indian Music System
21. History of Science & Engineering
22. Introduction to Art and Aesthetics
23. Economic Policies in India
24. Entrepreneurship Development(8^{th})

DETAILED CURRICULUM CONTENTS

Undergraduate Degree

In

Engineering & Technology

BRANCH: Electronics & Communication Engineering

SEMESTER -3

Course Code: EC01 **Course Name: Electronic Devices**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand basic semiconductor properties and hence improvement in future design consideration.
- To analyze different types of current in semiconductor.
- To understand characteristics of Transistor and MOS and other devices.
- To have an understanding of Integrated circuit fabrication process.

Course Description:

This course explores the theory and principles of electronic devices. Special attention is devoted to topics Semiconductor Physics, Generation and recombination, Bipolar Junction Transistor, MOS transistor, Integrated circuit fabrication process.

Course Contents:

UNIT 1

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

UNIT 2

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

UNIT 3

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

UNIT 4

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the principles of semiconductor Physics
- Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

Text books:

- G. Streetman, and S. K. Banerjee, ―Solid State Electronic Devices,‖ 7th edition, Pearson,2014.
- D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.

Reference books:

- S. M. Sze and K. N. Kwok, ―Physics of Semiconductor Devices,‖ 3rd edition, John Wiley &Sons, 2006.
- C.T. Sah, ―Fundamentals of solid state electronics,‖ World Scientific Publishing Co. Inc, 1991.
- Y. Tsividis and M. Colin, ―Operation and Modeling of the MOS Transistor,‖ Oxford Univ.Press, 2011.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/103/117103063/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC03 **Course Name:** Digital System Design

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems.

Course Description:

This course emphasizes on the fundamental of digital electronics. The student is first taught about the number system and logic gates before introducing them to digital IC technology. Then they are exposed to both combinational logic network and combinational MSI logic. In concurrence with this, the fundamental of sequential logic, flip-flop, counter and shift register will be taught. The memory devices are introduced. Finally the use of HDL is briefed.

Course Contents:

Unit 1

Logic Simplification: Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Unit 2

Combinational Logic Design: MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Unit 3

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Unit 4

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Unit 5

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.

- Use HDL & appropriate EDA tools for digital logic design and simulation
- Be able to use PLDs to implement the given logical problem.

Text books:

- Moris Mano, ‒Digital Logic and Computer Design‖, PHI Publications, 2002
- R. P. Jain, ―Modern Digital Electronics‖, TMH, 3rd Edition, 2003.

Reference books:

- Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
- R.L. Tokheim, ‒Digital Electronics, Principles and Applications‖, Tata McGraw Hill, 1999.
- W. Gothman, ‒Digital electronics‖, PHI.
- S. Salivahanan & S. Arivyhgan. ‒Digital circuits and design‖, Vikas Publication, 2001
- Malvino Leach, "Digital Principles and Application", TMH, 1999.
- V. Rajaraman : Computer Fundamentals (PHI)

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC05 **Course Name: Signals and System**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Description:

This course covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). Applications are drawn broadly from engineering and physics, including feedback and control, communications, and signal processing.

Course Content:-

Unit 1

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Unit 2

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response,

Unit 3

Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases,

Unit 4

The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

Unit 5

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

Unit 6

State-space analysis and multi- input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals.

Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Course Learning Outcomes(CLO):-

At the end of this course students will demonstrate the ability to

- CO1: Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
- CO2: Analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
- CO3: Classify systems based on their properties and determine the response of LSI system using convolution.
- CO4: Analyze system properties based on impulse response and Fourier analysis.
- CO5: Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
- CO6: Understand the process of sampling and the effects of under sampling.

Text books:

- A.Anand Kumar, "Signals and Systems", Second edition, PHI Learning Private Limited,2012.
- A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

Reference books:

- R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
- B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
- Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
- Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
- Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
- M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
- J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC06 **Course Name:** Network Theory
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.
- To analyze circuits in time and frequency domain.
- To explain concepts of driving point and transfer functions, poles and zeroes of network functions and their stability.

Course Description:

The course begins with description of circuit elements & sources. Understanding of various interesting network theorems applied to solve linear, time invariant network problems efficiently in time and s-domain is discussed. Steady and transient solution of network problems with various sources including impulse source, representing a circuit in s-domain (Laplace domain).

Course Contents:

UNIT 1

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits. Trigonometric and exponential

UNIT 2

Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

UNIT 3

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

UNIT 4

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits,

UNIT 5

Introduction to band pass, low pass, high pass and band reject filters.

Course Learning Outcomes (CLOs):

- At the Understand basics electrical circuits with nodal and mesh analysis.
- Appreciate electrical network theorems.
- Apply Laplace Transform for steady state and transient analysis.
- Determine different network functions.

Text books:

- Van, Valkenburg.; ―Network analysis‖ ; Prentice hall of India, 2000
- Sudhakar, A., Shyammohan, S. P.―Circuits and Network‖; Tata McGraw-Hill New Delhi, 1994

Reference books:

- A William Hayt, –Engineering Circuit Analysis‖ 8th Edition, McGraw-Hill Education

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105159/#

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BSC201 **Course Name:** Mathematics-III

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The main objective of this course is to provide students with the probabilistic and statistical analysis mostly used in varied applications in engineering and sciences and it provide the methods of organising and simplifying data so that their significance is comprehensible.

Course Description:

This course provides an introduction to probability and statistics with applications. Topics include: random variables, continuous and bivariate probability distributions, Bayesian inference, hypothesis testing, confidence intervals, curve fitting and regression.

Course Contents:

Unit 1: Basic Probability (12 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions (4 hours)

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions (4 hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 4: Basic Statistics (8 hours)

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics (8 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small samples (4 hours)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Course Learning Outcomes (CLOs):

- CLO-1: Recognize basic probability theory and its application.
- CLO-2: calculate Continuous Probability Distributions and their properties.
- CLO-3: Calculate bivariate distributions and their properties with applications.
- CLO-4: Basic concept of Statistics, Probability distribution and correlation.
- CLO-5: Fitting the data and large sample testing.
- CLO-6: Testing the hypothesis for Small samples

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
- S. Ross, ―A First Course in Probability‖, Pearson Education India,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- W. Feller, ―An Introduction to Probability Theory and its Applications‖, Wiley,

Online links for study & reference materials:

https://nptel.ac.in/courses/111/105/111105041/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC201 **Course Name:** Engineering Mechanics
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies
- To learn the effect of friction on equilibrium.
- To learn kinematics, kinetics of particle and rigid body, related principles.
- To implement the above know how to solve practical problems.

Course Description:

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses you have taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving.

Course Contents:

Unit 1

Force Vectors: Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton‘s laws and its completeness in describing particle motion; Form invariance of Newton‘s Second Law; Solving Newton‘s equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

Unit 2

Force System Resultant: Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application.

Unit 3

Oscillation and Resonance: Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Unit 4

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler‘s laws of motion, their independence from Newton‘s laws, and their necessity in describing rigid body motion; Examples.

Unit 5

Moment of Inertia: Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Analyze and solve the practical problems of statics and dynamics.
- Take up the subjects like TOM, SOM, Design of machine elements, DOS, TOS etc.

Text books:

- Hibbeler, R.C., "Engineering Mechanics: statics", 12th edition, and Prentice Hall
- Beer, F.P. and Johnston, E.R. (2007) –Vector Mechanics for Engineers (Statics)‖, McGraw-Hill.

Reference books:

- MK Harbola –Engineering Mechanics‖, 2nd ed.
- MK Verma –Introduction to Mechanics‖
- D Kleppner & R Kolenkow An Introduction to Mechanics, 2001
- JL Synge & BA Griffiths —Principles of Mechanics‖ TMH, 1999.
- JL Meriam —Engineering Mechanics – Dynamics‖, 7th ed.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **HSMC 201/301** **Course Name:** Human Psychology

Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- The student will acquire knowledge of human psychology including workplace environment, Motivation and perception.

Course Description:

- This course introduces the fundamental of human psychology includes important insights about motivation, leadership, perception and work environment.

Course Contents:

Unit 1: Introduction to Psychology (8 lectures)

Definitions & Scope. Types and branches of psychology Major influence on Psychology- Scientific Management and Human relations -Hawthorne Experiments. Taylor Principles, Implications of Psychology on Modern Industries and behavior

Unit 2: Individual at workplace (8 lectures)

Attention and Perception, Individual at Workplace-Attitude, Motivation and Job satisfaction. Stress management. Leadership and Group dynamics.

Unit 3: Work Environment & Engineering Psychology- (7 lectures)

Engineering psychology: fatigue, Monotony, Boredom. Accidents and Safety. Emotional and social development, Cognitive development. Consumer behavior analysis.

Unit 4: Job Analysis (7 lectures)

Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests. Performance Management: Training & Development, Appraisals.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human psychology.
CLO-2: Inculcate leadership and motivational skills.
CLO-3: To understand consumer behavior and emotional development.
CLO-4: To understand about job recruitment process and interviews methods.

Text books:

(i) Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.

(ii) Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.

Reference books:

(i) Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.

(ii) Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Electronic Devices Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC02**

Credits:1

1. To plot the V-I characteristics of junction tunnel & Schotky diode.
2. To plot the characteristics of P-N junction diode
3. To plot the C-V characteristics of P-N junction diode
4. To plot the halfwave & fullwave rectifier.
5. To plot the V-I Characteristics of zener diode.
6. To Study of zener diode as a voltage regulator.
7. To plot the input output characteristics of BJT in CB, CC, CE configuration.
8. To plot the input output characteristics of FET in CS Configuration.
9. To plot the optical (V-I) Characteristics of Photodiode.
10. To study the depletion mode & Enhancement mode MOSFET.

Digital System Design Lab

Teaching Scheme:- 0L: 0T: 2P **Paper Code: EC04**
Credits:1

1. Verification of NAND, NOR, Ex-OR,AND & OR Gates.
2. Implementation of half Adder & Full Adder
3. Implementation of half Subtractor & Full Subtractor.
4. Implementation of Demultiplexer / Decoder operation using IC-74138.
5. Implementation of Seven segment display.
6. Implementation of Binary to gray converter.
7. Implementation of Arithmetic algorithms.
8. Implementation of various flip-flops.
9. Implementation of Counters.
10. Implementation of shift register.
11. Verification of Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.

SEMESTER -4

Course Code:EC07 **Course Name:** Analog and Digital Communication
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand basic elements of a communication system
- To conduct analysis of baseband signals in time domain and in frequency domain
- To demonstrate understanding of various analog and digital modulation and demodulation techniques techniques.
- To analyse the performance of modulation and demodulation techniques in various transmission environments

Course Description:

This course provides a thorough introduction to the basic principles and techniques used in analog and digital communications. The course will introduce analog and digital modulation techniques, communication receiver and transmitter design, baseband and bandpass communication techniques, line coding techniques, noise analysis, and multiplexing techniques. The course also introduces analytical techniques to evaluate the performance of communication systems.

Course Contents:

Unit 1

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit 2

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Unit 3

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit 4

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion, Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit 5

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels-Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Analyze and compare different analog modulation schemes for their efficiency and bandwidth
- Analyze the behavior of a communication system in presence of noise
- Investigate pulsed modulation system and analyze their system performance
- Analyze different digital modulation schemes and can compute the bit error performance

Text books:

- Haykin S., "Communications Systems", John Wiley and Sons, 2001.
- Proakis J. G. and Salehi M.,"Communication Systems Engineering", Pearson Education, 2002.

Reference books:

- Taub H. and Schilling D.L., "Principles of Communication Systems‖, Tata McGraw Hill, 2001.
- Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
- Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
- Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/102/117102059/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code:EC09 **Course Name:** Analog Electronics
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To Understand the characteristics of diodes and transistors
- Design and analyze various rectifier and amplifier circuits
- Design sinusoidal and non-sinusoidal oscillators
- Understand the functioning of OP-AMP and design OP-AMP based circuits
- Design ADC and DAC

Course Description:

This **course** develops a basic understanding of the fundamentals and principles of **analog circuits** and **electronic** devices in electrical and **electronic** engineering. This understanding is a critical step towards being able to design new **electronic circuits** or use them appropriately as part of a larger engineering system.

Course Contents:

Unit 1

Amplifier models: Voltage amplifier, current amplifier, trans- conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Unit 2

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Unit 3

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

Unit 4

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Unit 5

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Know about the multistage amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain.
- Know about different power amplifier circuits, their design and use in electronics and communication circuits.
- Know the concept of feedback amplifier and their characteristics.
- Design the different oscillator circuits for various frequencies

Text books:

- J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV**.**

Reference books:

- J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
- P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
- Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102112/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC11 **Course Name: Microcontrollers**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

The objectives of the course are to make the students,

- Know the internal organization, addressing modes and instruction sets of 8085 & 8086 processor.
- Know the various functional units of 8051 microcontroller.
- Understand assembly language program by using 8051 Instruction sets and addressing modes.
- Know the various peripheral devices such as 8255, 8279, 8251, 8253, 8259, stepper motor etc.
- Know the various advance microcontroller like ARM processor etc.
- Understand microcontroller based system design for various applications.

Course Description:

The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation. Topics include Semiconductor memory devices and systems, microcomputer architecture, assembly language programming, I/O programming, I/O interface design, I/O peripheral devices, data communications, and data acquisition systems. Several laboratory exercises will be based on both microprocessor (Intel 8086), microcontroller (Intel 8051) and ARM (nuvoTon- Nu-LB-LUC140).

Course Content:

Unit 1

Overview of microcomputer systems and their building blocks, 8085 and 8086 microprocessor, instruction sets of microprocessors.

Unit 2

Memory interfacing, concepts of interrupts and Direct Memory Access, Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters.

Unit 3

Arithmetic Coprocessors; System level interfacing design, Concepts of virtual memory, Cache memory,

Unit 4

Advanced coprocessor Architectures- 286, 486, Pentium

Unit 5

Microcontrollers: 8051 systems, Introduction to RISC processors; ARM microcontrollers interface designs.

Course Learning Outcomes:

At the end of this course students will demonstrate the ability to

- CO1:- Describe the functionalities of 8085 architectures and Assembly language programming Describe the functionalities of 8086 architectures and Assembly language programming
- CO2:- Describe the architecture and functional block of 8051 microcontroller.

- CO3:- Program the functional units of 8051 microcontroller for the given specifications using C/Assembly language.
- CO4:- Describe various peripheral devices such as 8255, 8279, 8251, 8253, 8259 and 8237.
- CO5:-Explain various applications using 8051 microcontroller and basic architectures of PIC, ARM and ATMEGA microprocessors and microcontrollers.

Text Books:

- Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing.
- Muhammad Ali Mazidi , Janice Gillispie Mazidi and Rolin D McKinlay, The 8051 microcontroller and embedded systems using assembly and C, second edition Pearson education Asia.
- Mohamed Rafiquzzaman, Microprocessor and Microcomputer based system design, second edition, CRC press

Reference Books:

- Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, third Edition, Penram International Publishers.
- A.K Ray & K.M. Burchandi, Advanced Microprocessor and peripherals Architectures, Programming and interfacing –, second edition, Tata McGraw-Hill .
- Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

Online links for study & reference materials :

https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0

https://www.youtube.com/watch?v=95uGOJ1Ud2c&list=PLJGA4olwzpArvcdWULcRuMn2495g0n8j

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BSC202 **Course Name:** Biology (Biology for Engineers)
Course Credit: 3 **Total Contact Hour:** 33hr

Course Objective:

- To increase the understanding of living systems.
- To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
- To understand the Hierarchy of life forms at phenomenological level.
- To convey that ―Genetics is to biology what Newton‘s laws are to Physical Sciences‖ Mendel‘s laws, Concept of segregation and independent assortment.
- To learn the systems in relationship to the self and other organisms in the natural environment.
- To analyze biological processes at the reductionistic level Proteins- structure and function.
- To know and learn the fundamental principles of energy transactions.

Course Description:

This course explains the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal and population levels of the biological hierarchy.

Course Content:

Unit 1. *(2 hours)- Introduction*

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Unit 2. *(3 hours)- Classification*

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. *E. coli*, *S. cerevisiae*, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.

Unit 3. *(4 hours)-Genetics*

Purpose: To convey that ‒Genetics is to biology what Newton‘s laws are to Physical Sciences‖ Mendel‘s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Unit 4. *(4 hours)-Biomolecules*
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Unit 5. *(4 Hours). Enzymes*
Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Unit 6. *(4 hours)- Information Transfer*
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit 7. *(5 hours). Macromolecular analysis*
Purpose: How to analyses biological processes at the reductionistic level Proteins-structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Unit 8. *(4 hours)- Metabolism*
Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Unit 9. *(3 hours)- Microbiology*
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Course Learning Outcomes (CLOs):

At the end of this course students will learn:

- The major types of molecules that make up living organisms and how these molecules enable life functions.
- The structures found in cells and the functions of those sub-cellular structures.
- The processes by which cells replicate to produce genetically identical, or genetically variable, daughter cells.
- The roles carbohydrates play in biological systems
- The structure and function of proteins
- Nucleic acids and the role they play in DNA and RNA
- Thermodynamics as applied to biological systems
- Identification and classification of microorganisms.

Text Books:

- N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, ―Biology: A global approach‖, Pearson Education Ltd, 2014.
- E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, ―Outlines of Biochemistry‖, John Wiley and Sons, 2009.

Reference Books:

- D. L. Nelson and M. M. Cox, ―Principles of Biochemistry‖, W.H. Freeman and Company, 2012.
- G. S. Stent and R. Calendar, ―Molecular Genetics‖, Freeman and company, 1978.
- L. M. Prescott, J. P. Harley and C. A. Klein, ―Microbiology‖, McGraw Hill Higher Education, 2005.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 202 **Course Name:** Human Values
Course Credit Hour: 3Hr T**otal Contact Hour:** 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Description:

- This course introduces the fundamental of human values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; _Natural Acceptance‘ and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4.Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5.Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

1.Understanding human being as a co-existence of the sentient _I‘ and the material _Body‘.
2.Understanding the needs of Self (_I‘) and _Body‘ - happiness and physical facility.
3.Understanding the Body as an instrument of _I‘ (I being the doer, seer and enjoyer).
4.Understanding the characteristics and activities of _I‘ and harmony in _I‘.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Unit 3: Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

2. Understanding the meaning of Trust; Difference between intention and competence

3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students‘ lives.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. 4.Holistic perception of harmony at all levels of existence.

Unit 5 : Implications of the above Holistic Understanding of Harmony on Professional Ethics

1.Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

- CLO-1: Develop the basic concept of human values
- CLO-2: To understand the importance of self-exploration process
- CLO-3: To understand harmony at individual levels
- CLO-4: To understand harmony at nature level
- CLO-5: Develop professional ethics

Textbooks:

- Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:

- Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1 - 05%

Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MC-02 **Course Name:** Python
Course Credit Hour: 3hr **Total Contact Hour:** 34hr

Course Objective:

- Master the fundamentals of writing Python programs
- Learn basic Python coding elements such as variables, identifiers and flow control structures.
- Discover how to work with lists and sequence data.
- Write Python functions to facilitate code reuse.
- Work with the Python standard library
- Explore Python's object-oriented features

Course Description:

This is an introductory course designed for any student interested in using computation to enhance their problem solving abilities. No prior experience in programming is necessary. Students will use their problem solving abilities to implement programs in Python. This course will develop a basic understanding the Python programming language

Course Contents:

Unit 1

Introduction to Python: - History of python programming language, thrust areas of python, overview of programming in Python, identifiers, variables, Expressions and statements, Operators and Operands, data types, indentation, comments, reading input.

Unit 2

Control flow Statements:-if statement, if-else statement, if-else-elif control flow statement, nested if statement, the while loops, the for loop, Strings: Creating and storing strings, basic string operations, formatting strings and string operations.

Unit 3

Functions: Built in functions, function definition and calling the function, default parameters, Lists: Creating list, basic list operations, build in functions used in list, list methods, Dictionaries: Creating dictionaries, built on functions used in dictionaries, dictionary methods.

Unit 4

Tuples: Creates tuples, basic tuple operations, tuple methods, Sets: set methods, Basics Object –oriented Programming: classes and objects, creating classes and objects in python, classes with multiple objects, class attributes vs. data attributes .

Course Learning Outcomes (CLOs):

At the end of the course students will demonstrate the ability to

- Understand python identifiers, variables, Expressions, statements, Operators, operand and data types.
- Implement Conditionals and Loops for Python Programs.
- Use functions and represent Compound data using Lists, Tuples, Dictionaries and strings.
- Implement basics object –oriented components.

Text books:

- Bill Lubanovic, Introducing Python- Modern Computing in Simple Packages, O_Reilly Publication.
- Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.

Reference books:

- Guido Van Russom, Fred L. Drake, An Introduction to Python, Network Theory Limited.
- Magnus Lie Hetland, Beginning Python: From Novice To Professional, Pearson Education.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106212/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-05%
Assignment -2	- 05%
Assessment -3(Mid Term-exam)	-20%
Assignment -3	- 05%
Assessment-4/ Quiz	- 05%
Total Internal Assessment	**- 40%**

Analog and Digital Communication Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC08**
Credits:1
List of Experiments:
1. To study the sampling and reconstruction of a given signal.
2. To study amplitude modulation and demodulation.
3. To study frequency modulation and demodulation.
4. To study time division multiplexing.
5. To study pulse amplitude modulation and demodulation.
8. To study pulse code modulation & differential pulse code modulation as well as relevant demodulations.
9. To study quadrature phase shift keying & quadrature amplitude modulation.
10. Study of pulse code modulation and demodulation.
11. Study of delta modulation and demodulation and observe effect of slope overload.
12. Study pulse data coding and decoding techniques for various formats.
13. Study of ASK/FSK/PSK modulator and demodulator.
14. Error Correction and detection using Hamming code.

Analog Electronics Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC10**
Credits:1

1. To find the voltage gain of a CE amplifier and to find its frequency response.
2. Design a single stage RC coupled amplifier(BJT and FET).
3. Design a emitter follower circuit using darlington pair.
4. Design a two stage RC coupled amplifier and plot of frequency v/s gain, estimation of Q factor and bandwidth.
5. To design a Class A and Class B amplifier.
6. Design of inverting, non inverting and differential amplifier.
7. Measurement of common mode gain, Differential mode gain, CMRR, Slew Rate.
8. Application of Op-Amp as summing amplifier, Difference Amplifier, Integrator, Differentiator.
9. Oscillator Sinusoidal oscillator (i) Wein bridge (ii) Phase shift (iii) Colpitt's (iv) Hartley.
10. To design and obtain the frequency response of (i) First order low pass Filter,(ii) First order High Pass Filter, Band Pass Filter.
11. To construct a 3-bit R-2-R ladder type D/A converter using op-amp IC 741.

Microcontroller Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC12**
Credits: 1

List of Experiments for microcontroller:

1. Write a program to add starting five natural number, odd number and even number using microcontroller.
2. Write a program to multiply and divide two number using microcontrollers.
3. Write a program to find largest and smallest number using microcontroller.
4. Write a program to interface Stepper motor using 8051 Microcontroller.
5. Write a program to interface a DC Motor using 8051 microcontroller.

List of experiment of 8085/8086 micrporocessor.

1. Using 8085/86 Write two different programs for 16 bit addition, one using instruction DAD and another without using instruction DAD.
2. Using 8085/86 Write assembly language program for 8 bit multiplication and division.
3. Using 8085/86 write an ALP to sum two largest number & smallest number.
4. Using 8085/86 write an ALP to count negative numbers from a given list of 10 numbers.
5. Using 8085/86 write an ALP to add odd & even number & Square of a given no.
6. To obtain interfacing of keyboard controller.
7. To obtain interfacing of DMA controller.
8. To perform microprocessor based traffic light control.

SEMESTER -5

Course Code: EC13 **Course Name:** Electronic Measurement & Instruments
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To understand operation of different instruments.
- To describe different terminology related to measurements.
- To understand the principles of various types of transducers and sensors.

Course Description:

Electronic measuring instruments are widely used for measuring the electrical charge quantity and amount of flow of electricity through different electronic appliances The course deals with topics such as Principle of measurements, Errors, Accuracy, Units of measurements and electrical standards, , introduction to the design of electronic equipment‘s for temperature, pressure, level, flow measurement, speed etc.

Course Contents:

Unit 1

Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, other unit systems, dimension and standards. Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohmmeter.

Unit 2

Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multimeters, digital frequency meter system.

Unit 3

Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter.

Unit 4 CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications.

Unit 5

Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters.

Course Learning Outcomes (CLOs):

- Employ appropriate instruments to measure given sets of parameters.
- Practice the construction of testing and measuring set up for electronic systems.
- To have a deep understanding about instrumentation concepts this can be applied to Control systems.

Text books:

- David A. Bel, ―Electronic Instrumentation and Measurements‖, 2nd Ed., PHI, New Delhi 2008.
- Oliver and Cage, ―Electronic Measurements and Instrumentation‖, TMH, 2009.

Reference books:

- Alan S. Moris, ‒Measurement and Instrumentation Principles‖, Elsevier (Buterworth Heinman), 2008.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105153/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC15 **Course Name: Computer Architecture**
Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on microprogramming
- Concepts of advanced pipelining techniques.

Course Description:

- This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems.
- Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors.

Course Contents:

Module 1: Introduction to computer organization (6 hours)
Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

Module 2: Memory organization (6 hours)
System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Module 3: Input – output Organization (8 hours)
Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Module 4: 16 and 32 microprocessors (8 hours)
80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Module 5: Pipelining(8 hours)
Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Module 6: Different Architectures (8 hours)
VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Course learning outcomes:
Understand the concepts of microprocessors, their principles and practices.

- Write efficient programs in assembly language of the 8086 family of microprocessors.

- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor.

Text Books:

- ―Computer Architecture and Organization‖, 3rd Edition by John P. Hayes, WCB/McGraw-Hill

Reference Books:

- ―Computer Organization and Architecture: Designing for Performance‖, 10th Edition by William Stallings, Pearson Education.
- ―Computer System Design and Architecture‖, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Online links for study & reference materials:

NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC16 **Course Name: Probability Theory and Stochastic Processes**
Course Credit Hour: 3hr **Total Contact Hour:** 30hrs

Course Objective:

The main objective of this course is to provide students uunderstand representation of random signals and application in different areas, analysis characteristics of any random processes, make use of theorems related to random signals and understand propagation of random signals in LTI systems.

Course Description:

This course provides an introduction to Probability and Stochastic Processes with applications. Topics include: basic probability, conditional probability, random variables, probability distributions, Markov, Chebyshev and Chernoff bounds , Random sequences and modes of convergence, Transmission of random process.

Course Contents:

Unit-1

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Unit 2

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions.

Unit-3

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

Unit-4

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. Random process, Stationary processes, Mean and covariance functions. Ergodicity, Transmission of random process through LTI. Power spectral density.

Course Learning Outcomes (CLOs):

- CLO-1: Understand representation of random signals.
- CLO-2: Investigate characteristics of random processes
- CLO-3: Make use of theorems related to random signals
- CLO-4: To understand propagation of random signals in LTI systems.

Text books:

- H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education.
- Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes, McGraw Hill.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,

- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.

Reference books:

- K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
- W. Feller, –An Introduction to Probability Theory and its Applications‖, Wiley.

Online links for study & reference materials:

https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ma19/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: EC17 **Course Name: Digital Signal Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To develop a thorough understanding of the central elements of discrete time signal processing theory and the ability to apply this theory to real-world signal processing applications.
- Use z-transforms and discrete time Fourier transforms to analyze a digital system.
- Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
- Design and understand finite & infinite impulse response filters for various applications.

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.

Course Contents:

Unit 1

Discrete time signals: Sequences; representation of signals on orthogonal basis; Samplingand reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequencyAnalysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit 2

Designof FIR Digital filters: Windowmethod,Park-McClellan's method.Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Lowpass, Bandpass, Bandstop and High pass filters.

Unit 3

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit 4

Introduction to multirate signalprocessing, Application of DSP.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications

Text books:

- S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV**.**

Reference books:

- A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.

- John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
- L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105055/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : ECEL1 **Course Name: Bio-Medical Electronics**
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective :

To study the working of different medical equipments

Course Description :

Bio medical electronics (**BME**) is the application of engineering principles and design concepts to medicine and biology for healthcare purposes (e.g. diagnostic or therapeutic). This field seeks to close the gap between engineering and medicine, combining the design and problem solving skills of engineering with medical and biological sciences to advance health care treatment, including diagnosis, monitoring, and therapy.

Course Contents :

Unit 1

Introduction to the physiology of cardiac, nervous & muscular and respiratory systems. Transducers and Electrodes: Different types of transducers & their selection for biomedical applications. Electrode theory, selection criteria of electrodes & different types of electrodes such as, Ag – Ag Cl, pH, etc.

Unit 2

Cardiovascular measurement: The heart & the other cardiovascular systems. Measurement of Blood pressure-direct and indirect method, Cardiac output and cardiac rate. Electrocardiography-waveform-standard lead systems typical ECG amplifier, phonocardiography, Ballisto cardiography, Cardiac pacemaker –defibrillator –different types and its selection.

Unit 3

EEG Instrumentation requirements –EEG electrode –frequency bands – recording systems EMG basic principle-block diagram of a recorder –pre amplifier. Bed side monitor –block diagram- measuring parameters-cardiac tachometer-Alarms-Lead fault indicator-central monitoring. Telemetry – modulation systems – choice of carrier frequency – single channel telemetry systems.

Unit 4

Instrumentation for clinical laboratory: Bio electric amplifiers-instrumentation amplifiers isolation amplifiers-chopper stabilized amplifiers –input guarding – Measurement of pH value of Blood-blood cell counting, blood flow, Respiratory transducers and instruments.

Mode of Evaluation: The theory and lab performance of students are evaluated separately.

Course Learning Outcomes (CLOs) :

On completion of this course, the students will be able to

- Introduce the student to the electronic devices and theory of operation in the medical area.
- Data Interpretation: Learn to design, test, and analyze electronic circuits using oscilloscopes and other electronic test equipment. Apply knowledge of engineering and science to interpret data. Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.

- Electronic circuits for Biomedical Applications: Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits. Understand how to apply, measure circuit performance, and solve problems in the areas of biomedical signals.
- Work in Multi-disciplinary teams: Learn to work and communicate effectively with peers on multi-disciplinary teams to attain a common goal.

Text Books

- J J Carr, –Introduction to Biomedical Equipment Technology‖ : Pearson Education 4th e/d.

Reference Books

- K S Kandpur, –Hand book of Biomedical instrumentation‖, Tata McGraw Hill 2nd e/d.
- John G Webster, –Medical Instrumentation application and design‖, John Wiley 3rd e/d.
- Richard Aston, –Principle of Biomedical Instrumentation and Measurement

Online links for study & reference materials :

https://www.slideshare.net/CHINTTANPUBLICATIONS/biomedical-electronics-by-j-f-khan-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL2 **Course Name: CMOS Design**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

The objectives of the course is to enable students to:

- Impart knowledge of MOS transistor theory and CMOS technologies.
- Impart knowledge on architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology.
- Cultivate the concepts of subsystem design processes.

Course Description :

This is an introductory course which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation

Course Contents :

Unit 1

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

Unit 2

MOS Theory Analysis: Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships,MOS Transistor Threshold Voltage Vth, Gradual channel approximation, MOS Capacitance, Short Channel and Narrow Channel Width Effects, Scaling of CMOS Circuits.

Unit 3

Inverter characteristics:- NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

Unit 4

Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.

Unit 5

CMOS Circuits and Logic Design Rules:, MOS Layers, Stick Diagrams, Design Rules and Layout, 2µm, 1.2 µm Design Rules, Rules for Vias and Contacts, Stick Diagrams and Simple Symbolic Encodings for NMOS, PMOS, CMOS and BiCMOS Logic Gates.

Unit 6

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops. Pass Transistor, Transmission Gate

Course Learning Outcomes (CLOs) :

At the end of the course, the students will be able to:

- **CO1 & CO2**: be able to use mathematical methods and circuit analysis models in analysis of CMOS , CMOS fabrication flow and technology scaling.
- **CO3**: Be able to create models of moderately sized CMOS circuits that realize specified digital functions.

- **CO4:** Estimate and optimize combinational circuit delay using RC delay models and logical effort,and optimize interconnect delay and noise
- **CO5:** be able to use the physical design aspects to draw the basic gates using the stick and layout diagrams.
- **CO6**: Be able to design static CMOS combinational and sequential logic at the transistor level, including mask layout.

Text books :

- Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.
- Neil H.E.Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 1998.
- J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.

Reference books :

- C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
- L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.
- K. Martin, Digital Integrated circuit design, Oxford University press, 2001.
- A.Mukherji, Introduction to nMOS and CMOS VLSI system design, Prentice Hall Inc., 1986.
- C.Mead and L.Conway, Introduction to VLSI systems, Addison Wesley, 1986.

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL3 **Course Name: Information Theory and Coding**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the basics of information theory and coding theories.
- Introduce the concept of amount of information, entropy, channel capacity, errordetection and error-correction codes, block coding, convolution coding, and Viterbi decoding algorithm.
- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.

Course Description:

This course comprises of the concepts of entropy, mutual information, the Asymptotic Equipartition property, applications to source coding (data compression), applications to channel capacity (channel coding), differential entropy and its application to waveform channel capacities, and a subset of advanced topics such as Kolmogorov complexity, timing (covert) communications, or rate-distortion theory, as time permits. The second half of the course comprises Hamming codes, cyclic codes (CRC and BCH codes), a brief introduction to Reed-Solomon codes, and perhaps universal codes (Lempel-Ziv coding). Students will be encouraged to choose non-traditional applications of information theory or coding for the course research project.

Course Contents:

Unit 1

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless codingtheorem; Encoding of discrete sources.Different types of optical fibers, Modal analysis of a step index fiber.

Unit 2

Markov sources; Shannon's noisy coding theorem and converse for discrete channels;Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Unit 3

Techniques of coding and decoding; Huffman codes and uniquely detectable codes

Unit 4

Cyclic codes, convolutional arithmetic codes.

Course Learning Outcomes(CLOs) :

- Understand the concept of information and entropy
- Understand Shannon‘s theorem for coding
- Calculation of channel capacity
- Apply coding techniques

Text books:

- N. Abramson, Information and Coding, McGraw Hill, 1963.
- M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Reference books:

- R.B. Ash, Information Theory, Prentice Hall, 1970.
- Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102117/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 501 **Course Name:** Organization Behavior
Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- The student will acquire knowledge of organizational behavior including workplace environment, leadership skills, and organization management.
- To enhance the understanding of the dynamics of interactions between individuals and the organization. To facilitate a clear perspective to diagnose and effectively handle human behavior issues in Organization and to develop greater insight into their behavior in interpersonal and groups and team.

Course Description:

- This course introduces the fundamental of organizational behavior includes important insights about motivation, leadership, perception, and learning theories.

Course Contents:

Unit 1: Introduction of OB: (6 lectures)

The concept and nature of OB, need to understand human behavior, Its significance, and impact, Challenges, and opportunities.

Unit 2: Individual dimensions of behavior:(8 lectures)

Individual characteristics, Ability, Values, Attitudes, Formation, Organization related attitude, Relationship between attitude and behavior, Personality, Types, Determinants and traits, learning and Learning theories, Motivation and Motivation theories.

Unit 3: Group behavior and team development: (8 lectures)

Concept of groups and group dynamics, Types of groups, Formal and Informal group, Stages of group development, Group cohesiveness, Group decision making, Concept of team vs group, Types of teams, Managing teams.

Unit 4: Organizational culture and conflict management: (8 lectures)

Organizational culture, Leadership: What is leadership, types of leaders and leadership styles, traits and qualities of an effective leader, managing conflicts, resolution of conflicts, Change management.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of organization and types.
CLO-2: Inculcate skills and understand behavior.

CLO-3: To understand group behavior and emotional development.
CLO-4: To understand organization culture and management.

Textbooks:

(i) Fred Luthans, ―Organizational Behavior‖, 12th Edition, McGraw Hill International Edition
(ii) Stephen P. Robbins, ―Organizational Behavior‖, 12th Edition, Prentice Hall
(iii) Aswathappa K, ―Organizational Behavior (Text, Cases, and Games)‖, Himalaya Publication

Reference books:
Udai Pareek, ―Organizational Behavior‖, Oxford University Press

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

EC18: Digital Signal Processing Laboratory [0L:0T:2P 1 credit]

List of Experiments:

1. Generation of Basic Signals using MATLAB.
2. Generation of Basic Signals using SCILAB.
3. Basic operations on Matrices using SCILAB.
4. Perform Linear Convolution of two sequences using SCILAB.
5. To perform Linear Convolution using MATLAB.
6. To perform Circular Convolution using MATLAB.
7. Perform circular convolution of two given discrete sequences using SCILAB.
8. Evaluate DFT of given sequence using MATLAB.
9. Verify Blackman and Hamming windowing techniques sequences using SCILAB.
10. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency using SCILAB.
11. To verify FIR filters using MATLAB.
12. To design and implement IIR (LPF/HPF) filters.

EC22: EMI Laboratory [0L:0T:2P 1 credit]

List of Experiments:

1. Study of Cathode Ray Oscilloscope.
2. Study of displacement measurement by LVDT.
3. Force measurement by strain gauge.
4. Measurement of Capacitor using Q-meter..
5. Temperature measurement by thermistor.
6. Study of optical Transducers: Photo-diode, Photo-Transistor.
7. Design of digital to analog converter, R-2R ladder Type and analysis of its characteristics.
8. To measurement of the unknown Inductance by using Maxwell's bridge method
9. To measurement of the unknown capacitance by using Schering bridge method.
10. To measurement of the unknown Frequency by using Wein's bridge method.
11. To measurement of the unknown Inductance by using Hay's bridge method.
12. To calculate Frequency using Lissajious Pattern.
13. To study digital Multimeter.

SEMESTER -6

Course Code: EC19 **Course Name:** Control Systems
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

- To understand fundamental concepts of Control systems and mathematical modelling of the system.
- To understand concept of time response and frequency response of the system.
- To understand basics of stability analysis of the system.

Course Description:

This course provides an introduction to linear systems, transfer functions, and Laplace transforms. It covers stability and feedback, and provides basic design tools for specifications of transient response. It also briefly covers frequency-domain techniques.

Course Contents:

Unit 1

Introduction to control problem- Industrial Control examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2

Feedback control systems- Stability, steady-state accuracy,transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

Unit 4

Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution

Unit 5

State variable Analysis- Concepts of state, state variable, state model, state modelsfor linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Introduction to Optimal control & Nonlinear control, Optimal Control problem,Regulator problem, Output regulator, treking problem. Nonlinear system – Basic concept & analysis.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Characterize a system and find its study state behavior
- Investigate stability of a system using different tests
- Design various controllers

- Solve liner, non-liner and optimal control problems

Text books:

- Gopal. M., ―Control Systems: Principles and Design‖, Tata McGraw-Hill, 1997.
- Kuo, B.C., ―Automatic Control System‖, Prentice Hall, sixth edition, 1993.

Reference books:

- Ogata, K., ―Modern Control Engineering‖, Prentice Hall, second edition, 1991.
- Nagrath & Gopal, ―Modern Control Engineering‖, New Age International, New Delhi

Online links for study & reference materials:

https://nptel.ac.in/courses/107/106/107106081/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC20 **Course Name:** Computer Networks
Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Description:

The course covers the basic and advanced concepts and techniques of Computer Networks from both theoretical and practical perspective. The material includes Data communication Components, Data Link Layer and Medium Access Sub Layer, Network Layer, Transport Layer and Application Layer. The students will be able to understand almost all algorithms required to understand real world network issues.

Course Contents:

Unit-1

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit-2

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA.

Unit-3

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routingprotocols.

Unit-4

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-5:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Course Learning Outcomes (CLOs):

- **CLO-1**: Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- **CLO-2:** For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
- **CLO-3**: For a given problem related TCP/IP protocol developed the network

programming.

- **CLO-4**: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text books:

- BehrouzA. Frozen, Data Communication and Networking, 4th Edition, McGraw- Hill.
- William Stallings, Data and Computer Communication, 8th Edition, , Pearson Prentice Hall India.

Reference books:

- Andrew S. Tanenbaum , Computer Networks, 8th Edition, , Pearson New International Edition.
- Douglas Comer , Internetworking with TCP/IP, Volume 1, 6th Edition , Prentice Hall of India.
- Richard Stevens , TCP/IP Illustrated, Addison-Wesley, United States o f America.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105183/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code : ECEL04 **Course Name : Introduction to MEMS**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective : The goal of this course is to introduce students to MEMS devices, microsystems and their applications as follows

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Description : Micro-electro-mechanical is one of the emerging fields.. The course will start with an introduction on the mechanical and electrical properties of materials commonly used in MEMS. The micro-fabrication processes, including bulk and surface micromachining processes for realization of these micro/nano transducers will be discussed, along with integration of MEMS with CMOS electronics. Some representative sensors and actuators, including capacitive & piezoelectric pressure sensors, mechanical resonators and filters, minimally invasive implantable medical devices, and biomedical lab-on-a-chip will be used to illustrate the capabilities & advantages of these miniaturized devices. This course designs for the give the knowledge of the fabrication of different micro electronics system. It covers the different topic related with the micro system, fabrication technology at micro level.

Course Contents :

Unit1

INTRODUCTION Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

Unit2

SENSORS AND ACTUATORS-I Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

Unit3

SENSORS AND ACTUATORS-II Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

Uint4

MICROMACHINING Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies –Basic surface micro machining processes –

Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

Unit 5

POLYMER AND OPTICAL MEMS Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Text Books:

- Chang Liu, _Foundations of MEMS', Pearson Education Inc., 2012.
- Stephen D Senturia, _Microsystem Design', Springer Publication, 2000.
- Tai Ran Hsu, –MEMS & Micro systems Design and Manufacture‖ Tata McGraw Hill, New Delhi, 2002.

References Books:

- Nadim Maluf,— An Introduction to Micro Electro Mechanical System Design‖, Artech House, 2000.
- Mohamed Gad-el-Hak, editor, ― The MEMS Handbook‖, CRC press Baco Raton, 2001.
- Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
- James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
- Thomas M.Adams and Richard A.Layton, –Introduction MEMS, Fabrication and Application,‖ Springer, 2010.

Course Learning Outcomes(CLOs) :

- **CLO1** : Ability to understand the operation of micro devices, micro systems and their applications.
- **CLO2 &CLO3** : able to understand the concept of sensors and actuators, their uses& application
- **CLO4** : Ability to design the micro devices, micro systems using the MEMS fabrication process
- **CO5:-Able to understand about the** polymer and optical mems

Online links for study & reference materials :

https://nptel.ac.in/courses/117/105/117105082/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL5 **Course Name:** Electromagnetic Waves
Course Credit:3 **Total Contact Hour:** 40hr

Course Objective:

- To introduce students with different coordinate systems.
- To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.
- To expose the students to the ideas of electromagnetic waves and structure of transmission line.

Course Description:

This course includes the knowledge of Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields. It distinguishes between the static and time-varying fields establish the corresponding sets of Maxwell‘s Equations and Boundary Conditions. It analyzes the Wave Equations for good conductors, good dielectrics and evaluate the UPW Characteristics for several practical media of interest.

Course Contents:

Unit 1

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmitssion line sections as circuit elements.

Unit 2

Maxwell‘s Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Unit 3

Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Poincare‘s Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor.

Unit 4

Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Unit 5

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Unit 6

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna.

Course Learning Outcomes (CLOs):

- Understand characteristics and wave propagation on high frequency transmission lines.
- Use sections of transmission line sections for realizing circuit elements.
- Characterize uniform plane wave.

- Calculate reflection and transmission of waves at media interface
- Understand principle of radiation and radiation characteristics of an antenna

Text books:

- E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
- Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.

Reference books:

- R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101056/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL06 **Course Name: Speech and Audio Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To introduce the models of speech and audio production and acoustic phonetics
- To teach time and frequency domain techniques for estimating speech parameters
- To teach predictive techniques for speech coding
- To introduce speech recognition and speech synthesis applications

Course Description:

This course covers the basic principles of digital speech processing, fundamentals of speech production and perception with basic techniques for digital speech processing: like short – time energy, magnitude, autocorrelation ,short – time Fourier analysis ,homomorphic (convolutional) methods, linear predictive methods – Speech estimation methods ,speech/non-speech detection , voiced/unvoiced/non-speech segmentation/classification , Applications of speech signal processing , Speech coding , Speech synthesis, Speech recognition/natural language processing

Course Contents:

Unit 1

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit 2

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Unit 3

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Unit 4

Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero- state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Unit 5

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically model the speech signal
- Analyze the quality and properties of speech signal.
- Modify and enhance the speech and audio signals.

Text books:

- –Digital Speech‖ by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

Reference books:

- –Speech Coding Algorithms: Foundation and Evolution of Standardized Coders‖, W.C. Chu, WileyInter science, 2003.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105145/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL07 **Course Name:** Power Electronics
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand and acquire knowledge about various power semiconductor devices.
- To prepare the students to analyze and design different power converter circuits.

Course Description:

The course focuses on presenting concepts for conversion, control and monitoring of electric energy using power semiconductor devices.Methods for analyzing power electronic converters suitable for AC/DC, DC/DC and DC/AC electrical energy conversions including resonance converters are presented. Additionally, principles for designing power electronic converters, including their power semiconductors and passive elements are established. Computer-aided analysis and simulations of the electrical and thermal performance of power electronic converters is also among the course objectives.

Course Contents:

Unit 1

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit 2

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit 3

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Unit 4

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Unit 5

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters-need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Build and test circuits using power devices such as SCR
- Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
- Learn how to analyze these inverters and some basic applications.

Text books:

- Muhammad H. Rashid, ―Power electronics‖ Prentice Hall of India.
- Ned Mohan, Robbins, ―Power electronics‖, edition III, John Wiley and sons.

Reference books:

- P.C. Sen., –Modern Power Electronics‖, edition II, Chand& Co.
- V.R.Moorthi, ―Power Electronics‖, Oxford University Press.
- Cyril W., Lander,‖ Power Electronics‖, edition III, McGraw Hill.
- G K Dubey S R Doradla,: Thyristorised Power Controllers‖, New Age International Publishers. SCR manual from GE, USA.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102145/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : ECEL8 **Course Name :** Nano electronics

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

Students undergoing this course are exposed to:

- Know the types of nanotechnology, atomic structure, molecular technology and preparation of nano materials.
- Understand the fundamentals of nano electronics and its properties.
- Know the Silicon MOSFET‘s, QTD and carbon nano tubes.
- Understand the fundamentals of molecular electronics.

Course Description :

The major goals and objectives are to provide graduate students with knowledge and understanding of physical background and applications of nanoelectronics. The course will cover electrical and optical properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices, as well as applications of nanotechnologies in molecular biology and medicine.

Course Contents :

Unit 1

Introduction To Nanotechnology:- Introduction: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics From microelectronics towards biomolecule electronics Background to nanotechnology: Types of nanotechnology and nanomachines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space – top down and bottom up. Molecular Nanotechnology: Electron Microscope – Scanning Electron Microscope – Atomic Force Microscope –Scanning Tunneling Microscope. Nanomaterials: Preparation –Plasma Arcing – Chemical Vapor Deposition – Sol-Gels – Electrode Position – Ball Milling –Applications Of Nanomaterials.

Unit 2

Fundamentals Of Nanoelectronics:-Fundamentals of logic devices:- Requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation:- power dissipation limit – dissipation in reversible computation – the ultimate computer.

Unit 3

Silicon MOSFET & Quantum Transport Devices:-Silicon MOSFETS - Novel materials and alternate concepts:- fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applicationssingle electron devices – applications of single electron devices to logic circuits.

Unit 4

Carbon Nanotubes:-Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube fets – Nanotube for memory applications – prospects of all carbon nanotube nanoelectronics.

Unit 5

Molecular Electronics:-Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices

Course Learning Outcomes(CLOs) :

Upon the successful completion of the course, students will be able to:

- CLO1: Discuss the types of nanotechnology, molecular technology and the preparation of nano materials.
- CLO2: Explains the fundamental of the devices such as logic devices, field effect devices, and spintronics
- CLO3: Describe the concepts of silicon MOSFET and Quantum Transport Devices.
- CLO4: Summarize the types, synthesis, interconnects and applications of carbon nano tubes.
- CLO 5: Explain the concepts, functions, fabrications and applications of molecular electronics.

Text books :

- Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and Burkhard 2. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
- Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.
- T. Pradeep, NANO: The Essentials – Understanding Nanoscience and Nanotechnology, TMH, 2007.

Reference books :

- M.Ziese and M.J Thornton(Eds.)‖Spin Electronics ―, Springer-verlag 2001.
- M.Dutta and M.A Stroscio Edited by ―Quantum Based Electronic Devices and systems‖, world Scientific, 2000.
- K.E. Drexler, Nanosystems, Wiley, 1992.
- J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
- C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Online links for study & reference materials :

https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL9 **Course Name:** Scientific Computing
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To make students familiar with the concepts of programming and the get they accustomed with high-level languages like MATLAB etc.
- To provide an overview of some of the issues and problems that arise in scientific computation, such as (non-)linear systems, numerical and symbolic integration, differential equations and simulation.

Course Description:

After this course the student should be able to understand simple mathematical models and scientific problems (such as finite capacity growth models, plotting a line through data points, etc.) and implement a solution in an adequate scientific programming language (such as MATLAB).

Course Contents:

UNIT-1

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

UNIT-2

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

UNIT-3

Eigen-values and singular values: Eigen-values and Eigenvectors, Methods for Computing All Eigen-values, Jacobi Method, Methods for Computing Selected Eigen-values, Singular Values Decomposition, Application of SVD

UNIT-4

Nonlinear equations: Fixed Point Iteration, Newton‘s Method, Inverse Interpolation
Method Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

UNIT-5

Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Course Learning Outcomes (CLOs):

- Exploring the properties for numerical methods and mathematical models by using the analysis methods covered in the course.

- Understanding the results when running a MATLAB program, and describe a problem with an algorithm or a programming code in MATLAB (which might include self-written MATLAB functions);
- Structure and divide a computational problem into sub-problems, formulate an algorithm and implement the algorithm in MATLAB;

Text books:

- Heath Michael T., ‒Scientific Computing: An Introductory Survey‖ , McGraw-Hill, 2nd Ed., 2002
- Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, ‒Numerical Recipes: The Art of Scientific Computing‖, Cambridge University Press, 3rd Ed., 2007

Reference books :

- Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, ‒Scientific Computing With MATLAB And Octave‖, Springer, 3rd Ed., 2010

Online links for study & reference materials :

https://nptel.ac.in/courses/111/102/111102137/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Open Elective 1 for 6th Sem

EC21: Computer Networks Laboratory [0L:0T:4P 2 credit]
Hands-on experiments related to the course contents EC20

EC22: Control System Laboratory [0L:0T:4P 2 credit]
Hands-on experiments related to the course contents EC19

Course Code : EC23 **Course Name :** Mini Project/Electronic Design Workshop
Course Credit: 2 **Total Contact Hour:** 20hr

Guidelines:

2. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.

3. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

4. Mini Project should cater to a small system required in laboratory or real life.

5. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

6. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

7. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

8. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

9. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

10. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

11. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.

- Design, implement and test the prototype/algorithm in order to solve the conceived problem.

- Write comprehensive report on mini project work.

SEMESTER -7

Course Code: ECEL10 **Course Name: Adaptive Signal Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand multirate DSP and design efficient digital filters.
- To construct multi-channel filter banks.
- To select linear filtering techniques to engineering problems.
- To describe the most important adaptive filter generic problems and various adaptive filter algorithms.

Course Description:

This **course** develops the concepts, key issues and motivating examples for adaptive filters; Discrete time linear systems and filters; Random variables and random processes, covariance matrices; Z transforms of stationary random processes. Optimum Linear Systems - Error surfaces and minimum mean square error; Optimum discrete time Wiener filter; Principle of orthogonality and canonical forms; Constrained optimisation; Method of steepest descent - convergence issues; Stochastic gradient descent LMS - convergence in the mean and misadjustment Case study. Least squares and recursive least squares. Linear Prediction - Forward and backward linear prediction; Levinson Durbin; Lattice filters.

Course Contents:

Unit1

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit 2

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 3

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank andnullity, innerp roduce space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Unit 4

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 5

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
- Mathematically represent the _adaptability requirement'.
- Understand the mathematical treatment for the modeling and design of the signal processing systems.

Text books:

- S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

Reference books:

- C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105075/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL11 **Course Name:** Antenna & Propagation
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To introduce the student to antennas, covering their principles of radiation, their basic parameters, (radiation resistance, radiation pattern, polarization, reciprocity, effective radiated power), their general types, and those commonly used in wireless systems.
- Concept of radiation mechanism of various antennas.
- Mechanism and models for radio-wave propagation.

Course Description:

Antenna and Wave Propagation is to introduce to the students the basics of radiating elements and effect of propagation of radio waves in actual environment. This course provides students with comprehensive coverage of a wide variety of antennas and propagation topics related to numerous communication systems with a particular emphasis on military applications.

Course Contents:

UNIT-1

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT-2

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT-3

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT-4

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

UNIT-5

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Course Learning Outcomes (CLOs):

- Understand the properties and various types of antennas.
- Analyze the properties of different types of antennas and their design.
- Operate antenna design software tools and come up with the design of the antenna of required specifications.

Text books:

- J.D. Kraus, Antennas, McGraw Hill, 1988.
- C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.

Reference books :

- R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.

Online links for study & reference materials :

https://nptel.ac.in/courses/108/101/108101092/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code ECEL12 **Course Name: Digital Image & Video Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the need for image transforms different types of image transforms and their properties.
- To develop any image processing application.
- To understand the rapid advances in Machine vision.
- To learn different techniques employed for the enhancement of images.

Course Description:

This course will cover the fundamentals of image and video processing. We will provide a mathematical framework to describe and analyze images and videos as two- and three-dimensional signals in the spatial, spatio-temporal, and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image/video enhancement, recovery, and compression – but you will also learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools. We will introduce and use a wide variety of such tools – from optimization toolboxes to statistical techniques.

Course Contents:

UNIT 1

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

UNIT 2

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT 3

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

UNIY 4

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

UNIT 5

Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices,

macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding

Text books:

- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Reference books:

- Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105079/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL13 **Course Name: Mobile Communication and Networks**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies for 4 G standards.

Course Description:

This Course is to expose the students to the most recent technological developments in Mobile communication systems.. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course.This course deals with various methodologies to improve the received signal quality in mobile communication.The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

Course Contents:

Unit 1

Cellular concepts-Cell structure, frequency reuse, cell splitting, channelassignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Unit 2

Signal propagation-Propagation mechanism- reflection, refraction, diffraction andscattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit 3

Capacity of flat and frequency selective channels. Antennas-Antennas for mobileterminal-monopole antennas, PIFA, base station antennas and arrays.

Unit 4

Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulationschemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKEreceiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Unit 5

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the working principles of the mobile communication systems.
- Understand the relation between the user features and underlying technology.
- Analyze mobile communication systems for improved performance

Text books:

- WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
- WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

Reference books:

- Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
- AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
- VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Online links for study & reference materials:

http://www.nptelvideos.in/2012/12/wireless-communication.html

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL14 **Course Name:** Mixed Signal Design

Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLLs

Course Description:

This course provides the understanding of the practical situations where mixed signal analysis is required and analyze to handle the inter-conversions between signals. It includes the concepts of design systems involving mixed signals.

Course Contents:

UNIT-1

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

UNIT-2

Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

UNIT-3

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT-4

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

UNIT-5

Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

Course Learning Outcomes (CLOs):

- Apply the concepts for mixed signal MOS circuit.
- Analyze the characteristics of IC based CMOS filters.
- Design of various data converter architecture circuits.
- Design of oscillators and phase lock loop circuit.

Text books:

- CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.

Reference books :

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Reprint, 2016.

Online links for study & reference materials :

https://nptel.ac.in/content/storage2/courses/117101105/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL15 **Course Name:** Microwave Theory & Techniques
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To understand the microwave waveguides, passive & active devices, tubes and network analysis.
- To design microwave matching networks.
- To perform microwave measurements.

Course Description:

Microwaves are everywhere in current technology, especially in the most popular television industries. Microwaves is very much applicable between local and national security channels. For instance, microwaves are used missile guidance infrastructures to control the speed of their missiles as well as parameters.

Course Contents:

UNIT-1

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT-2

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

UNIT-3

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes,

Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

UNIT-4

Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave

Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave

UNIT-5

General measurement setup, Microwave bench, Power measurement – low, Medium & high, Attenuation measurement, Measurement of VSWR, Measurement of dielectric constant, Measurement of Impedance: using Smith Chart, Measurement with spectrum analyzer, Scalar & vector network analyzer operation.

Course Learning Outcomes (CLOs):

- Understand about different modes of wave propagation (TE, TM and TEM) and waveguide structure.
- Knowledge about different microwave components
- Understanding about devices used in microwave generation
- Microwave measurement theory and technology

Text books:

- R.E. Collins, Microwave Circuits, McGraw Hill
- K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Reference books:

- Liao, S.Y., Microwave Devices & Circuits, Tata McGraw Hill (2006) 2nd edition.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/101/108101112/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL16 **Course Name: Fiber Optic Communication**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.

Course Description:

The course is aimed at equipping the undergraduate Engineering and Physics students with the basic understanding of optical fibers and optical fiber communication. The course provides knowledge of optical fiber waveguide at fundamental level, essentials of an optical fiber communication system and understanding of various components of an optical fiber telecommunication system.

Course Contents:

Unit 1

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.Different types of optical fibers, Modal analysis of a step index fiber.

Unit 2

Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Unit 3

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.

Unit 4

Optical amplifiers - EDFA, Raman amplifier.WDM and DWDM systems. Principles of WDM networks.

Unit 5

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Course Learning Outcomes(CLOs) :

- Understand the principles fiber-optic communication, the components and the bandwidth advantages.
- Understand the properties of the optical fibers and optical components.
- Understand operation of lasers, LEDs, and detectors
- Analyze system performance of optical communication systems
- Design optical networks and understand non-linear effects in optical fibers

Text books:

- J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).

- T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.

Reference books:

- J. Gowar, Optical communication systems, Prentice Hall India, 1987.
- S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/106/108106167/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL17 **Course Name:** Radar & Satellite Communication
Course Credit: 3 T**otal Contact Hour:** 40hr

Course Objective:

- To become familiar with satellites and satellite services.
- Study of satellite orbits and launching.
- Study of earth segment and space segment components
- Study of satellite access by various users.

Course Description:

The course introduces the students to the basic concept in the field of satellite communication. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The satellite services like broadcasting are also studied thoroughly.

Course Contents:

Unit-1

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Unit-2

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit-3

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit-4

Typical Phenomena in Satellite Communication:Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit-5

Satellite link budget, flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes:Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA**.**

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Text books:

- Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002

Reference books:

- Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
- Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105131/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40**

Course Code : ECEL18 **Course Name : High Speed Electronics**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

Aim of this subject is to understand significance and the areas of application of high-speed electronics circuits

Course Description :

Important parameters governing the high speed performance of devices and circuits are described, mainly emphases on transmission line, Noise analysis, RF amplifier design, mixer circuit,oscillators and understanding of PCB Designing is given.

Course Contents :

Unit 1

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses, radiated emissions and minimizing system noise.

Unit 2

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation,Cross-modulation, Dynamic range.

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs highfrequency)

Unit 3

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Unit 4

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Unit 5

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Learning Outcomes(CLOs) :

At the end of the course, students will demonstrate the ability to:

- CLO1 : Understand significance and the areas of application of high-speed electronics circuits.
- CLO2& CLO3: Understand the properties of various components used in high speed electronics
- CLO4 : Design High-speed electronic system using appropriate components.
- CLO5: Understand about CAD tools for PCB Design

Text books :

- Stephen H. Hall, Garrett W. Hall, James A. McCall –High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, –The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

Reference books :

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, –Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, –RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Online links for study & reference materials :

https://nptel.ac.in/courses/117/106/117106089/
https://nptel.ac.in/courses/117/104/117104071/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Open Elective-2 for 7th SEM

Course Code: ECP1 **Course Name:** Project Stage-I
Course Credit: 5

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

2. Survey and study of published literature on the assigned topic;
3. Working out a preliminary Approach to the Problem relating to the assigned topic;
4. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
5. Preparing a Written Report on the Study conducted for presentation to the Department;
6. Final Seminar, as oral Presentation before a departmental committee.

SEMESTER -8

Course Code: ECEL19 **Course Name:** Wavelets
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To expose to the basics of wavelet theory
- To illustrate the use of wavelet processing for data compression
- To understand denoising and noise suppression.

Course Description:

This course focus on the concepts, methodologies and tools of signal processing using wavelets. We will discuss the basics of wavelets, and aim at the appropriate balance of theory and applications. Topics of interest include multiresolution analysis, wavelet packets, and selected applications to data compression, denoising and signal and image processing.

Course Contents:

Unit 1

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform,

Unit 2

Wigner-Ville transform.;Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis,

Unit 3

Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory,

Unit 4

Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

Course Learning Outcomes(CLOs) :

At the end of the course, students will demonstrate the ability to:

- Understand time-frequency nature of the signals.
- Apply the concept of wavelets to practical problems.
- Mathematically analyze the systems or process the signals using appropriate wavelet functions.

Text books:

- Stephen H. Hall, Garrett W. Hall, James A. McCall ‒High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, ‒The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

Reference books:

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, ‒Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, ‒RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101001/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL20 **Course Name:** Wireless Sensor Network

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
- Understand the medium access control protocols and address physical layer issues
- Learn key routing protocols for sensor networks and main design issues
- Learn transport layer protocols for sensor networks, and design requirements
- Understand the Sensor management ,sensor network middleware, operating systems.

Course Description:

This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications. Topics will include sensor network architectures, hardware platforms, physical layer techniques, medium access control, routing, topology control, quality of service (QoS) management, localization, time synchronization, security, storage, and other advanced topics. Each student must complete a semester-long course project related to wireless sensor networks.

Course Contents:

Unit 1

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit 2

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit 3

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,

Unit 4

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.

Unit 5

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Course Learning Outcomes(CLOs) :

At the end of the course the students will be able to

- Design wireless sensor networks for a given application
- Understand emerging research areas in the field of sensor networks

- Understand MAC protocols used for different communication standards used in WSN
- Explore new protocols for WSN

Text books:

- Waltenegus Dargie , Christian Poellabauer, –Fundamentals Of Wireless Sensor Networks Theory And Practice‖, By John Wiley & Sons Publications ,2011
- Sabrie Soloman, –Sensors Handbook" by McGraw Hill publication. 2009

Reference books:

- Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks‖, Elsevier Publications,2004
- Kazem Sohrby, Daniel Minoli, –Wireless Sensor Networks‖: Technology, Protocols and Applications, Wiley-Inter science
- Philip Levis, And David Gay "TinyOS Programming‖ by Cambridge University Press 2009

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105160/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : ECEL21 **Course Name : Embedded Systems**
Course Credit:3 **Total Contact Hour:** 40hr

Course Objective :

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Description :

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

Course Contents :

Unit 1

Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit 2

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit 3

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit 4

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit 5

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Course Learning Outcomes(CLOs) :

- CLO1 : Expected to understand the selection procedure of Processors in the Embedded domain.
- CLO2: Design Procedure for Embedded Firmware.
- CLO 3: Expected to visualize the role of Real time Operating Systems in Embedded Systems
- CLO 4. Expected to evaluate the Correlation between task synchronization and latency issues

Text books :

- Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference books :

- Embedded Systems - Raj Kamal, TMH.
- Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
- Embedded Systems – Lyla, Pearson, 2013
- An Embedded Software Primer - David E. Simon, Pearson Education.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/106/105/106105193/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Open Elective-3 for 8th sem

Open Elective-4 for 8th sem

Course Code: ECP2 **Course Name:** Project Stage -II

Course Credit: 9

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.