COURSE BOOK B. TECH. II YEAR

Electronics & Communication Engineering

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CURRICULUM STRUCTURE & SYLLABUS

Effective from the Session: 2025-26

B.Tech (ECE) 3rd Sem

S.No.	Course Category (AICTE)	Course Category (UGC)	BOS	Course Code	Course Name	Type	Academic Learning (AL)			Continuous Internal Examination (CIE)			End Sem Examination (ESE)	Total Marks	Total Credits
							L	T	P	MSE	CA	TOTAL		CIE+ ESE	
1	PC	Major (Core)	EC	EC204L	Network Analysis	L	2	0	0	40	10	50	50	100	2
2	PC	Major (Core)	EC	EC205L	Analog Communication	L	3	0	0	60	15	75	75	150	3
3	PC	Major (Core)	EC	EC301L	Microelectronic Circuits	L	3	0	0	60	15	75	75	150	3
4	BS	Major (Core)	ASH	MA105L	Probability and Statistics	L	3	0	0	60	15	75	75	150	3
5	MC	Value Added	ASH	HS109L	Constitution of India	L	2	0	0	25	-	25	25	-	NC
6	HS	AEC	ASH	HS110L	Aptitude-1	L	1	0	0	-	25	25	25	50	1
7	HS	AEC	ASH	HS111L	Soft Skills Essential-1	L	1	0	0	-	25	25	25	-	NC
Blended															
8	PC	Major (Core)	EC	EC203B	Basics of Signals and Systems	B	2	0	2	60	15	75	75	150	3
9	PC	Major (Core)	CSE (AIML)	AI101B	Introduction to AI	B	2	0	2	60	15	75	75	150	3
10	PE	Major (Core)/SEC	-	-	Professional Elective-I	B	3	0	2	80	20	100	100	200	4
Lab/Practical															
11	PC	Major (Core)	EC	EC205P	Analog Communication Lab	P	0	0	2	--	25	25	25	50	1
12	PC	Major (Core)	EC	EC301P	Microelectronic Circuits Lab	P	0	0	2	--	25	25	25	50	1
13	PW	Summer internship	CSIT	IT105P	Social Internship Assessment	P	0	0	0	-	50	50	-	50	1
Total Hours : 32 hrs.							**22**	**0**	**10**					**1250**	**25**

B.Tech (ECE) 4th Sem

S.No.	Course Category (AICTE)	Course Category (UGC)	BOS	Course Code	Course Name	Type	Academic Learning (AL)			Continuous Internal Examination (CIE)			End Sem Examination (ESE)	Total Marks	Total Credits
							L	T	P	MSE	CA	TOTAL		CIE + ESE	
1	PC	Major (Core)	EC	EC206L	Modern Control Systems	L	3	0	0	60	15	75	75	150	3
2	PC	Major (Core)	EC	EC302L	Digital Communication	L	3	0	0	60	15	75	75	150	3
3	PC	Major (Core)	EC	EC401L	Linear Integrated Circuits	L	3	0	0	60	15	75	75	150	3
4	PC	Major (Core)	EC	EC207L	Electro-Magnetic Field Theory	L	2	0	0	40	10	50	50	100	2
5	PC	Major (Core)	IT	IT301L	Database Systems	L	3	0	0	60	15	75	75	150	3
6	MC	Value Added	ASH	HS112L	Universal Human Values	L	3	0	0	60	15	75	75	150	3
7	HS	AEC	ASH	HS113L	Aptitude-2	L	1	0	0	-	25	25	25	50	1
8	HS	AEC	ASH	HS114L	Soft Skills Essential 2	L	1	0	0	-	25	25	25	-	NC
Blended															
9	PE	Major (Core)/SEC	-	-	Professional Elective-II	B	3	0	2	80	20	100	100	200	4
Lab/Practical															
10	PC	Major (Core)	IT	IT301P	Database Systems Lab	P	0	0	2	-	25	25	25	50	1
11	ES	Major (Core)	EC	EC302P	Digital Communication Lab	P	0	0	2	-	25	25	25	50	1
12	PC	Major (Core)	EC	EC401P	Linear Integrated Circuits Lab	P	0	0	2	-	25	25	25	50	1
Total Hours: 30 hrs.							**22**	**0**	**08**					**1250**	**25**

Professional Electives (PE)

S.No.	Course Type (PE)	Professional Elective: Wireless Communication	Professional Elective: Bio-Medical Electronics	Professional Elective: VLSI Design	Professional Elective: Space Technologies	Professional Elective: Next-Gen Automation: IIoT & Gateways	Professional Elective: AI and Data-Driven Smart Grid Technologies	Professional Elective: Systems Engineering
1	**BOS**	**ECE**	**ECE**	**ECE**	**ECE**	**EEE**	**ELCE**	**ECE**
	PE I-(3rd Sem)	Adaptive Signal Processing (EC216E)	Biology For Engineers (EC210E)	Digital Integrated Circuit Design (EC212E)	Remote Sensing and Applications (EC218E)	Sensors & Automation Essentials (EE207E)	Smart Grid Fundamentals and Applications (EL206E)	System Engineering-I (EC220E)
2	**BOS**	**ECE**	**ECE**	**ECE**	**ECE**	**EEE**	**ELCE**	**ECE**
	PE II-(4th Sem)	Wireless Communications Networks (EC217E)	Bio-Medical Electronics & Devices (EC211E)	Analog Integrated Circuit Design (EC213E)	Radar and Satellite Communication (EC219E)	Integration of SCADA and PLC with IIOT Gateways (EE208E)	AI and Machine Learning for Smart Grids (EL207E)	System Engineering-II (EC221E)

Theory Courses Detail Syllabus

Course Code: EC204L	Course Name: Network Analysis	L	T	P	C
		2	0	0	2

Pre-requisite: NA

Course Objectives:

1. To understand the basic laws to solve any electric network.
2. To familiarize the students to different network theorems to apply and analyze the different circuits.
3. To provide valuable insights of network transients and steady state through different techniques learnt.

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate a thorough understanding of the basic principles and concepts of Network analysis and synthesis.
2. Apply and analyze the circuits using various network theorems.
3. Apply Laplace transform and perform transient and steady analysis of RC, RL, RLC circuit.
4. Analysis of various parameters of two port networks.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	2	-	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	2

Unit 1	Basics of Networks	10 hours

Introduction to Networks and Circuits, Ohm's law, Kirchhoff laws KCL, KVL. Circuit Topologies - Star form, Delta form, Star to delta conversion, delta to star conversion. Mesh and Node Analysis with linearly dependent and independent source for DC and AC networks, Concepts of super node and super mesh.

Unit 2	Network Theorems	8 hours

Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum power transfer theorem.

Unit 3	Transient and steady state analysis	6 hours

Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace Transform.

Unit 4	Two Port Networks	6 hours

Two-port network parameters: Z, Y, h, g and transmission parameters, conversion of parameters, various inter connections, condition for reciprocal and symmetrical network.

Total Lecture hours	30 hours

Textbook

1. "Network Analysis" by M.E.Van Valkenburg, Third Edition; Prentice Hall,
2. "Engineering Circuit analysis" by Hyat Jr. & Kemmerly, McGraw Hill
3. "Fundamental of electrical circuits" by Charles K. Alexander and Mathew Sadiku
4. "Circuit theory" by A. Chakrabarti, Dhanpat Rai Publications.

Reference Books

1. "Network Analysis & Synthesis" by F.F.Kuo, Wiley India edition, 2nd edition
2. "Fundamentals of Network Analysis & Synthesis" by Behrouz Peikari, Jaico Publishing house.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3 (ATT)		
20	20	4	4	2		
40		10			50	100

Course Code: EC205L	Course Name: Analog Communication	L	T	P	C
		3	0	0	3

Pre-requisite: NA

Course Objectives:

1. Apply the applications of probability theory for analog communication.
2. Analyze amplitude modulation systems including DSB-C, DSB-SC, SSB, VSB, and QAM.
3. Study angle modulation techniques, FM/PM relation, bandwidth calculation, FM modulators/demodulators, and stereophonic FM broadcasting.

Course Outcome: After completion of the course, the student will be able to

1. Apply the fundamental knowledge of engineering mathematics to communication signals.
2. Analyze the power and transmission bandwidth of amplitude modulated signals.
3. Analyze the power and transmission bandwidth of angle-modulated signals.
4. Apply the process of reproduction from analog to digital signaling.
5. Apply the knowledge of analog modulation for various applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	1	-	-	-	-	-	2
CO3	3	3	2	2	1	1	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2
CO5	3	3	2	2	1	1	-	-	-	-	-	2

Unit 1	Probability Theory for Communications	9 hours

Concept of Probability, Random variables, Statistical averages, Random process, Power Spectral Density & Autocorrelation Function of Random Processes, Gaussian Random Process.

Unit 2	Amplitude Modulation	9 hours

Amplitude Modulation: Double sideband with Carrier (DSB-C), Double side band without Carrier DSB-SC, Single Side Band Modulation SSB, Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator. Bandpass AWGN, Noise and SNR improvements in AM, DSB-SC, SSB-SC.

Unit 3	Angle Modulation	9 hours

Angle Modulation, Tone Modulated FM Signal, Phase Modulation, Arbitrary Modulated FM Signal, Bandwidth of FM Signals using Bessel's Function, Relation between FM and PM, FM Modulators (Direct using Varactor Diode & Indirect Method), and FM Demodulators: Demodulation using Phase Locked Loop. Approximately Compatible SSB Systems, Stereophonic FM Broadcasting, Noise in FM: Pre-emphasis and De-emphasis.

Unit 4	Pulse Communication Digital Base Band Communication	9 hours

Pulse Modulation, Digital Transmission of Analog Signals: Sampling Theorem and its applications, PCM, DM, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation, Their generation, and Demodulation.		
Unit 5	**Applications of Analog Communication**	**9 hours**
Superheterodyne receiver, Stereophonic transmission using FM, PLL for FM, Wireless microphone systems, Wireless audio/video transmission systems, Analog telemetry systems, Analog remote sensing systems.		
	Total Lecture hours	**45 hours**

Textbook

1. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw Hill.
2. R P Singh and S D Sapre, "Communication Systems: Analog and Digital", Mc Graw Hill

Reference Books

1. B. P. Lathi, "Modern Digital and Analog Communication Systems",3rd Edition, Oxford University Press.
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley India.
3. H. P. HSU & D. Mitra "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.
4. Analog and Digital Communication, 2nd edition, HWEI HSU, Schaum series, book.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3		
60		15			75	150

Course Code: EC301L	Course Name : Microelectronic Circuits	L	T	P	C
		3	0	0	3

Pre-requisite: NA

Course Objectives:

1. Understand the Energy band diagram, charge carrier transport phenomenon, recombination generation process of different types of semiconductor materials.
2. To understand the various design parameters of P-n junction.
3. Analyze the design parameters of BJT and its various models.
4. Analyze the MOS capacitor and its various design parameters.
5. Analyze the design parameters of MOSFET i.e.- Channel length & width, depletion width, surface field and potential, ON resistance, trans conductance, equivalent circuits, amplification factors, capacitances, noise margins, scaling & short channel effects MOSFET.

Course Outcome: After completion of the course, the student will be able to

1. Understand the principles of semiconductor Physics.
2. Understand and utilize the mathematical models of semiconductor junctions.
3. Understand carrier transport in semiconductors, BJT and MOSFET.
4. Analyze the mathematical models of MOS transistors for circuits and system.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	2	-	-	-	-	2	2
CO2	3	3	3	2	2	2	-	-	-	-	1	2
CO3	3	3	3	2	1	2	-	-	-	-	2	3
CO4	3	3	2	3	2	2	-	-	-	-	1	3

Unit 1	Semiconductor Physics and PN junction	9 hours

Equilibrium and non-equilibrium properties: carrier transport phenomena- Drift, diffusion; excess carriers in semiconductors- Carrier Generation and Recombination; continuity equation; surface effects, Poison equation.
P-N junction: Linearly graded junction; Abrupt p-n junction; Transient Response of P-N junction; Forward bias Diode current (minority and majority carrier current); Small signal model of the pn junction; Reverse bias Diode breakdown.

Unit 2	BJT applications and its Model	9 hours

Bipolar junction transistors: Device Structure and Physical Operation; Minority Carrier Profiles in a Bipolar Junction Transistor; Current Components and Current Gain; Bias modes and operation of bipolar transistor; non-ideal effects; Base width modulation; Biasing in BJT Amplifier Circuits, Small-Signal Operation and Models of BJT based amplifier (CB, CE & CC).

Unit 3	MOS Capacitor	9 hours

MOS Capacitors: Surface Charge in Metal Oxide Semiconductor Capacitors; Surface Potential: Accumulation, Depletion, and Inversion Capacitance-Voltage Characteristics of a MIS Structure; Low frequency capacitance; High frequency capacitance.

Unit 4	MOSFET and its Current	9 hours

Field Effect Transistor types- Construction and working MOSFET (Depletion and Enhancement) Type, Transfer and Drain Characteristic of MOSFET., basic physics behind the fabrication.

Unit 5	MOSFET and its Model	9 hours

Metal Oxide Semiconductor Field Effect Transistors (MOSFETs): Gradual Channel Approximation and Constant Mobility Model; Threshold Voltage; Onset of Pinch off and Current Saturation; Sub Threshold Characteristics; Substrate Bias Effects; Temperature effects.

	Total Lecture hours	45 hours

Textbook

1. Sedra & Smith-Microelectronic Circuits- Oxford.
2. Streetman & Banerjee - Solid State Electronic Devices, PHI.

Reference Books

1. Milman, Halkias–Integrated Electronics – TMH.
2. Neamen-Semiconductor Physics and Devices TMH.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3 (ATT)		
30	30	6	6	3		
60		15			75	150

Course Code: MA105L	Course Name: Probability & Statistics	L	T	P	C
		3	0	0	3

Pre-requisite: X+2

Course Objectives:

1. To familiarize the graduate engineers with the concept of Statistics and Probability.
2. It aims to analyze the practical/ real life problems and solve them in scientific manner.

Course Outcome: After completion of the course, the student will be able to

1. Employ the concept of measure central tendency and regression analysis.
2. Apply knowledge of probability on distribution function.
3. Apply the concept of probability density function and normal distribution.
4. Apply the concept of random variable and time series.
5. Employ the knowledge of hypothesis by means of Chi-square and ANOVA test.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	-	-	1	-	-	-	1
CO2	2	2	2	-	-	-	-	1	-	-	-	1
CO3	2	2	1	-	-	-	-	1	-	-	-	1
CO4	2	2	1	-	-	-	-	1	-	-	-	1
CO5	2	2	2	-	-	-	-	1	-	-	-	1

Unit 1	**Basic Statistics**	**09 hours**

Introduction to Descriptive Statistics, Measure of Central Tendency, Histogram in sampling, Method of least square (basic concept), Fitting of Straight line and exponential curve, Correlation, Rank correlation and Regression Analysis.

Unit 2	**Probability I**	**09 hours**

Probability, Law of total Probability, Conditional Probability, Baye's Theorem, Discrete Random Variable, Probability Mass function. Binomial Distribution, Poisson Distribution., Introduction to confusion matrix.

Unit 3	**Probability II**	**09 hours**

Continuous Random Variable, Probability density function, Properties of Probability density function, Expectation and variance, Normal Distribution and its applications.

Unit 4	**Bivariate Random Variable and Time Series**	**09 hours**

Introduction to two dimensional random variable, Joint probability density function and its properties, Marginal probability distribution, Introduction to Time series, component of time series, Measure of trend (Graphic method, method of Averages)

Unit 5	**Sampling Theory**	**09 hours**

Introduction to Inferential Statistics, Testing of Hypothesis: Introduction, Sampling Theory (Small and Large), Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, t-test, Chi-square test, one way analysis of variance (ANOVA).

	Total Lecture Hours	**45 hours**

Textbook:

1. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2017
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2017.
3. R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.
4. S. C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons.

Reference Books:

1. Seymour Lipschutz, John Schiller, Introduction to Probability and Statistics, McGraw Hill
2. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. TKV Iyenger, B. Krishna Gandhi, S. Ranganatham, MVSN Prasad, Probability and Statistics (S. Chand Publishing House).
4. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3	75	150
60		15				

Course Code: HS109L	Course Name: Constitution of India	L	T	P	C
		2	0	0	NC

Pre-requisite: NA

Course Objectives:

1. To acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

Course Outcome: After completion of the course, the student will be able to

1. Understand basic features and modalities about Indian constitution.
2. Clarify the functioning of Indian parliamentary system at the center and state level.
3. Understand the aspects of Indian Legal System and its related bodies.
4. Apply different laws and regulations related to engineering practices.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	2	-	-	-	2
CO2	-	-	-	-	-	-	1	1	1	-	-	2
CO3	-	-	-	-	-	-	1	1	1	-	1	2
CO4	-	-	-	-	-	-	1	2	1	1	1	2

Unit 1	Basic Information about Indian Constitution	08 hours

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Unit 2	Union Executive and State Executive	08 hours

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, Lok Pal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit 3	Basic Information about Legal System	07 hours

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Unit 4	Election provisions, Emergency provisions, Amendment of the constitution	07 hours

Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution- meaning, procedure and limitations

	Total Lecture Hours	30 hours

Textbook:

1. Brij Kishore Sharma: *Introduction to the Indian Constitution*, 8th Edition, PHI Learning Pvt. Ltd.
2. Granville Austin: *The Indian Constitution: Cornerstone of a Nation (Classic Reissue)*, Oxford University Press.
3. S.G Subramanian: *Indian Constitution and Indian Polity*, 2nd Edition, Pearson Education 2020.
4. Subhash C. Kashyap: *Our Constitution: An Introduction to India's Constitution and constitutional Law*, NBT,

2018.
5. Madhav Khosla: *The Indian Constitution*, Oxford University Press.
6. PM Bakshi: *The Constitution of India*, Latest Edition, Universal Law Publishing.
7. V.K. Ahuja: *Law Relating to Intellectual Property Rights* (2007)
8. Suresh T. Viswanathan: *The Indian Cyber Laws, Bharat Law House*, New Delhi-88
9. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
10. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36).https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
11. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e- Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf
12. Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights- and-analysis.pdf

Reference Books:

1. Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
2. Maneka Gandhi V. Union of India AIR, 1978 SC 597.
3. S.R. Bammai V. Union of India, AIR 1994 SC 1918.
4. Kuldip Nayyar V. Union of India, AIR 2006 SC312.
5. A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
6. Remshwar Prasad V. Union of India, AIR 2006 SC980.
7. Keshav Singh in re, AIR 1965 SC 745.
8. Union of India V. Talsiram, AIR 1985 SC 1416.
9. Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
10. SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
11. Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.
13. Contemporary Newer case studies can be developed using AI tools
14. ** (Other relevant case studies can be consulted by the teacher as per the topic). Prescribed Legislations:
15. Information Technology Act, 2000 with latest amendments. **Compare this with GDPR of Europe**
16. RTI Act 2005 with latest amendments.
17. Information Technology Rules, 2000
18. Cyber Regulation Appellate Tribunal Rules, 2000 Suggested aid for Students and Pedagogic purpose
19. RSTV debates on corporate law, IPR and patent issues
20. NPTEL lectures on IPR and patent rights

Episodes of 10 -part mini TV series "Samvidhan: The Making of Constitution of India" by RSTV.

Mode of Evaluation:

MSE		CA			ESE	Total	
MSE	MSE2	CA1	CA2	CA4 (ATT)			
-	25	-	-	-	25	NC	
25		-					

Course Code: HS110L	Course Name: Aptitude-1	L	T	P	C
		1	0	0	1

Pre-requisite: NA

Course Objectives:

1. To provide adequate exposure to the students regarding the use of aptitude tests in the recruitment process and competitive examinations.
2. To improve the logical & numerical ability of the students.

Course Outcome: After completion of the course, the student will be able to

1. Illustrate their comprehension by solving the given problems
2. Apply the learned concepts to new problems and solve them aptly.

3. Make use of their thought process to interpret and draw inferences from the given data to reach logical conclusions.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	-	1	-	-	-	-	-	1
CO2	1	1	-	1	-	2	-	-	-	-	-	1
CO3	1	1	-	1	-	1	-	-	-	-	-	2

Unit 1	**Series, Coding and Decoding**	**04 hours**

Importance and overview of Quantitative Aptitude and Logical Reasoning, Number Series, Letter Series, Analogies, Coding and Decoding.

Unit 2	**Data Arrangement**	**04 hours**

Ranking and Order, Direction Sense, Linear and Circular sitting arrangement.

Unit 3	**Blood Relation and Puzzles**	**03 hours**

Basic concepts, definition and terminology related to blood relationships, Conversation-based blood relationships, Family Tree-based problems, Coded relationships and related puzzles.

Unit 4	**Critical and Non-Verbal Reasoning**	**04 hours**

Statement arguments, course of action, classification and grouping of images, Figure series, Mirror image, Water image, Paper cutting, Paper folding, Embedded figures.

Total Lecture Hours **15 hours**

Textbook:

1. A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publication.

Reference Books:

1. How to Prepare for Logical Reasoning for the CAT" by Arun Sharma, TMH Publication.

Mode of Evaluation:

CA			ESE	Total
CA1	CA2	CA3(ATT)		
10	10	5	25	50
25				

Course Code: HS111L	**Course Name: Soft Skills Essentials-1**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**NC**

Pre-requisite:

- Students should have foundational knowledge of grammar, vocabulary, and sentence structure to participate effectively in tasks like extempore, scenario writing after studying Communication skills subject in first year.
- Prior exposure to basic communication concepts (like verbal/non-verbal communication and listening skills) helps students to enhance persuasion, negotiation, and professional etiquette.

Course Objectives:

To develop students' communication, presentation, and interpersonal skills through interactive activities, elevating confidence and professionalism for academic and workplace success

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate improved self-awareness and communication skills through structured presentations and vocabulary-building activities.
2. Apply effective verbal communication techniques, including pronunciation and elevator pitch delivery, to express ideas clearly and confidently.
3. Exhibit professional behaviour, grooming, and teamwork skills in group discussions, interviews, and workplace-related role plays.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	1
CO2	-	-	-	-	-	-	-	-	2	3	-	2

CO3	-	-	-	-	-	-	-	-	2	3	-	2

Unit 1	**Foundation of Communication and Self-Awareness**	**05 hours**
British Council-English Score Test, Team Presentations on Change Management Models, Presentations on Personality Profiling for professional growth		
Unit 2	**Verbal Communication and Clarity**	**04 hours**
Pronunciation Drill 1 & 2, Elevator Pitch Practice Session 1 & 2		
Unit 3	**Professionalism and Workplace Readiness**	**06 hours**
Professional Grooming and Etiquette, Group Discussion (General Topics), Panel Discussion on workplace scenarios using caselets		
	Total Lecture Hours	**15 hours**

Useful Resources:

1. www.mindtools.com
2. https://englishonline.britishcouncil.org/
3. www.toastmasters.org
4. https://www.futurelearn.com/
5. English Score Test
6. Duo Lingo Test

Mode of Evaluation

MSE		CA			ESE	Total
MSE1	**MSE2**	**CA1**	**CA2**	**CA3(ATT)**		
-	-	**10**	**10**	**5**		
-		**25**			**25**	**50**

Course Code: EC203B	**Course Name: Basics of Signals and Systems**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Pre-requisite: NA

Course Objectives:

1. To familiarize different types of signals and systems typically encountered in Communication engineering.
2. To explore students to different transformation techniques to apply and analyze different real-life periodic and aperiodic signals to systems (typically LTI).
3. To provide valuable insights of continuous time complex systems/signals analyzed through different techniques learnt.
4. To provide valuable insights of discrete time complex systems/signals analyzed through different techniques learnt.
5. To familiarize different types of methods to convert continues time signal to discrete time signal and its applications.

Course Outcome: After completion of the course, the student will be able to

1. Classify different types of signals and systems.
2. Express continuous and discrete signals in time and frequency domain using Fourier transform.
3. Apply complex frequency (Laplace) domain representation of continuous time signals and systems.
4. Apply complex frequency (Z) domain representation of discrete time signals and systems.
5. Analyse the process of sampling and reconstruction of a signal with real time application.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	2	3	-	-	-	-	-	-	-
CO2	2	2	3	3	2	-	-	-	-	-	-	1
CO3	2	3	3	3	1	-	-	-	-	-	-	1
CO4	3	3	3	2	2	-	-	-	-	-	-	1
CO5	3	2	2	2	3	-	-	-	-	-	-	1

Unit 1	Basics of Signals and Systems	12 hours

Signals in everyday life, basic elementary signals, various operations on the signals, classification of signals, numerical problems on types of signals, Systems in everyday life, interconnections of systems, classification of systems, stability of system and convolution, numerical problems on types of systems.

Unit 2	Continuous Time Fourier Transform (CTFT) & Discrete Time Fourier Transform (DTFT)	12 hours

Introduction to continuous time Fourier transform, properties of CT-Fourier transform, inverse Fourier transform, numerical problems on CTFT.
Introduction to discrete time Fourier transform, properties of DT-Fourier transform, inverse Fourier transform, numerical problems on DTFT.

Unit 3	Complex frequency domain representation of continuous time signals and systems	12 hours

Introduction to Laplace transform, region of Convergence (ROC), properties of Laplace transform, numerical problems on the Laplace transform, inverse Laplace transform (partial fraction method), system representation through differential equations.

Unit 4	Complex frequency domain representation of discrete time signals and systems	12 hours

Introduction to Z transform, region of Convergence (ROC), properties of ROC, properties of Z transform, numerical problems on the Z transform, inverse Z transform (long division and partial fraction method), system representation through difference equations.

Unit 5	Sampling Theorem and its Application	12 hours

Introduction to sampling, sampling theorem (construction and reconstruction), spectra of sampled signals, Nyquist Criteria, numerical problems on sampling theorem, aliasing and its effect.

List of Experiments:

1. Basic Plotting of Signals using MATLAB / PYTHON: i) Step Function ii) Impulse Function iii) Exponential Function iv) Ramp Function v) Sine Function
2. Program to perform amplitude-scaling, time-scaling and time shifting on a given signal.
3. Program to identify whether the given system is Linear Time Invariant or not.
4. Program to obtain linear convolution of the two finite point sequences.
5. Program to plot magnitude and phase curves of a given CT signal using Continuous Time Fourier Transform.
6. Program to calculate the CTFT of a triangular signal using time differentiation property of CTFT.
7. Program to plot magnitude and phase curves of a given DT signal using Discrete Time Fourier Transform.
8. Program to calculate and plot Laplace Transform of a given CT signal.
9. Program to calculate and plot Z-Transform of a given DT signal.
10. Program to find the impulse response and step response of a system form its difference equation. Also, compute and plot the response of a given system to a given input. PBL based Mini Project

Total Lecture hours	**60 hours**

Textbook

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Pearson, 2015.
2. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, 1998.

Reference Books

1. A. Anand Kumar, "Signals and Systems", PHI 3rd edition, 2018.
2. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
3. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
30	30	6	6	3		
60		15			75	150

Course Code: AI101B	Course Name: Introduction to AI	L	T	P	C
		2	0	2	3

Pre-requisite: Python Programming

Course Objectives:

To provide students with a understanding of AI principles and applications, gain insights into computer vision, natural language processing and Gen AI, explore ethical considerations, and acquire hands-on skills in implementing AI solutions for real-world scenarios.

Course Outcome: After completion of the course, the student will be able to

1. Acquire the basic understanding of the fundamental concepts of AI to implement search algorithms
2. Develop the insights of data pre-processing techniques and its visualization
3. Gain a basic understanding of ML, NLP and computer vision to solve real-world problems
4. Apply concepts of uncertainty on AI, decision-making frameworks and reinforcement learning techniques to solve real-world problems
5. Understand the fundamentals of ANN, Gen AI, ChatGPT and AI ethics while exploring the future potential of AI applications

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	-	3	-	3	1	3	3
CO2	3	3	3	1	3	-	3	-	3	1	3	3
CO3	3	3	3	1	3	-	3	-	3	1	3	3
CO4	3	3	3	1	3	-	3	-	3	1	3	3
CO5	3	3	3	1	3	-	3	3	3	3	3	3

Unit 1	**Introduction to AI**	**12 hours**

Discussion on Course outcomes and Introduction to AI, Motivation and role of Artificial Intelligence, AI from Turing Test to Humanoids, Various approaches to AI, AI concept , terminology and application area, Agents and Environments, Types of AI: Search Based System, Rule Based system, Learning Based System, Adversarial search and Games: Optimal Decisions in games, min-max algorithm, alpha-beta pruning, Constraint satisfaction problem: Constraint Propagation, Backtracking search, local search

Case Study 1 : Intro to n-queens and sudoku solver(using backtracking search) on Google Colab

Unit 2	**Understanding Data**	**12 hours**

History Of Data, Data Storage And Importance of Data and its Acquisition , The Stages of data processing , Data visualisation

Case study 2: Customer Segmentation data visualization on Google colab

Unit 3	**Domains of AI**	**12 hours**

Overview of ML: Supervised Learning, Unsupervised Learning, Overview of NLP : Speech recognition , Natural language understanding, Natural language generation, Machine Translation , Overview of Computer vision: image formation, image classification, image detection

Case Study 3 : Image annotation, image classification using Google Colab

Unit 4	**Uncertainty In AI**	**12 hours**

Uncertainty in AI: conditional independence, Baye's rule, naive baye's model, Simple decision: utility function, decision network. Reinforcement learning: Active learning, Passive learning, Model Based Learning

Case Study 4: Classification with Naive Bayes on Google Colab

Unit 5	**Emerging in AI**	**12 hours**

Overview of ANN, Generative Adversarial Networks Chatbot, Gen AI, Overview of ChatGPT
Ethics of AI, Future of AI

Case study 5: Handwritten digit Recognition using ANN on Google colab

	Total Lecture Hours	**60 hours**

Textbook:

1. NORVIG, P. R. (2021). Artificial intelligence: A modern approach, 4th edition, Pearson
2. Aurelien Geron (2023): Hands-On Machine Learning With Scikit-Learn, Keras & Tensorflow, 3rd Edition, O'Reilly

Reference Books:

1. Rajendra Aketkar, "Introduction to Artificial Intelligence" (E-book)

Mode of Evaluation

Evaluation Scheme						
MSE		**CA**			**ESE**	**Total Marks**
MSE 1	**MSE 2**	**CA1**	**CA2**	**CA3(ATT)**		
30	30	6	6	3	**75**	**150**
60		**15**				

Course Code: EC216E	Course Name: Adaptive Signal Processing	L	T	P	C
		3	0	2	4

Pre-requisite: Basics of Signal Systems

Course Objectives:

1. Understand the fundamentals of digital signal processing, including sampling, reconstruction, and aliasing.
2. Learn design principles of IIR and FIR filters and multirate DSP techniques for efficient signal transformation.
3. Explore adaptive filtering methods and apply algorithms like LMS and RLS for real-time signal processing.
4. Acquire proficiency in the Go programming language to implement efficient, concurrent, and modular code.
5. Apply Go programming concepts to solve engineering problems involving data processing, file I/O, and testing

Course Outcome: After completion of the course, the student will be able to

1. Analyze and apply sampling techniques and signal reconstruction for processing continuous-time signals
2. Design and evaluate digital filters (IIR, FIR) and implement multirate DSP systems such as interpolators and decimators.
3. Implement adaptive filters using LMS and RLS algorithms to enhance signal performance in dynamic environments.
4. Develop and debug programs in Go using structured control flows, functions, arrays, slices, maps, and structures.
5. Build robust and concurrent Go applications incorporating interfaces, goroutines, channels, file handling, and testing strategies.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-	-
CO4	2	2	2	1	3	-	-	-	-	-	-	-
CO5	2	2	3	2	3	-	-	-	-	-	-	1

Unit 1		15 hours

Digital Processing of Continuous-Time Signals: Sampling of low pass continuous-time signals; Bandpass Sampling, Aliasing, reconstruction of sampled signal. Anti-aliasing filter characteristics, Physical reliability of systems, analog to discrete signal representations.

Unit 2		15 hours

IIR filter design by approximation of derivatives, Inverse Chebyshev filter, Elliptic filters. Overview of FIR filter design using window function.

Unit 3		15 hours

Multirate digital signal processing, Basic structures for sampling rate conversion, Decimators, and Interpolators; Multistage design of interpolators and decimators; Polyphase decomposition and FIR structures.

Unit 4		15 hours

Filtering Problems, Adaptive filters, Linear Filter Structures: Transversal Filter. Introduction of Adaptive filtering algorithms: LMS Algorithm, RLS Algorithm.

Unit 5	Go Programming Concepts	15 hours

Module 1 - Getting Started: Go Runtime and Compilations, Keywords and Identifiers, Constants and Variables, Operators and Expressions, Local Assignments, Booleans, Numerics, Characters, Pointers and Addresses, Strings
Module 2 – Constructs: if-else and switch, for Statements, Counter-controlled Iterations, Condition-controlled Iterations, Range Loops, using break and continue
Module 3 – Functions: Parameters and Return Values, Call by Value and Reference, Named Return Variables, Blank Identifiers, Variable Argument Parameters, Using defer statements, Recursive Functions, Functions as Parameters, Closures
Module 4 - Working with Data: Array Literals, Multidimensional Arrays, Array Parameters, Slices and Slice Parameters, Multidimensional Slices, Reslicing, Maps and Map Parameters, Map Slices, Structures and Structure Parameters, Structure Tags and Fields, Embedded Structures, Recursive Structures
Module 5 - Methods and Interfaces: Method Declarations, Functions vs. Methods, Pointer and Value Receivers, Method Values and Expressions, Interface Types and Values, Type Assertions and Type Switches, Method Sets with Interfaces, Embedded Interfaces, Empty Interfaces, Working with Interfaces
Module 6 - Goroutines and Channels: Concurrency vs. Parallelism, Goroutine Functions and Lambdas, Wait Groups, Channels, Sending and Receiving, Unbuffered and Buffered Channels, Directional Channels, Multiplexing with select, Timers and Tickers
Module 7 - Packages and Testing: Packages and Workspaces, Exporting Package Names, Import Paths and Named Imports, Package Initializations, Blank Imports, Unit Testing with Test Functions, Table Tests and Random Tests, Benchmarking
Module 8 - Working with Go: Files and Directories, Reading Directories, Reading Files, Writing Files, Copying Files, Error Strategies, Panic and Recover, Package Error Handling, Regular Expressions

Total Lecture hours	**75 hours**

Textbook

1. "Digital Signal Processing, 4th Edition" by Proakis and Manolakis, Prentice Hall, 2007 (ISBN: 0-13-187374-1).
2. Vetterli, J. Kovacevic, and V. K. Goyal, "Foundation of Signal Processing", Cambridge University Press, 2014.
3. **"**The Go Programming Language**"** by Alan A. A. Donovan & Brian W. Kernighan, Addison-Wesley, 2015.

Reference Books

1. Rabiner & Gold, "Theory & application of digital Signal Processing", PHI 1992.
2. Roman kuc, "Introduction to Digital Signal Processing," McGraw hill Edition.
3. Openheim AV & Schafer RW, "Discrete Time Signal Processing" PHI.
4. Fredric J Harris, "Multirate Signal Processing for Communication Systems", ISBN: 9788770222105, River Publishers Series in Signal, Image and Speech Processing.
5. "Introducing Go: Build Reliable, Scalable Programs" by Caleb Doxsey, O'Reilly Media, 2016 (ISBN: 9781491941959).
6. "Go Programming Blueprints: Build real-world, production-ready solutions in Go" by Mat Ryer, Packt Publishing, 2016 (ISBN: 9781785881542).
7. "Mastering Go" by Mihalis Tsoukalos, Packt Publishing, 2019 (ISBN: 9781788626543).

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	**MSE2**	**CA1**	**CA2**	**CA3**		
40	**40**	**8**	**8**	**4**		
80		**20**			**100**	**200**

Course Code: EC210E	Course Name: Biology for Engineers	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To introduce students to modern biology with emphasis on evolution of biology as a multi-disciplinary field
2. To make them aware of application of engineering principles in biology
3. To create engineering robust solutions inspired by biological examples.

Course Outcome: After completion of the course, the student will be able to

1. Apply the concepts of biology in electronics applications
2. Understand the function of Human Organ Systems.
3. Understand the functional architecture of Nature-Bioinspired Materials.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	3	-	-	-	-	-	-	-
CO2	1	2	3	2	1	-	-	-	-	-	-	-
CO3	2	2	3	3	3	-	-	-	-	-	-	2
CO4	1	1	3	1	3	2	-	-	-	-	1	2

Unit 1	HUMAN ORGAN SYSTEMS AND BIO DESIGNS-1	19 hours

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye), Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators)

Unit 2	HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2	19 hours

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine), Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis)

Unit 3	NATURE-BIOINSPIRED MATERIALS AND MECHANISMS	19 hours

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

Unit 4	TRENDS IN BIOENGINEERING	18 hours

Bioprinting techniques and materials, 3D printing of ear, bone and skin. Electrical tongue and electrical nose in food science, Bioimaging and Artificial Intelligence for disease diagnosis.

	Total Lecture hours	75 hours

Textbook

1. G. K. Suraishkumar, Oxford University Press.
2. C.V Raman rao , I.K International press
3. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

Reference Books

1. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
2. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
40	40	8	8	4		
80		20			100	200

Course Code: EC212E	Course Name: Digital Integrated Circuit Design	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To understand the RTL-to-GDSII digital design flow.
2. To learn the fundamentals of Static Timing Analysis (STA), covering timing paths, setup/hold times, and timing constraints.
3. To provide hands-on exposure to STA tools, functional verification techniques, and power analysis.

Course Outcome: After completion of the course, the student will be able to

1. Understand the digital design flow, including RTL-to-GDSII.
2. Design and implement RTL models using Verilog, and apply synthesis optimizations.
3. Perform Static Timing Analysis (STA) by understanding timing parameters and constraints.
4. Apply functional verification methods and use EDA tools for equivalence checking.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1			-	-	-	-	2
CO2	2	2	2	3	3			-	-	-	-	2
CO3	2	2	3	2	2	-	-	-	-	-	-	2
CO4	2	2	3	2	3	-	-	-	-	-	-	2

Unit 1	Fundamentals of Digital Design Flow and HDL	15 hours

Introduction to ASIC and FPGA Design Flow: RTL-to-GDSII flow, Basics of Hardware Description Languages (HDLs): Verilog vs. VHDL, Verilog design flow and simulation basics, Module definition, ports, and data types, Modeling styles: Gate-level modeling Dataflow modeling, Behavioral modeling.

Unit 2	Verilog Programming	15 hours

Verilog Operators, expressions, and procedural assignments, Verilog code for basic combinational logic circuits (e.g., adder, multiplexer, encoder) and sequential circuit (e.g. Flip flops, counter, register, FSM).

Unit 3	Introduction to Logic Synthesis	15 hours

Definition and purpose of synthesis, Technology-independent vs. technology-dependent optimizations, Synthesis tools overview.

Unit 4	Static Timing Analysis (STA) Basics and Timing Paths	15 hours

Fundamentals of Timing Analysis: Setup time, hold time, propagation delay, Clock period, clock skew, and clock jitter. Types of Timing Paths in a Digital Circuit: Data path, clock path, asynchronous paths, Critical path analysis, Timing Models and STA Basics: Transition time, cell delay, net delay, Wire-load models, parasitic extraction.

Unit 5	Introduction to Functional Verification	15 hours

Concept of Functional Verification, Pre & Post Synthesis Analysis. Introduction to Power Analysis.

	Total Lecture Hours	75 hours

Textbook:

1. Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication, Hubert Kaeslin, Cambridge University Press, 2008.
2. Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar, Pearson, 2nd Edition, 2003.

Reference Books:

1. Introduction to VLSI Design Flow, Sneh Saurabh, Cambridge University Press 2023.
2. Charles Roth & Lizy Kurian John – Digital Systems Design Using Verilog, Cengage
3. Michael D. Ciletti – Advanced Digital Design with the Verilog HDL, Pearson
4. Stephen Brown and Zvonko Vranesic – Fundamentals of Digital Logic with Verilog Design, McGraw Hill.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EC218E	Course Name: Remote Sensing and Applications	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To understand the fundamental principles of remote sensing and their applications in engineering contexts.
2. To apply image processing techniques for interpreting remote sensing data across various engineering scenarios.
3. To analyze remote sensing systems to assess their suitability and performance for specific engineering challenges.

Course Outcome: After completion of the course, the student will be able to

1. Understand the fundamental principles and applications of remote sensing in engineering contexts.
2. Demonstrate proficiency in applying image processing techniques to interpret remote sensing data.
3. Evaluate and select appropriate remote sensing systems for specific engineering challenges.
4. Design remote sensing systems tailored to meet specific engineering requirements.
5. Assess the impact of emerging trends in remote sensing technologies on engineering applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	-	-	-	-	1
CO2	3	3	2	3	2	2	2	-	-	-	-	1
CO3	3	2	3	2	3	-	-	-	-	-	-	2
CO4	3	2	3	2	3	-	-	-	-	-	-	2
CO5	3	3	2	2	3	-	2	-	-	-	-	1

Unit 1	Satellite Communication and Remote Sensing Applications	15 hours

Introduction to Satellite Communication includes types of satellites such as geostationary and polar-orbiting, orbit selection and coverage, data transmission and reception, and the role of ground stations for remote sensing.

Unit 2	Applications & Methods of Satellite Remote Sensing	15 hours

Agriculture, crop monitoring, urban planning, Defence applications, health and medical uses, disaster management and climate studies for atmospheric research and forecasting. Various Methods of Data acquisition for remote sensing.

Unit 3	Camera Technologies for Satellite Remote Sensing	15 hours

Camera resolution, type of resolution, image bandwidth, Image data volume, size of the optic, aperture for light revelation, field of view (FOV), radiometric resolution, pixel pitch, focal length, types of lenses, and optical payloads for satellite imagery, brief study of camera sensors used in the satellite payload available in literature.

Unit 4	Image Processing and Interpretation in Remote Sensing	15 hours

Basics of Digital Image Processing, Preprocessing Techniques (Radiometric and Geometric Corrections), Image Enhancement and Classification (Supervised & Unsupervised), Introduction to GIS (Geographic Information System).

Unit 5	Emerging Trends and Practical Applications of Remote Sensing	15 hours

Hands-on Project: Analysing Satellite Images Using Open-Source Tools (QGIS, Google Earth Engine)
Case Studies: Identifying Land Use, Vegetation Mapping, and Climate Monitoring using NOAA/ Landsat etc.

Total Lecture hours	75 hours

Textbook

1. Remote Sensing and Image Interpretation,7ed (An Indian Adaptation), Thomas Lillesand, Ralph W. Kiefer, Dr. P. K. Champati Ray, Wiley, 2022
2. Principle of Remote Sensing, Wim H. Bakker, et al., ITC Educational Textbooks, 2001

Reference Books

1. Space Optical Remote Sensing, Jiasheng Tao, Springer, 2023.
2. Introduction to Remote Sensing, Sixth Edition, James B. Campbell, Randolph H. Wynne, and Valerie A. Thomas, 2022

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
40	40	8	8	4		
80		20			100	200

Course Code: EE207E	Course Name: Sensors & Automation Essentials	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

Aim to give exposure to the students about Sensors & Automation which are required in industry.

Course Outcome: After completion of the course, the student will be able to

1. Understand the PLC, Communication protocol role in industrial automation and role of IIOT gateways.
2. Understand the PLC panel electrical wiring on PLC Analog and digital cards.
3. Apply the Role of industrial gateways in IIOT.
4. Develop the real time application covering of IIOT.
5. Establish Communication between two industrial devices.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	2	2	-	-	-	-	2
CO2	2	-	2	-	2	2	2	-	2	-	-	2
CO3	3	-	3	2	3	2	2	-	2	-	-	2
CO4	3	2	3	3	3	2	2	-	2	-	-	2
CO5	3	2	3	3	3	2	2	-	2	-	-	2

Unit 1 | **Introduction Industrial Automation & IIOT** | **15 hours**

Types of Industrial Automation Factory & Process automation, Hierarchy involved Field to operating level, Internal structure of PLC (Internal electronics) and their IP ratings, Selection criteria of PLC, Communication protocol role in industrial automation, Role of IIOT gateways, PLC programming Languages, data types in PLC (real time application based Digital number system), practical application based on digital logic gates.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Study and Simulation of Industrial Automation Hierarchies: From Field Devices to Control Rooms
- Digital Logic Gate Implementation and Real-Time PLC Programming Using Ladder Logic

Unit 2 | **Digital & Analog signal types in PLC** | **15 hours**

Pheonix PLC panel electrical wiring on PLC Analog and digital cards, covering how digital & analog signal processing with analog signal scaling with real time application (covering temperature & pressure transmitter). CAD and SLD drawing reading as per application.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Wiring and Testing of Phoenix PLC Digital and Analog I/O Cards for Real-Time Applications
- Analog Signal Conditioning and Processing: Interfacing with Phoenix PLC Analog Cards

Unit 3 | **Communication protocols in IIOT** | **15 hours**

Role of industrial gateways in IIOT, discussing key protocols Modbus TCP-IP, RS-232, RS-485, Profinet Profibus, and web data sharing protocols like MQTT etc.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Experimenting with Modbus TCP/IP Communication via Industrial Gateways
- RS-485 to MQTT Data Transmission: A Hands-On Approach
- Integrating Profibus and Profinet Networks Using Industrial Gateways

- Cloud Data Sharing via MQTT: Real-Time Monitoring in IIoT
- RS-232 to Cloud Integration: Leveraging Industrial Gateways for IIoT

Unit 4	Sensor & Instrumentation Interfacing with PLC	15 hours

Sensor & Instrumentation Interfacing with PLCs, Sensor Signal Conditioning and Interfacing Techniques (Interfacing techniques (sink/source wiring, voltage/current input, relay outputs), Real-world applications: motor control, process automation.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Sensor and Instrumentation Interfacing with PLCs in Industrial Automation
- Signal Conditioning Techniques for Sensor Integration with PLCs
- Understanding Sink/Source Wiring and Voltage/Current Input in PLC Systems
- Motor Control Applications Using PLCs in Industrial Automation
- Real-World Process Automation: PLC-Based Control of Temperature, Pressure, and Flow

Unit 5	Application Development	15 hours

Developing real time application covering all above topics (like analog digital processing with analog signal scaling), Establishing communication between two industrial devices.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Developing a Real-Time PLC Application for Analog and Digital Signal Processing
- Establishing Communication Between Industrial Devices: A Real-Time PLC-Based System
- Analog Signal Scaling and Digital Processing in Real-Time Industrial Applications
- Designing a Real-Time Motor Control System Using PLCs and Sensor Integration
- Building a Real-Time Process Automation System with PLC Communication and Signal Conditioning

Total Lecture Hours	75 hours

Textbook:

1. V. Kumar, *Getting Started with S7-1200*. Siemens Automation, 2017.

Reference Books:

1. J. W. Webb and R. A. Reis, *Programmable Logic Controllers: Principles and Applications*, 5th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2002.
2. R. Singh, *SCADA for Engineers*, New Delhi, India: KHANNA Publishing, 2016.
3. R. Srinivasan, *PLC and SCADA for Beginners*, Chennai, India: Technical Publications, 2020.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EL206E	Course Name: Smart Grid Fundamentals and Applications	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To provide a foundational understanding of the Smart Grid and its architecture.
2. To introduce key enabling technologies like AI/ML, AMI, PMUs, IoT, and cyber-physical systems in smart grids.
3. To demonstrate the integration of renewable energy sources and distributed generation in the modern grid.
4. To impart skills for data-driven analysis, fault detection, and demand-response systems.
5. To expose students to industry practices through Tata Power-DDL use cases and real-world implementations.

Course Outcome: After completion of the course, the student will be able to

1. Understand the core architecture, features, and components of a Smart Grid.
2. Explain the role of ICT, AMI, and data acquisition in modern energy systems.
3. Apply AI/ML techniques for load forecasting, fault diagnosis, and predictive maintenance.
4. Analyze and evaluate case studies and deployment strategies in Smart Grid applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	-	-	-	-	1	-	1
CO2	2	2	3	2	3	-	-	-	-	1	-	2
CO3	2	3	3	3	3	-	-	-	-	2	2	2
CO4	2	2	2	2	3	1	-	-	-	2	2	3

Unit 1	Smart Grid Concepts and Architecture	19 hours

Conventional grid vs. smart grid, Smart grid functions and benefits, Smart grid architecture: generation, transmission, distribution, DERs, Roles of utilities, prosumers, and regulators, Smart Grid Components (smart meters, sensors, energy management systems), Distributed Generation (DG), microgrids, and virtual power plants (VPPs).

Activities:

- Simulate power flow for both traditional and smart grid models in MATLAB/Simulink.
- Visualize smart grid parameters (voltage, current, frequency) using SCADA platforms.

Unit 2	Enabling Technologies in Smart Grid	19 hours

Smart meters and their functionality, Advanced Metering Infrastructure (AMI), AMI components (HAN, NAN, WAN), Communication protocols (ZigBee, RF Mesh, Power Line Communication), 5G, Interoperability and data standards, Phasor Measurement Units (PMUs), SCADA, Smart substations, and remote terminal units.

Activities:

- Load forecasting using regression and neural networks Activities
- Simulate or import sample smart meter data (e.g., hourly consumption) in Python or Excel.
- Interface sensors with microcontrollers to emulate energy monitoring and wireless data transmission.

Unit 3	Data Analytics and AI/ML Applications	19 hours

Data acquisition and preprocessing for Smart Grids, Load forecasting using ML (regression, neural networks), Fault detection and diagnostics, Demand response, load shaping, and predictive maintenance using AI/ML

Activities:

- Use historical data to forecast short-term load demand using linear regression in Python.
- Apply FFT in MATLAB or Python on current/voltage signals to detect abnormal grid behavior.

Unit 4	Real-World Applications and Case Studies	18 hours

Tata Power DDL Delhi Smart Grid initiatives, Real-time pricing and smart billing systems, Cybersecurity and privacy concerns in smart grid environments, Regulatory framework, standards (IEEE 1547, IEC 61850), and policy interventions.

Activities:

- Simulate dynamic pricing algorithms based on grid demand and implement a simple billing system.
- Develop a dashboard or chart showing the evolution of smart grid policies (e.g., IEEE 1547 compliance) and their technical implications.

Total Lecture Hours	75 hours

Textbook:

1. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley
2. S. M. Islam, Smart Grid Systems: Modeling and Control, CRC Press.

Reference Books:

1. Krzysztof (Kris) Iniewski, Smart Grid Infrastructure & Networking, McGraw-Hill
2. Elissaios Sarmas, Vangelis Marinakis, Haris Doukas, Artificial Intelligence for Energy Systems (Driving Intelligent, Flexible and Optimal Energy Management), Springer
3. Tata Power-DDL Whitepapers, Technical Reports, and Use Cases.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EC220E	Course Name: System Engineering-I	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To understand the fundamental principles of Systems Engineering.
2. To understand the technical process of system design.
3. To understand the Organization Project-enabling Processes.

Course Outcome: After completion of the course, the student will be able to

1. Understand the fundamental concepts and principles of systems engineering and its application in complex engineering projects.
2. Analyze and model system requirements using structured approaches such as functional decomposition, requirement traceability, and stakeholder analysis.
3. Utilize tools and techniques for system architecture design, including block diagrams, interface definitions, and trade-off analysis.
4. Evaluate system performance and verify system requirements through appropriate verification and validation (V&V) techniques.
5. Apply system life cycle models (e.g., Waterfall, V-Model, Spiral) to the planning and execution of system development projects.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	-	-	-	-	1
CO2	3	3	2	3	2	2	2	-	-	-	-	1
CO3	3	2	3	2	3	-	-	-	-	-	-	2
CO4	3	2	3	2	3	-	-	-	-	-	-	2
CO5	3	3	2	2	3	-	2	-	-	-	-	1

Unit 1	Basics of System Engineering	15 hours

Introduction to Systems through examples, Systems Engineering Overview, System of Systems, Generic Life-Cycle Stages, the V-cycle model, alternative approaches.

Unit 2	Technical Processes	15 hours

Requirements Definition and Analysis, System Design Specifications, Architectural Design.

Unit 3	Sub-system Design	15 hours

Sub-system Design Specifications, Verification, Implementation, Modular Integration, Validation, Deployment, Operation and Maintenance.

Unit 4	Project Processes	15 hours

Planning, Assessment, Control, Decision, Risk, Configuration and Information- Management Processes, Measurement Process.

Unit 5	Organization Project-enabling Processes	15 hours

Life-Cycle Management Process (MP), Infrastructure MP, Project Portfolio MP, Human Resource MP, Quality MP. Experiments: Strategy, Design, Analysis.

	Total Lecture hours	75 hours

Textbook

1. Benjamin S. Blanchard and Wolter J. Fabrycky, *Systems Engineering and Analysis*, 5th Edition, Pearson Education.
2. Andrew P. Sage and James E. Armstrong Jr., *Introduction to Systems Engineering*, Wiley.
3. Dennis M. Buede and William D. Miller, *The Engineering Design of Systems: Models and Methods*, 3rd Edition, Wiley.

Reference Books

1. NASA Systems Engineering Handbook, NASA/SP-2007-6105 Rev 2.
2. INCOSE Systems Engineering Handbook, *A Guide for System Life Cycle Processes and Activities*, 4th Edition, Wiley.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
40	40	8	8	4		
80		20			100	200

Course Code: EC206L	Course Name: Modern Control Systems	L	T	P	C
		3	0	0	3

Pre-requisite: NA

Course Objectives:

1. Apply knowledge of basic components of control systems and study about the signal flow graph analysis.
2. Identify state variables and analyze the response of various control systems in time domain to obtain their steady-state error.
3. Improved transient response of the system in terms of overshoots, settling time and rise time.
4. Use Routh Hurwitz criterion to determine the stability of linear control system to design practical stable physical systems necessary for engineering practice.
5. To design a practical control system in frequency domain with the help of Nyquist stability criterion, relative stability, bode plot etc., to meet desired requirements in realistic environment.

Course Outcome: After completion of the course, the student will be able to

1. Understand the basics of Control Systems Engineering with real-time applications.
2. Evaluate the Improved transient response of the system in terms of overshoots, settling time and rise time.
3. Apply Routh Hurwitz criterion to determine the stability of linear control system to design practical stable physical systems necessary for engineering practice.
4. Identify state variables and analyze the response of various control systems in time domain to obtain their steady-state error.
5. Design a practical control system in frequency domain with the help of Nyquist stability criterion, relative stability, bode plot etc., to meet desired requirements in realistic environment.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	2	1	1	-	-	-	-	-	3
CO2	2	1	3	3	1	1	-	-	-	-	-	2
CO3	3	2	2	2	2	1	-	-	-	-	-	1
CO4	2	3	3	3	1	3	-	-	-	-	-	3
CO5	3	3	2	2	1	1	-	-	-	-	-	3

Unit 1	Introduction and Basics of Control Systems	9 hours

Concept of control system, Classification of control systems - Open loop and closed loop control systems. Transfer Function Representation: Block diagram Representation, Determining the Transfer function from Block Diagrams, Signal flow graphs Analysis - Reduction using Mason's gain formula.

Unit 2	Time Response Analysis of Control Systems	9 hours

Standard test signals, Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications, Steady state response, Steady state errors and Static Errors Coefficients.

Unit 3	**Stability Analysis in S-Domain**	**9 hours**

The concept of stability – Routh-Hurwitz's stability criterion–qualitative stability and conditional stability – Limitations of Routh-Hurwitz's stability. Root Locus Technique: Concept of root locus - Construction of root locus.

Unit 4	**Frequency Response Analysis**	**9 hours**

Introduction, Frequency domain specifications, bode plot Analysis, Analysis of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots, and Nyquist Plot.

Unit 5	**State Space Analysis and Digital Control Systems**	**9 hours**

Concepts of state, state variables and state model, Solution of the time invariant state equations, State Transition Matrix and its properties, Concepts of Controllability and Observability. Introduction of Digital control system, Tunable PID Controllers.

	Total Lecture hours	**45 hours**

Textbook

1. Linear Control Systems with MATLAB Applications, B.S. Manke, Khanna Publications.
2. K. Ogata, "Modern Control Engineering", Prentice Hall publication.
3. Control Systems Engineering - I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers.
4. Control Systems - A. Anand Kumar, PHI.
5. Control Systems Engineering by A. Nagoor Kani, RBA Publications.

Reference Books

1. Control Systems Theory and Applications - S. K. Bhattacharya, Pearson.
2. Control Systems Engineering - S. Palani, TMH.
3. Control Systems - N. K. Sinha, New Age International (P) Limited Publishers.

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3**		
30	**30**	**6**	**6**	**3**		
60		**15**			**75**	**150**

Course Code: EC302L	**Course Name: Digital Communication**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite: NA

Course Objectives:

1. Analyze the Digital Data Transmission techniques and apply them to Digital Communication.
2. Apply different types of coding techniques to design the optimum receiver for AWGN channels.
3. Develop the practical skills for implementation of information theory and error detection & correction for various digital applications.

Course Outcome: After completion of the course, the student will be able to

1. Analyze various digital passband Modulation Techniques and digital data transmission.
2. Apply the knowledge of mathematics for the analysis of Digital Communication System
3. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
4. Analyze the behavior of information theory and its role in a digital communication system.
5. Apply the principles of digital communication to implement the error control coding techniques for reliable data transmission.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	1	-	-	-	-	-	2
CO3	3	3	2	2	1	1	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2
CO5	3	3	2	2	1	1	-	-	-	-	-	2

Unit 1	**Digital Base Band Transmission**	**9 hours**

Principles of digital data transmission: Digital Line Coding, Scrambling, Review of Digital Representation of Analog Signals: Differential Pulse Code Modulation (DPCM), Adaptive Delta Modulation, Frequency Division Multiplexing, Time Division Multiplexing, T1 Digital System, TDM Hierarchy. Mathematical representation of Pulse shaping, Digital receivers, Eye diagram.

Unit 2	**Performance Analysis of Digital Communication System**	**9 hours**

Optimum linear Detector for Binary polar signaling, General Binary Signaling, Signal Space Analysis of Optimum Detection, Correlator, General Expression for Error Probability of Optimum Receivers (Matched Filter).

Unit 3	**Digital Data Transmission Techniques**	**9 hours**

Digital Bandpass Transmission: Methods of generating and detecting coherent & non-coherent binary ASK, FSK & PSK, DPSK, QPSK, and MSK, M-ary Digital carrier Modulation.

Unit 4	**Introduction to information theory**	**9 hours**

Measure of Information, Source Encoding, Error-Free Communication over a Noisy Channel. Capacity of a discrete and continuous memoryless channel.

Unit 5	**Error-Correcting Codes Fundamentals and Linear block codes**	**9 hours**

Hamming sphere, Hamming distance, and Hamming bound, the relation between minimum distance and error-detecting and correcting capability, Encoding and syndrome decoding. Cyclic codes: encoder and decoder for systematic cyclic codes. Convolution codes, code tree, and Trellis diagram, Viterbi decoding.

	Total Lecture hours	**45 hours**

Textbook

1. Lathi B. P., and Ding Zhi, "Modern Digital and Analog Communication Systems", 4th Ed., Oxford University Press 2010/ 5th Ed., 2018.
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley India.

Reference Books

1. Proakis J. and Salehi M., "Fundamentals of Communication Systems", 1st Ed., PHI/Pearson Education-LPE, 2006.
2. H. P. HSU & D. Mitra "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.
3. R P Singh and S D Sapre, "Communication Systems: Analog and Digital", McGraw-Hill
4. Leon W. Couch, II "Digital and Analog Communication Systems", 8th Ed., Pearson Education LPE, 2013. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw-Hill.
5. Analog and Digital Communication, 2nd edition, HWEI HSU, Schaum series, book.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
30	30	6	6	3		
60		15			75	150

Course Code: EC401L	Course Name: Linear Integrated Circuits	L	T	P	C
		3	0	0	3

Pre-requisite: NA

Course Objectives:

1. Know about the operational amplifier and its applications.
2. To familiarize about the filters and feedback topologies.
3. To know the bridge of Analog to Digital Electronics.
4. To learn about the current biasing schemes in Analog Electronics.
5. To know the concepts of OTA.

Course Outcome: After completion of the course, the student will be able to

1. Analyze Opamp based linear and non-linear applications.
2. Analyze second order filters and feedback topologies.
3. Apply the Concept of CMOS inverter to implement various Boolean Expressions.
4. Analyze the Current mirror circuits
5. Apply the Concept of OTA.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	1	1	1
CO2	3	3	2	1	1	-	-	-	-	1	1	1
CO3	3	3	2	1	1	-	-	-	-	1	1	1
CO4	3	3	2	1	1	-	-	-	-	1	1	1
CO5	3	3	2	1	1	-	-	-	-	1	1	1

Unit 1	Operational Amplifier	09 hours

Model of ideal and practical operational amplifier. Ideal and Practical inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications as monostable and astable multivibrator.

Unit 2	Active Filters	09 hours

Second order Low pass, high pass, band pass and band stop filters, All pass filter and Notch Filter, Universal Active Filter. **Feedback Topologies:** Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., Concept of stability, gain margin and phase margin.

Unit 3	Digital Integrated Circuit Design	09 hours

VTC of CMOS inverter, Calculation of Noise Margin, CMOS implementation of Logic Gates, SR, JK, D Flip Flops and Boolean Expressions.

Unit 4	Current Mirrors using BJT and MOSFET	09 hours

V I characteristics of Simple current Mirror, Base current compensated current Mirror, Wilson and Improved Wilson Current Mirrors, Widlar Current Mirror. Calculation of Output Currents and output impedance.

Unit 5	Operational Transconductance Amplifier	09 hours

Elementary Trans-conductor building blocks, resistors, integrators, amplifiers, summers, Gyrator, First and second order filters, Higher order filters.

	Total Lecture hours	45 hours

Textbook

1. "Microelectronic Circuits", Sedra and Smith, Adopted by Arun N. Chandorkar, Sixth Edition, Oxford, 2013.
2. R. Schaumann and M.E. Valkenberg, "Design of Analog Circuits", Oxford University Press
3. Gayakwad: Op-Amps and Linear Integrated Circuits, 4th edition Prentice Hall of India, 2002.

Reference Books

1. Michael Jacob, "Applications and Design with Analog Integrated Circuits", PHI, 2nd Edition, 2004
2. Salivahnan, Electronics Devices and Circuits, TMH, 2nd Edition, 2015
3. Millman and Halkias: Integrated Electronics, Tata Mc. Graw Hill, 2nd Edition, 2010.
4. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGrawHill
5. Analog Design Essentials by Willy M. C. Sansen, Springer
6. Analysis and Design of Analog Integrated Circuits by Gray, Hurst, Lewis and Meyer, Wiley

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
30	30	6	6	3		
60		15			75	150

Course Code: EC207L	Course Name : Electro-Magnetic Field Theory	L	T	P	C
		2	0	0	2

Pre-requisite: NA

Course Objectives:

1. To introduce various co-ordinate system and review of Maxwell's equations.
2. To familiarize the students about various concepts and properties of the electric field and magneto-static field in material space and learn to solve boundary value problems.
3. To formulate and solve propagation of electromagnetic waves and their applications in practical problems.

Course Outcome: After completion of the course, the student will be able to

1. Apply the concept of coordinate system and Del operator.
2. Analyze the fundamental concept of electrostatics.
3. Analyze the fundamental concept of magnetostatics.
4. Analyze the Maxwell's equation for static field.
5. Analyze the boundary value conditions between two mediums.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	-	-	-	-	-	-
CO2	2	2	3	3	2	1	-	-	-	-	-	1
CO3	2	3	3	3	1	2	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	2	2	2	3	2	-	-	-	-	-	1

Unit 1	Coordinate systems and transformation	10 hours

Cartesian coordinates, circular cylindrical coordinates, spherical coordinates Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stoke's theorem, Laplacian of a scalar.		
Unit 2	**Electrostatics**	**08 hours**
Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields.		
Unit 3	**Magnetostatics**	**06 hours**
Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, application of ampere's law, magnetic flux density-Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.		
Unit 4	**Boundary Value Problems**	**06 hours**
Continuity Equation, Relaxation time, Electric boundary conditions, Magnetic boundary conditions, inductors and inductances, magnetic energy.		
	Total Lecture hours	**30 hours**

Textbook

1. M. N. O. Sadiku, "Elements of Electromagnetics", 4th Ed, Oxford University Press.

Reference Books

1. W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7 th Ed., TMH.
2. E. C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating System"2nd ed, PHI.
3. John D Kraus, "Electromagnetics" 4th ed., Mcgraw-Hill.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
20	20	4	4	2		
40		10			50	100

Course Code: IT301L	Course Name: Database Systems	L	T	P	C
		3	0	0	3

Pre-requisite: Concepts of any programming language

Course Objectives:

1. To develop a strong foundation in database management concepts.
2. To equip students with practical skills in database design, normalization, transaction management, and recovery techniques.

Course Outcome: After completion of the course, the student will be able to

1. Acquire knowledge of database design methodology for real-life applications.
2. Design an information model using the concept of ER diagram.
3. Apply the concept of SQL on real-life databases.
4. Analyze the redundancy problem in the database and reduce it using normalization.
5. Identify the broad range of database management issues including data integrity, security, and recovery transactions, as well as enforce entity integrity, referential integrity, key constraints, and domain constraints on the database.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	1	1	1	1	1	2
CO2	2	2	3	2	3	1	1	1	2	2	2	2

CO3	3	3	2	1	3	1	1	1	1	1	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	2
CO5	3	3	2	2	3	2	1	2	1	1	1	2

Unit 1	**Introduction to Database System & Entity Relationship Model**	**09 hours**

Introduction to Database System: Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and its Types, Overall Database Structure.
Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Key attribute, Generalization, Aggregation, Reduction of an ER Diagrams to Tables.
Use Case: Discuss one or two case studies like Banking System, and National Hockey League (NHL).

Unit 2	**Relational data Model & Database Implementation using SQL**	**09 hours**

Relational data Model: Relational Data Model Concepts, type of keys, Integrity Constraints- Entity integrity and referential integrity, Keys Constraints, Domain Constraints, Relational Algebra-Unary Relational Operations- SELECT and PROJECT, Binary Relational Operations-CROSS, JOIN and DIVISION, Queries in Relational Algebra.
Database Implementation using SQL: Introduction to SQL, Characteristics of SQL, SQL Data Types, Basic Queries in SQL-create, select Insert, Delete and Update Statements, concepts of group by and having, order by, Sub Queries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views.

Unit 3	**Database Design and Normalization**	**09 hours**

Database Design: Functional Dependencies, Inference rules, Closure of attributes, FD equivalence and Minimal cover.
Normalization: Normal forms, first, second, third normal forms, and BCNF. Lossless join decompositions, Dependency Preservation, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Unit 4	**Transaction Processing & Concurrency Control Techniques**	**09 hours**

Transaction Processing: Transaction and its States, ACID property, Transaction Scheduling, Serializability of scheduling, Conflict, and View Serializability
Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Two-phase locking techniques for concurrency control, Time Stamping Protocols for Concurrency Control.

Unit 5	**Database Recovery Techniques & PL/SQL**	**09 hours**

Database Recovery Techniques: Recovery Concepts, Recoverability, Log Based Recovery, Checkpoints, Shadow Paging, The ARIES recovery, Deadlock Handling
PL/SQL: Introduction, features, syntax, DDL within Pl/SQL, DML in PL/SQL, Cursors, stored procedures, stored function, database triggers, indexing, Case Study-Microsoft Azure SQL.

	Total Lecture hours	**45 hours**

Textbook

1. Elmasri, Navathe, “Fundamentals of Database Systems”, Addision Wesley
2. Korth, Silbertz, Sudarshan, “Database Concepts”, McGraw Hill
3. Date C J, “An Introduction to Database Systems”, Addision Wesley.

Reference Books

1. Bipin C. Desai, “An Introduction to Database Systems”, Gagotia Publications 8. Majumdar & Bhattacharya, “Database Management System”, TMH
2. RAMAKRISHNAN, "Database Management Systems", McGraw Hill
3. Rafe Colburn, Using SQL, PHI

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3**		
30	**30**	**6**	**6**	**3**		
60		**15**			**75**	**150**

Course Code: HS112L	Course Name: Universal Human Values	L	T	P	C
		3	0	0	3

Pre-requisite: NA

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content, and process of value education.
2. To help students initiate a process of dialog within themselves to know what they really want to be in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcome: After completion of the course, the student will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education, explore the meaning of happiness and prosperity, and do a correct appraisal of the current scenario in the society.
2. Distinguish between the Self and the Body, and understand the meaning of Harmony in the Self and the Co-existence of Self and Body.
3. Understand the value of harmonious relationships based on trust, respect, and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Understand the harmony in nature and existence, and workout their mutually fulfilling participation in nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	2	1	-	1	1
CO2	-	-	-	-	-	2	2	2	1	-	1	1
CO3	-	-	-	-	-	2	2	2	1	-	1	1
CO4	-	-	-	-	-	2	2	2	1	-	1	1
CO5	-	-	-	-	-	2	2	3	1	-	1	1

Unit 1	Introduction to Value Education	10 hours

Understanding the need, basic guidelines, content, and process for Value Education, Self- Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation –as the mechanism for self-exploration, Continuous Happiness, and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship, and Physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit 2	Understanding Harmony in the Human Being	10 hours

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer, and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

Unit 3	Understanding Harmony in the Family and Society	10 hours

Harmony in Human-Human Relationship Understanding harmony in the Family-the basic unit of human interaction, Understanding values in the human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect(Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah- astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) – from family to world family!

Unit 4	Understanding Harmony in Nature and Existence	09 hours
Whole existence as Co-existence Understanding the harmony in Nature, Inter connectedness, and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.		
Unit 5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**	**06 hours**
Natural acceptance of human values, Definiteness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics.		
	Total Lecture Hours	**45 hours**

Textbook:

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.

Reference Books:

1. Ivan Illich, Energy & Equity, The Trinity Press, Worcester and Harper Collins, USA,1974.
2. E.F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain,1973.
3. A Nagraj, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak 1998.
4. P L Dhar, RR Gaur, Science and Humanism, Commonwealth Publishers 1990.

Mode of Evaluation

MSE		CA			ESE	Total	
MSE1	MSE2	CA1	CA2	CA3 (ATT)			
30	30	6	6	3			
60		15			75	150	

Course Code: HS113L	Course Name: Aptitude-2	L	T	P	C
		1	0	0	1

Pre-requisite: NA

Course Objectives:

1. To provide adequate exposure to the students regarding the use of aptitude tests in the recruitment process and competitive examinations.
2. To improve the logical & numerical ability of the students.

Course Outcome: After completion of the course, the student will be able to

1. Illustrate their comprehension by solving the given problems
2. Apply the learned concepts to new problems and solve them aptly.
3. Make use of their thought process to interpret and draw inferences from the given data to reach logical conclusions.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	-	1	-	-	-	-	-	1
CO2	1	1	-	1	-	2	-	-	-	-	-	1
CO3	1	1	-	1	-	1	-	-	-	-	-	2

Unit 1	Analytical Reasoning & Logical Puzzles	04 hours
Definition and Introduction of Concept and Relation of Cube and Cuboids, Cut the cube in different layer and then solve questions accordingly. Problems related with open and closed dice.		
Unit 2	**Syllogism**	**03 hours**
Understanding of Venn diagram, Problems related with Venn diagram, Statement and Conclusion, Syllogism and reverse syllogism.		
Unit 3	**Clock and Calendar**	**04 hours**
Definition and Introduction of Concept and Relation of angle and time, Overtaking, overlapping, right-angle and straight Angle with respect to time, Error in clock (faster and slower), Correct time of clock, Mirror and Water Image of clock, Introduction of Calendar, Concept of Normal and Leap Year, Finding Odd days, Finding the day of the week of given date with and without reference.		
Unit 4	**Data Interpretation and Critical Reasoning**	**04 hours**
Tables (Understand of Table, Fillers in table), **Line Graph** (Understand the graph, Percentage change, Ratio based comparison), **Bar Graph** (Type of Bar Graph, Average and Comparison, Stacked Bar Graph), **Pi Chart** (Conversion of Percentage and Degree,		

Fillers in Pie chart, Multiple Pie chart), **Mixed Graph (problems** related with combination of various charts**) Critical Reasoning**: Assumptions, Cause and Effect, Assertion and Reason, Statement and Inference

Total Lecture Hours	**15 hours**

Useful resources:

1. "A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publication.
2. https://www.geeksforgeeks.org/most-important-aptitude-topics-for-placements/

Reference Books:

1. "How to Prepare for Logical Reasoning for the CAT" by Arun Sharma, TMH Publication.
2. https://www.indiabix.com/logical-reasoning/questions-and-answers/
3. https://testbook.com/placement-aptitude/test-series

Mode of Evaluation

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3 (ATT)		
-	-	10	10	5		
-		25			25	50

Course Code: HS114L	Course Name: Soft Skills Essentials 2	L	T	P	C
		1	0	0	NC

Pre-requisite:

- Successful completion of the subject 'Soft Skills Essentials-1' of the third semester.

Course Objectives:

To strengthen students' professional communication, cultural intelligence, and emotional awareness through advanced speaking activities, scenario-based discussions, and digital literacy tasks, equipping them for diverse workplace interactions.

Course Outcome: After completion of the course, the student will be able to

1. Apply advanced communication strategies that include vocabulary enhancement, storytelling to improve their cultural sensitivity (DEI).
2. Demonstrate prompt writing for AI-based tools and create effective elevator pitches to convey ideas with clarity and impact.
3. Exhibit interpersonal effectiveness by navigating negotiation, persuasion, and emotional intelligence in professional contexts

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	1	3	-	2
CO2	-	-	-	-	-	-	-	-	1	3	-	2
CO3	-	-	-	-	-	1	-	-	1	3	-	2

Unit 1	**Advanced Communication and Cultural Sensitivity**	**7 hours**

Vocabulary Enhancement through Gamification, Story Coining and Presentations Understanding Cross-Cultural, Communication (DEI) using Case Studies, Duo Lingo English Proficiency Tests

Unit 2	**Professional Expression and Digital Literacy**	**4 hours**

TMAY through Driver's test, Writing Effective Prompts on Various LLMs, Duo Lingo English Proficiency Tests

Unit 3	**Interpersonal Effectiveness and Emotional Intelligence**	**4 hours**

Negotiation & Persuasion Role Plays, Developing Emotional Intelligence via Scenario-Based Discussions

Total Lecture Hours	**15 hours**

Useful Resources:

1. https://youtu.be/5Wr-uaGzY7c
2. https://youtu.be/NcCwlqBapHo
3. https://youtu.be/SKNmQPIBPIg
4. RAISEC - B. Tech. MCA - Introduction
5. RAISEC - B. Tech. MCA - Social Personality Type
6. RAISEC - B. Tech. MCA - Enterprising Personality Type
7. RAISEC - B. Tech. MCA - Conventional Personality Type

Mode of Evaluation

MSE		CA			ESE	Total				
MSE1	MSE2	CA1	CA2	CA3						
-	-	10	10	5						
-		25			25	-				

Course Code: EC217E	Course Name: Wireless Communications Networks	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To understand the fundamentals of computer networking and the layered architecture models.
2. To gain an in-depth understanding of the functions and protocols of each network layer.
3. To analyze wireless communication systems, including their evolution and standards.
4. To understand cellular architecture, advanced modulation techniques, and wireless communication principles.
5. To analyze multiple access techniques, design challenges, and security issues in ad-hoc wireless networks.

Course Outcome: After completion of the course, the student will be able to

1. Analyze organizational requirements and select appropriate networking architectures and apply the OSI model effectively.
2. Design and analyze network topologies and routing strategies for IP-based infrastructures and demonstrate working knowledge of network security concepts.
3. Understand the operation and evolution of various wireless communication systems and standards.
4. Describe cellular architecture and advanced modulation techniques used in wireless communication.
5. Analyze multiple access techniques and evaluate design challenges and security issues in ad-hoc wireless networks.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	2	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	3	2	-	-	2
CO3	3	1	3	2	-	1	-	-	-	-	-	2
CO4	2	2	3	3	-	-	-	-	-	1	1	1
CO5	2	2	3	3	-	2	2	3	2	2	2	1

Unit 1	Introduction to OSI Model	15 hours

OSI Model, TCP/IP reference model, Understanding of Delay, Loss and Throughput, Networking Devices
The Physical Layer: guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.
Data Link Layer- Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols – HDLC, PPP

Unit 2	About Network Layer, Transport Layer and Application Layer	15 hours

Network Layer - Virtual and Datagram networks, IP protocol and addressing in the Internet the network layer in the internet (IPv4 and IPv6), Subnetting with IPs, Routing algorithms
Transport Layer - Multiplexing and Demultiplexing, UDP, Principles of reliable data transfer, TCP, Congestion control, SIP protocol.
Application Layer- Web and HTTP, E-mail, DNS, Socket programming with TCP and UDP. DNS, electronic mail, World Wide Web: architectural overview, dynamic web document and http. Application Layer Protocols, Network Security.

Unit 3	Introduction to 1G/2G/3G/4G/5G Terminology	15 hours

Evolution of cellular systems requirements, goals, and vision of the next-generation wireless communication systems Fading, Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTEA - Wireless Standards and Introduction to 5G technology.

Unit 4	Small Cells	15 hours

Past, present, and future trends of cellular networks coverage and capacity of small cell networks Interference management, D2D architecture Towards IoT Spectrum sharing.
Multicarrier modulation, OFDM, diversity multiplexing trade-off, OFDM system, smart-antenna: beam forming, cognitive radio, software-defined radio, communication relays, spectrum sharing.

Unit 5	**Contention-Free Multiple Access Schemes**	**15 hours**

FDMA TDMA, CDMA, SDMA, and Hybrid, contention-based multiple access schemes (ALOHA and CSMA), Waveforms, Variable subcarrier spacing, supported transmission numerologies. Design Challenges in Ad-hoc wireless networks, the concept of cross-layer design, security in wireless networks, energy-constrained networks, MANET and WSN.

	Total Lecture hours	**75 hours**

Textbook

1. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill
2. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimeter Wave Wireless Communication., Pearson Education, 2015.
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Reference Books

1. Computer Networks (4th edition), Andrew Tanenbaum, Prentice Hall.
2. William Stallings, Data and Computer Communications, 10th Edition, Pearson, 2013.
3. Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint).
4. "David Tse and Pramod Viswanath", Cambridge University Press, 2005 (ISBN: 9780521845274).
5. "4G: LTE/LTE-Advanced for Mobile Broadband", Erik Dahlman, Stefan Parkvall, Johan Sköld, Academic Press, 2013 (ISBN: 9780124157874).

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3**		
40	**40**	**8**	**8**	**4**		
80		**20**			**100**	**200**

Course Code: EC211E	**Course Name: Bio-Medical Electronics & Devices**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Pre-requisite: NA

Course Objectives:

1. To Understand the effect of biomedical signals on the human body.
2. To understand and Analysis of biomedical signals obtained from the human body and electronic signals.
3. To develop a new system for the areas related to biomedical engineering.

Course Outcome: After completion of the course, the student will be able to

1. Understand human activities on the basis of biomedical signals.
2. Analysis of biomedical signals obtained from the human body and electronic signals.
3. Identify, and solve the problems related to the area of biomedical engineering devices.
4. Design a new system, or process to achieve desired needs for solving a problem in biomedical electronics engineering.
5. Understand the testing analysis of the therapeutic equipment.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	2	2	1	-	-	-	-	-	1

CO2	2	2	1	2	2	1	-	-	-	-	-	1	
CO3	2	1	1	2	2	2	-	-	-	-	-	1	
CO4	2	2	1	2	2	2	-	-	-	-	-	1	
CO5	2	2	2	2	3	2	-	-	-	-	-	1	

Unit 1	**Physiological systems and Signals**	**15 hours**

Biology of the heart, circulatory and respiratory systems, auditory systems, physiology of nerve and muscle cells, fundamental organization of brain and spinal cord.
Bio signals: Origin of bioelectric signals, electrocardiogram (ECG), phonocardiogram (PCG), encephalogram (EEG), and electromyogram (EMG).

Unit 2	**Physiological Transducers Electrodes**	**15 hours**

Silver-silver chloride electrodes, electrodes for ECG, EEG, EMG, and Microelectrodes. Performance characteristics of transducers, classification of transducers based on Electrical principle involved: Resistive position transducer, resistive pressure transducer, inductive pressure transducer, capacitive pressure transducer; Self generating inductive transducer: linear variable differential transformer (LVDT), Piezoelectric Transducer.

Unit 3	**Recording Systems**	**15 hours**

Preamplifier, Signal conditioning: Differential amplifier, current to voltage converter, instrumentation amplifier; biomedical filters: LPF, HPF, bandpass, band stop (Notch filter); source of noise in low level measurement, Recording systems for ECG, PCG, EEG and EMG.

Unit 4	**Medical Imaging Systems**	**15 hours**

X-ray imaging, Computed tomography, ultrasonic imaging systems, Magnetic resonance imaging system, thermal imaging systems.

Unit 5	**Therapeutic equipment's**	**15 hours**

Cardiac pacemaker, cardiac defibrillators, hemodialysis machine.

	Total Lecture Hours	**75 hours**

Textbook:

1. Suresh R. Devasahayam, Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing, Springer, 2019.
2. Dr R. S. Khandpur, Handbook of biomedical instrumentation, 3rd Edition, McGraw Hill Education (India).
3. Andreas Maier Stefan Steidl Vincent Christlein Joachim Hornegger (Eds.), Medical Imaging Systems, Springer.

Reference Books:

1. Devasahayam, Suresh R., Signals and systems in biomedical engineering: signal processing and physiological systems modeling, New York: Kluwer Academic/Plenum Publishers, c2000.
2. Richard S. C. Cobbold, Richard Cobbold (S. C.), Transducers for Biomedical Measurements: Principles and Applications, Wiley, 1974.
3. Leslie Cromwell, Biomedical Instrumentation and Measurement, 1st edition, Pearson Education, New Delhi, 2007.

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3(ATT)**		
40	40	8	8	4	**100**	**200**
80		**20**				

Course Code: EC213E	**Course Name: Analog Integrated Circuit Design**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Pre-requisite: NA

Course Objectives:

1. Introduce core concepts of analog IC design and CMOS technology using EDA tools.
2. Enable simulation of analog circuits like current mirrors and amplifiers.
3. Provide hands on experience in layout design, verification, and post-layout simulation using EDA Tool.

Course Outcome: After completion of the course, the student will be able to

1. Understand CMOS technology and MOSFET behaviour for analog IC design.

2. Design and simulate key analog circuits like current mirrors and amplifiers.
3. Design and simulate key analog circuits like current mirrors and amplifiers.
4. Implement end-to-end analog design flow, from schematic to GDSII generation.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	2
CO3	3	3	2	3	3	-	-	-	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2

Unit 1	**Introduction to Analog IC Design & MOSFET Characterization**	**15 hours**

Introduction to Analog IC Design, CMOS Technology Overview, Overview of Analog and Mixed-Signal ICs.
Basics of Analog VLSI: Design flow overview, CMOS fabrication and process steps, MOSFET device physics: MOSFET I-V characteristics, Threshold voltage, body effect, channel length modulation effects, MOSFET models (long channel, short channel), DC analysis of NMOS/PMOS transistors using EDA Tool.

Unit 2	**Current Mirrors and Amplifier Circuits**	**15 hours**

Basic, Cascode and Wilson current mirror. Common-source amplifier, Common Gate Amplifier and Source follower. Differential amplifier Circuit, Schematic design of current mirrors and differential amplifiers, DC and transient analysis using EDA Tool, Measurement of gain, output resistance, and CMRR.

Unit 3	**Introduction to IC Physical Design**	**15 hours**

Introduction to IC Physical Design Flow, EDA tools for PD Flow. Functional Simulation, Schematic Capture using EDA Tool, Symbol Creation. Testbench Creation using Virtuoso Schematic Editor, Delay Estimation, Power estimation.

Unit 4	**Layout Design using EDA Tool**	**15 hours**

Layout Design using EDA Tool, Layout Editor, Physical Verification which includes DRC & LVS, Parasitic Extraction, Post Layout Simulation, Generation of GDSII.

Unit 5	**Physical Implementation using EDA Tool**	**15 hours**

Physical Implementation (Current Mirror Circuit as an example) using EDA Tool that includes- layout, Physical Verification, Parasitic Extraction, Post Layout Simulation, Generation of GDSII.

	Total Lecture Hours	**75 hours**

Textbook:

1. Sedra & Smith, "Microelectronic Circuits", Oxford Publication
2. N.A.Sherwani , "Algorithms for VLSI Physical Design Automation", (3/e), Kluwer,1999.

Reference Books:

1. Behzad Razavi, "Fundamentals of Microelectronics", McGraw Hill Education
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill Education
3. Allen & Holberg, "CMOS Analog Circuit Design" Oxford Univ Press
4. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation, , Wiley-IEEE, 3rd Edition, 2010.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EC219E	**Course Name: Radar and Satellite Communication**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Pre-requisite: NA

Course Objectives:

1. Understand the principles of radar and satellite communication systems.
2. Develop practical skills using SDR and satellite trainer kits.
3. Apply knowledge to design and evaluate communication systems.

Course Outcome: After completion of the course, the student will be able to

1. Explain the principles of radar and satellite communication systems.
2. Demonstrate practical skills in communication system analysis and implementation.
3. Evaluate radar and satellite communication link performance.
4. Apply concepts to design and implement radar and satellite communication solutions.
5. Analyze emerging trends and ethical considerations in satellite communication.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	-	1
CO2	3	3	2	3	2	-	-	-	-	-	-	1
CO3	3	2	3	2	3	-	-	-	-	-	-	2
CO4	3	2	3	2	2	-	-	-	-	-	-	2
CO5	3	3	2	3	3	1	-	-	-	-	-	1

Unit 1	**Introduction to Radar Systems**	**15 hours**

Analog vs. digital modulation methods, Fundamentals of radar, radar equation and parameters, types of radars and applications, basic concepts of radar signal processing, principles of Synthetic Aperture Radar (SAR), Orbital Mechanics relevant to Radar Satellites, Introduction to Small satellites and CubeSats & their bandwidth requirements, Key components of satellite systems.

Unit 2	**Radar Components and Signal Processing**	**15 hours**

Overview of radar transmitters and receivers, Understanding the radar range equation, Antenna types and their radiation patterns , Basics of radar signal processing, Analyzing radar signal characteristics using Software Defined Radio.

Unit 3	**Introduction to Satellite Communication**	**15 hours**

Evolution and applications of satellite communication, Satellite orbits: Geostationary and non-geostationary, Overview of modern satellite services (e.g., GPS, remote sensing), Concepts of GPS, GLONASS, and BEIDOU, and NAVIC.

Unit 4	**Satellite Communication Link Design**	**15 hours**

Understanding uplink and downlink frequencies, Concept of link budget and its significance, Factors affecting signal propagation, communication links setup using the satellite trainer kit and software-defined radio for weather forecast.

Unit 5	**Emerging Trends and Practical Applications**	**15 hours**

Ethical and regulatory considerations in satellite communication, Deployment and impact of Low Earth Orbit (LEO) satellite constellations, Development of Next Generation Networks and its convergence with satellite networks, Emergence of satellite-based Internet of Things (IoT) connectivity.

	Total Lecture hours	**75 hours**

Textbook

1. Introduction To Radar Systems (II International Edition), Merrill I. Skolnik, McGraw-Hill, Inc, ISBN 0-07-057909-1
2. Introduction To Satellite Communication (III International Communication), ARTEC House Boston, ISBN-13: 978-1-59693-210-4.
3. Satellite Communications, 3ed, An Indian Adaptation" by Timothy Pratt ISBN: 9789354243035.

Reference Books

1. Satellite Communications Systems Engineering Atmospheric Effects, Satellite Link Design and System Performance, Louis J. Ippolito, Jr. USA, WILEY
2. Understanding GPS/GNSS: Principles and Applications, Third Edition, Elliott D. Kaplan, Christopher Hegarty, ISBN: 9781630810580, ARTEC House, 2017.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
40	40	8	8	4		
80		20			100	200

Course Code: EE208E	Course Name: Integration of SCADA and PLC with IIOT Gateways	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To give exposure to the students about Sensors.
2. To give exposure to the students about Automation required in industry.

Course Outcome: After completion of the course, the student will be able to

1. Understand the types of SCADA and Data sharing between PLC.
2. Understand the Real-time Data Analytics in SCADA Systems using IIoT Edge Devices.
3. Apply the IIoT-Enabled Data Interfacing for ERP Systems.
4. Apply the data types involved in PLC & IIOT Gateway
5. Develop the real time application covering of IIOT.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	2	2	-	-	-	-	2
CO2	2	-	2	-	2	2	2	-	2	-	-	2
CO3	3	-	3	2	3	2	2	-	2	-	-	2
CO4	3	2	3	3	3	2	2	-	2	-	-	2
CO5	3	2	3	3	3	2	2	-	2	-	-	2

Unit 1	Introduction SCADA	15 hours

Introduction to SCADA, SCADA software types, Tags concepts of SCADA, SCADA programming along with report generation using VB scripting. Data sharing between PLC and SCADA software.

Hands-on/Case Study/ Mini-Project/ Problem solving:

1. SCADA Programming and Simulated Report Generation using VB Scripting
2. Simulated Data Exchange Between Virtual PLC and SCADA

Unit 2	Real-time Data Analytics in SCADA Systems using IIoT Edge Devices	15 hours

Designing a hybrid SCADA-IIOT architecture, Real-time Data Analytics Techniques, how edge devices communicate with SCADA and cloud., Data formats (JSON, XML).

Hands-on/Case Study/ Mini-Project/ Problem solving:

1. Design and Simulation of a Hybrid SCADA-IIoT Architecture
2. Implementation of Cloud Connectivity in SCADA via IoT Gateways
3. Data Format Handling and Parsing: JSON vs XML in IIoT Applications
4. Edge Device Communication with SCADA and Cloud via MQTT Protocol

Unit 3	IIoT-Enabled Data Interfacing for ERP Systems	15 hours

Architecture overview: Edge device → Gateway → ERP system (How data moves from sensors/machines to ERP via IIoT gateways), Types of data shared (e.g., machine status, production metrics, energy consumption)., Benefits of energy monitoring system.

Hands-on/Case Study/ Mini-Project/ Problem solving:

1. Simulating Edge-to-ERP Data Flow in a SCADA-IIoT Architecture
2. Role and Simulation of IIoT Gateways in Industrial Communication
3. Design and Simulation of an Energy Monitoring System

Unit 4	**Data Types involved in PLC & IIOT Gateway**	**15 hours**

Boolean (Binary Data), Integer, Float / Real, String (Device names, status messages, error codes, configuration parameters), Date Time / Timestamp.

Hands-on/Case Study/ Mini-Project/ Problem solving:

1. Handling Boolean (Binary) Data for Machine Status and Control
2. Transmission and Logging of Integer and Float Data in SCADA-IIoT
3. Using Strings in SCADA for Device Identification and Messaging

Unit 5	**Application Development**	**15 hours**

Developing real time application covering all above topics (Edge device → Gateway → ERP system)

Hands-on/Case Study/ Mini-Project/ Problem solving:

1. Real-Time Data Analytics and Visualization using Dashboards
2. Simulation of Edge Device Data Generation Using Multiple Data Types
3. Simulating Data Exchange from Gateway to ERP System

Total Lecture hours	**75 hours**

Textbook

1. S. K. Singh, *Industrial Automation and Control*. New Delhi, India: McGraw Hill, 2016.
2. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, *Industrial Internet of Things: Cyber manufacturing Systems*. Cham, Switzerland: Springer, 2017.

Reference Books

1. S. G. McCrady, *Designing SCADA Application with VB and Database*. Oxford, UK: Elsevier, 2006.
2. R. Buyya and A. V. Dastjerdi, *Internet of Things: Principles and Paradigms*. Cambridge, MA, USA: Morgan Kaufmann, 2016.
3. S. A. Boyer, *SCADA: Supervisory Control and Data Acquisition*, 4th ed. Durham, NC, USA: ISA, 2009.
4. T. Winters, *Practical Industrial Internet of Things (IIoT): A Guide to Smart Manufacturing and Industry 4.0*. Birmingham, UK: Packt Publishing, 2020.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
40	40	8	8	4		
80		20			100	200

Course Code: EL207E	Course Name: AI and Machine Learning for Smart Grids	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To introduce AI/ML fundamentals and their relevance in power systems and smart grids.
2. To develop skills for data acquisition, preprocessing, and analytics in smart grid scenarios.
3. To model and implement AI/ML solutions for load forecasting, fault detection, and demand-side management.
4. To expose students to industry-standard case studies, tools, and Tata Power-DDL's real-world implementations.

Course Outcome: After completion of the course, the student will be able to

1. Understand and interpret the role of AI/ML in the evolution of smart grid systems.
2. Apply ML models for load forecasting, anomaly detection, and predictive analytics in power networks.
3. Implement AI/ML algorithms using Python and MATLAB on real-world or simulated smart grid datasets.
4. Evaluate AI/ML-based smart grid case studies, especially from Tata Power-DDL, and suggest improvements.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	-	-	-	-	1	-	2
CO2	2	3	3	2	3	-	-	-	-	2	2	2
CO3	2	3	3	2	3	-	-	-	-	2	2	2
CO4	2	2	2	2	3	1	1	-	1	2	3	3

Unit 1	Introduction to AI and ML in Smart Grids	19 hours

Smart Grid recap (digitization, two-way communication, IoT, and DERs), AI/ML in power systems, Supervised vs Unsupervised learning; Overview of common models (LR, SVM, k-NN, Decision Trees, ANN), Smart grid data ecosystem: types, sources, and formats.

Activities:

- Import and explore power system datasets using Pandas and Matplotlib
- Simulate time-series power data and visualize trends using SCADA/Excel.

Unit 2	Load Forecasting using ML Techniques	19 hours

Short-term, medium-term, and long-term load forecasting, Regression models (Linear Regression, Ridge, Lasso), Neural Networks and LSTM models for time-series forecasting, Evaluation metrics (RMSE, MAPE, R^2)

Activities:

- Build and train a linear regression model to forecast daily load
- Implement LSTM-based load prediction using Keras/TensorFlow.

Unit 3	Fault Detection and Predictive Maintenance	19 hours

Nature of faults in transmission/distribution systems, Signal processing and feature extraction (FFT, DWT), Classification algorithms (SVM, Random Forest, CNN for fault identification), Predictive maintenance using anomaly detection and clustering (k-Means, DBSCAN)

Activities:

- Analyze voltage/current signal datasets using FFT in MATLAB
- Train a classifier for fault detection using SVM in Python.

Unit 4	Demand Response and Optimization using AI	18 hours

Demand response (DR) basics (TOU pricing, dynamic pricing, peak shaving), Optimization techniques (Genetic Algorithms, Reinforcement Learning), Consumer behavior prediction using unsupervised learning, Load disaggregation and demand-side flexibility.

Activities:

- Implement simple DR strategies using pricing signals in Python
- Simulate RL-based load control policy using OpenAI Gym.

Total Lecture Hours	75 hours

Textbook:

1. Elissaios Sarmas et al., Artificial Intelligence for Energy Systems, Springer
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Reference Books:

1. Tata Power-DDL Technical Reports, Whitepapers
2. IEEE Transactions on Smart Grid
3. GitHub Repositories for Power System AI Projects
4. Online datasets: Kaggle, UCI ML Repository, OpenEI.

Mode of Evaluation:

MSE	CA	ESE	Total

MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EC221E	Course Name: System Engineering-II	L	T	P	C
		3	0	2	4

Course Objectives:

1. To develop a deep understanding of systems thinking and its application in engineering contexts.
2. To analyze and apply different systems engineering process models, including both plan-driven and agile approaches.
3. To understand and design systems architectures, considering function, form, and innovation.
4. To integrate systems engineering concepts into production, operations, and long-term system support.
5. To perform comprehensive need analysis to derive operational and performance requirements.

Course Outcome: After completion of the course, the student will be able to

1. Apply systems thinking frameworks to understand and model complex engineering systems from environmental, structural, and functional perspectives.
2. Compare and contrast plan-driven and agile systems engineering process models and apply them to real-world projects.
3. Design system architectures with clear definition of subsystems, interfaces, and hierarchies in alignment with functional and performance goals.
4. Demonstrate understanding of system transition from development to production, and manage in-service support, upgrades, and modernization activities.
5. Formulate system-level objectives and evaluate alternative solutions using synthesis-analysis strategies and economic feasibility methods.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	-	-	-	-	1
CO2	3	3	2	3	2	2	2	-	-	-	-	1
CO3	3	2	3	2	3	-	-	-	-	-	-	2
CO4	3	2	3	2	3	-	-	-	-	-	-	2
CO5	3	3	2	2	3	-	2	-	-	-	-	1

Unit 1	Systems Thinking	15 hours

System Models as a basis for systems thinking, Environment-oriented, structure-oriented and effect-oriented View, Application of system-hierarchical thinking, Agility of Systems.

Unit 2	Process Models	15 hours

Components of systems engineering process model, Relations between individual components of the process model, Plan-driven models, Agile process models, Principle of variant creation, Project phases structuring as a macro-logic, Problem-solving cycle as a micrologic, Problem area and solution system, Systems thinking and solution, System-oriented thinking and teamwork, Systems thinking and project management.

Unit 3	Systems Architecture	15 hours

Task and meaning of systems architecture, Relationship of function and form to architecture, Characteristics of good architectures, Architecture and innovation, Role of systems architects, System building blocks and interfaces, Hierarchy of complex systems, The system environment, Interfaces and Interactions.

Unit 4	Need Analysis and Formulation of Objectives	15 hours

Need Analysis: Originating a new system, Implementation of concept exploration, Principles and approaches of need analysis, Techniques for need analysis, System requirements, Operational requirements, Performance requirements.
Formulation of Objectives: Formulation of objectives at different system levels, Methods and process for formulating objectives, Search for solutions: Synthesis/analysis strategies for finding solutions, The Procedure of synthesis/analysis. Evaluation methods, Economic feasibility Calculation.

Unit 5	Production, Operations and Support	15 hours

Systems engineering in the factory, Engineering for production, Transition from development to production, Production operations, acquiring production knowledge base, Installing, maintaining, and upgrading the system, Installation and testing, Inservice support, Major system upgrades, Modernization.

Total Lecture hours	**75 hours**

Textbook

1. Benjamin S. Blanchard and Wolter J. Fabrycky, *Systems Engineering and Analysis*, 5th Edition, Pearson Education.
2. Andrew P. Sage and James E. Armstrong Jr., *Introduction to Systems Engineering*, Wiley.
3. Dennis M. Buede and William D. Miller, *The Engineering Design of Systems: Models and Methods*, 3rd Edition, Wiley.

Reference Books

1. Andrew P. Sage and William B. Rouse, *Handbook of Systems Engineering and Management*, 2nd Edition, Wiley.
2. Peter Checkland, *Systems Thinking, Systems Practice*, Wiley.
3. John W. S. Hearns, *Systems Engineering: Principles and Practice*, 2nd Edition, Wiley.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	**MSE2**	**CA1**	**CA2**	**CA3**		
40	**40**	**8**	**8**	**4**		
80		**20**			**100**	**200**

Practical Courses Detail Syllabus

Course Code: EC205P	Course Name: Analog Communication Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

1. Apply the applications of probability theory for analog communication.
2. Design and analyze amplitude modulation systems including DSB-C, DSB-SC, SSB, VSB, and QAM.
3. Study angle modulation techniques, FM/PM relation, bandwidth calculation, FM modulators/demodulators, and stereophonic FM broadcasting.

Course Outcome: After completion of the lab, the student will be able to

1. Apply the fundamental knowledge of engineering mathematics to communication signals.
2. Analyze the power and transmission bandwidth of amplitude modulated signals.
3. Analyze the power and transmission bandwidth of angle modulated signals.
4. Apply the process of reproduction from analog to digital signaling.
5. Apply the knowledge of analog modulation for various applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	1	-	-	-	-	-	2
CO3	3	3	2	2	1	1	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2
CO5	3	3	2	2	1	1	-	-	-	-	-	2

List of Experiments:

1. Design and Perform Frequency and Power Spectrum analysis of Sine wave, and Modulated Signals using a Spectrum Analyzer or SDR.
2. Analyze Frequency Division Multiplexing (FDM) System using MATLAB and Spectrum Analyzer/SDR
3. Implement an Amplitude Modulation and Demodulation System and analyze the waveforms and calculate the modulation index.
4. Implement Frequency Modulation and Demodulation System, analyze waveforms, and calculate Modulation Index.
5. Analyze the Effect of Additive Noise on AM, FM & PM Signals Using CWL MATLAB.
6. Implement a PCM Modulation and Demodulation System & analyze its waveforms.
7. Implement a Delta Modulation and Demodulation System & analyze its waveforms.
8. Implement a Pulse Amplitude Modulation (PAM) & Demodulation System, and Analyze the effect of sampling parameters (under sampling, critical sampling, & oversampling) on Signal Reconstruction
9. Design and construct an AM Demodulator.
10. Design and construct a sampling and hold circuit.
11. Mini project using MATLAB

Total Hours: 30 hours

Mode of Assessment (Lab)

CA		ESE	Total
CA1	CA2		
12	13	25	50
25			

Course Code: EC301P	Course Name : Microelectronic Circuits Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

1. Understand the Energy band diagram, charge carrier transport phenomenon, recombination generation process of different types of semiconductor materials.
2. To understand the various design parameters of P-n junction.
3. Analyze the design parameters of BJT and its various models.
4. Analyze the MOS capacitor and its various design parameters.
5. Analyze the design parameters of MOSFET i.e.- Channel length & width, depletion width, surface field and potential, ON resistance, trans conductance, equivalent circuits, amplification factors, capacitances, noise margins, scaling & short channel effects MOSFET.

Course Outcome: After completion of the lab, the student will be able to

1. Understand the principles of semiconductor Physics.
2. Understand and utilize the mathematical models of semiconductor junctions.
3. Understand carrier transport in semiconductors, BJT and MOSFET.
4. Analyze the mathematical models of MOS transistors for circuits and system.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	2	-	-	-	-	2	2
CO2	3	3	3	2	2	2	-	-	-	-	1	2
CO3	3	3	3	2	1	2	-	-	-	-	2	3
CO4	3	3	2	3	2	2	-	-	-	-	1	3

List of Experiments:

1. Study V-I characteristics of PN junction diode and its application as full wave rectifier.
2. Study V-I characteristics of Zener diode, graphical measurement of forward, reverse resistance and its application as voltage regulator.
3. Study fixed bias circuit of BJT, draw the load line and analyze its Q point.
4. Study input and output characteristics of BJT in CE/CB/CC Configuration.
5. Study output and transfer characteristics of MOSFET in CS/CD/CG Configuration.

6. Simulate and analyze the dc and transient characteristic of diode-based clipper and clamper circuit.
7. Simulate and analyze the transfer and output characteristics of NMOS transistor.
8. Simulate and analyze the DC and transient response of a CMOS inverter.
9. Simulate and analyze the transfer characteristic of BJT based simple current mirror.
10. Simulate and analyze the transfer characteristic of NMOS based simple current mirror.
11. Mini-Project

Total Hours: 30 hours

Mode of Assessment

CA		ESE	Total
CA1	CA2		
12	13	25	50
25			

Course Code: IT301P	Course Name: Database Systems Lab	L	T	P	C
		0	0	2	1

Pre-requisite: Concepts of any programming language

Course Objectives:

1. Develop Hands-on SQL Skills
2. Design and Normalize Databases
3. Work with PL/SQL and Advanced Database Concepts

Course Outcome: After completion of the lab, the student will be able to

1. Design Logical and Conceptual database schema for real life problem using ERD
2. Apply SQL to store, retrieve and manipulate data in relational database.
3. Apply PL/SQL to solve real world database management and automation task

CO-PO Mapping (scale 1: low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	3	1	1	1	2	2	1	2
CO2	3	3	2	1	3	1	1	1	1	1	1	2
CO3	3	3	2	1	3	1	1	1	1	2	1	2

List of Experiments:

EXP 01

Creating Entity-Relationship Diagram using case tool (STAR UML)
[Group formation and assigned project to submit a report at the end of the semester as project-based learning]

1	Insurance Database
2	Banking Enterprise Database
3	Supplier Database
4	Student Faculty Database
5	Airline Flight Database
6	Order Processing Database
7	Book dealer Database
8	Student Enrolment Database
9	Movie Database
10	College Database
11	Hostel Database
12	Library Database
13	Clinic Database
14	Medical Store Database
15	Exam Process Database

EXP 02

Introduction to date types and database implementation using Create, insert, and Basic SQL SELECT statements.
Create these two tables with following specifications and insert data in the table:

Table Name: Client master

Attribute	**Data Type**	**Size**
Client_no	number	10
Client_Name	Varchar2	20
City	Varchar2	15
State	Varchar2	15
Pin	Number	6
Balance_due	Number	10,2

Data for Client master:

CLIENT_NO	**Client_NAME**	**CITY**	**STATE**	**PIN_CODE**	**BAL_DUE**
0001	Ivan	Bombay	Maharastra	400057	15000
0002	Vandura	Madras	Tamilnadu	980001	0
0003	Pramod	Bombay	Maharastra	400057	5000
0004	Basu	Bombay	Maharastra	400056	0
0005	Ravi	Delhi	Null	100001	2000
0006	Rukmini	Bombay	Maharastra	900050	0

PRODUCT_MASTER

COLUMN	**DATA TYPE**	**Size**
PRODUCT_NO	VARCHAR2	6
DESCRIPTION	VARCHAR2	20
PROFIT%	NUMBER	10
QTY_ON_HAND	NUMBER	10
ORDER_LEVEL	NUMBER	10

SELL_PRICE	NUMBER	10
COST_PRICE	NUMBER	10

Data for Product_Master Table

Product_No	Description	Profit %	Qty_on hand	Reorder_level	Sell price	Cost price
P00001	1.44 floppies	5	100	20	525	500
P03453	Monitors	6	10	3	12000	11200
P06734	Mouse	5	20	5	1050	500
P07865	1.22 floppies	5	100	20	525	500
P07868	Keyboards	2	10	3	3150	3050
P07885	CD drive	2.5	10	3	5250	5100
P07965	540 HDD	4	10	3	8400	8000
P07975	1.44 Drive	5	10	3	1050	1000
P08865	1.22 Drive	5	2	3	1050	1000

Perform following queries on the above data:

(a) Find out the name of all the clients.
(b) Retrieve the list of names and cities of all the clients.
(c) List all the clients who are located in Bombay.
(d) Display the information for client no 0001 and 0002.
(e) Find the list of all clients who stay in city 'Bombay' or 'Delhi' or 'Madras'.
(f) List the name, city, and state of clients not in state of 'Maharashtra'

EXP 03

To manipulate data in the existing tables

Using the table client master and product master answer the following queries:

(a) Delete the record of Client no. 0001 from the Client master table.
(b) Change the city of Client no. 0005 to 'Bombay'.
(c) Change the balance due of Client no. 0002 to 1000.
(d) Find out the clients who stay in a city or state where second letter is a.
(e) Calculate the average balance due of all the clients.
(f) Change the selling price of 1.44 floppy drive to Rs. 1150.00.
(g) Count the number of products having price greater than or equal to 1500.

EXP 04

To create, manage tables with constraints and alter the structure of tables.

CREATE THE TABLES WITH FOLLOWING SPECIFICATIONS AND CONSTRAINTS:

TABLE NAME: SALES MASTER

ATTRIBUTE	DATA TYPE	SIZE	CONSTRAINT
SALESMAN_NO	VARCHAR2	6	PRIMARY KEY, FIRST LETTER IS 'S'
SALES_NAME	VARCHAR2	20	NOT NULL
ADDRESS	VARCHAR2	20	NOT NULL
CITY	VARCHAR2	20	---
STATE	VARCHAR2	20	---
PINCODE	NUMBER	6	---
SAL_AMT	NUMBER	8,2	NOT NULL, CAN'T BE ZERO
Tgt_to_get	NUMBER	6,2	NOT NULL, CAN'T BE ZERO
Ytd_sales	NUMBER	6,2	NOT NULL, CAN'T BE ZERO
Remark	VARCHAR2	30	

TABLE NAME: SALES ORDER

ATTRIBUTE	DATA TYPE	SIZE	CONSTRAINT
S_ORDER_No	VARCHAR2	6	PRIMARY KEY, FIRST LETTER IS 'O'
S_ORDER_DATE	DATE	---	---
CLIENT_NO	NUMBER	10	FOREIGN KEY FROM CLIENT MASTER

SALESMAN_NO	VARCHAR2	26	FOREIGN KEY FROM SALES MASTER
DELIVERY_TYPE	CHAR	1	P FOR PARTIAL AND F FOR FULL, DEFAULT IS F
BILLED_YN	CHAR	1	'Y' FOR YES AND 'N' FOR NO
DELIVERY_DATE	DATE	---	CAN'T BE LESS THAN S_ORDER_DATE
ORDER_STATUS	VARCHAR2	10	IN(IN-PROCESS, FULFILLED, BACK ORDER, CANCELLED)

TABLE NAME: Sales_order_detail

Column	Dadatype	Size	Attributes
S_order_no	Varchar2	6	PK/FK references s_order_no of sales_order
Product_no	Varchar2	6	PK/FK references product_no of product_master
Qty_order	Number	8	
Qty_disp	Number	8	
Product_rate	Number	10,2	

DATA OF SALES_MASTER:

Sales No.	Sales_Name	Address	City	Pincode	State	Salamt	Tgt_to_get	Ytd_sales	Remark
S00001	Kiran	A/14 worli	Bombay	400002	MAH	3000	100	50	Good
S00002	Manish	65, Nariman	Bombay	400001	MAH	3000	200	100	Good
S00003	Ravi	P-7, Bandra	Bombay	400032	MAH	3000	200	100	Good
S00004	Ashish	A/5 Juhu	Bombay	400044	MAH	3500	200	150	Good

DATA OF SALES_ORDER

S_order_no	S_order_date	Client no	Dely type	Bill yn	Salesman no	Delay date	Orderstatus
O19001	12-Jan-96	1	F	N	50001	20-Jan-96	IP
O19002	25-Jan-96	2	P	N	50002	27-Jan-96	C
O16865	18-Feb-96	3	F	Y	500003	20-Feb-96	F
O19003	03-Apr-96	1	F	Y	500001	07-Apr-96	F
O46866	20-May-96	4	P	N	500002	22-May-96	C
O10008	24-May-96	5	F	N	500004	26-May-96	IP

Data for sale_order_detail

S_order_no	Product_no	Qty_order	Qty_disp	Product_rate
O19001	P00001	4	4	525
O19001	P07965	2	1	8400
O19001	P07885	2	1	5250
O19002	P00001	10	0	525
O46865	P07868	3	3	3150
O46865	P07885	10	10	5250
O19003	P00001	4	4	1050
O19003	P03453	2	2	1050
O46866	P06734	1	1	12000

	<table><tr><td>O46866</td><td>P07965</td><td>1</td><td>0</td><td>8400</td></tr><tr><td>O10008</td><td>P07975</td><td>1</td><td>0</td><td>1050</td></tr><tr><td>O10008</td><td>P00001</td><td>10</td><td>5</td><td>525</td></tr></table> 1) Make client_no primary key in client_master. 2) Add new column phone_number inclient_master table. 3) Add not null constraint in product master with columns : description, profit_percent, sellprice, costprice 4) Change size of client_no field in client_master. 5) Add check constraint to product_master such that sellprice is always greater than costprice. 6) Select produc_no,description where profit percent is between 20 and 30 both inclusive.
EXP 05	To implement join concepts. 1. Find out the product which has been sold to 'Ivan'. 2. Find out the product and their quantities that will have to be delivered. 3. Find out the names of clients who have purchased 'CD DRIVE' 4. List the product_no and s_order_no of customers having qty ordered less than 5 from the order details table for the product '1.44 floppies'. 5. Find the product and their quantities for the orders placed by 'Vandan' and 'Ivan'. 6. Find the products and their quantities for the orders placed by client_no 'C00001" 7. Find the order_no, Client_noanssalesman_no where a client has been received by more than one salesman.
EXP 06	To aggregate data using group function and implement the concept of sub-queries. **Perform following queries based on all 5 tables mentioned above:** 1. Print the description and total quantity sold for each product. 2. Find the value of each product sold. 3. Find out the products which have been sold to 'Ivan'. 4. Find the names of clients who have 'CD Drive'. 5. Find the products and their quantities for the orders placed by 'Vandana' and 'Ivan' 6. Select product_no, total_qty_ordered for each product. 7. Display the order number and day on which clients placed their order. 8. Display the month and date when the order must be delivered. **To implement concept of sub-queries.** 1. Find the product_no and description of non moving products. 2. Find the customer name, address, city and pincode for the client who has placed order no "019001". 3. Find the client name who have placed order before the month of may 2006. 4. Find out if product "1.44 Drive" is ordered by only client and print the client_no, name to whom it was soled. 5. Find the name of client who have placed orders worth Rs. 10000 or more. 6. Select the orders placed by "Rahul Desai". 7. Select the name of person who are in Mr.Pradeep's department and who have also worked on inventory control system. 8. Select all the clients and the slaesman in the city of Bombay. 9. Select slaesman name in Bombay who has atleast one client located at Bombay. 10. Select the product_no, description, qty_on-hand, cost_price of non_moving items in the product_master tab.
EXP 07	To implement the concept of views and indexes 1. Create an index on the table client_master, field client_no. 2. Create an index on the sales_order, fields_order_no. 3. Create a composite index on the sales_order_details table for the columns_order_no. and product_no. 4. Create view on salesman_master whose sal_amt is less than 3500. 5. Create a view client_view on client_master and rename the columns as name, add1, add, city, pcode, state respectively. 6. Select the client names from client_view who live in city 'Bombay' 7. Drop the view client_view.
EXP 08	**To implement concept of PL/SQL** 1. WAP in PL/SQL for addition of two numbers. 2. WAP in PL/SQL for addition of 1 to 100 numbers. 3. WAP in PL/SQL to inverse a number, eg. NUMBER 5639 when inverted must be display as output 9365.
EXP 09	**To implement concept of cursor** Create a explicit cursor which updates the salary of an employee such that,

	1. If salary > 10000, then increase the salary by 15% 2. If 5000<salary <10000, then increase the salary by 12% 3. Otherwise, increase the salary by 25%.

EXP 10	**To create procedures and functions and triggers in Oracle.**
	DECLARE
	x VARCHAR2(20);
	BEGIN
	SELECT RTRIM (TO_CHAR(SYSDATE, 'DAY'), ' ') INTO x from DUAL;
	IF x = 'SUNDAY' THEN
	RAISE_APPLICATION_ERROR (-20001, 'Transaction is not allowed');
	END IF;
	END;
	
	Solution2. This package has one subprogram; procedure, update_sal.
	CREATE OR REPLACE PACKAGE emp_pack
	IS
	PROCEDURE update_sal (eno IN NUMBER);
	
	END emp_pack;
	CREATE OR REPLACE BODY emp_pack
	IS
	PROCEDURE update_sal (eno IN NUMBER)
	IS
	x EMP.Empno % type
	y EMP. Sal % type
	BEGIN
	SELECT empno, sal INTO x, y FROM emp WHERE empno=eno;
	IF y> 3000 THEN
	UPDATE EMP SET Sal= sal*1.1 WHERE Empno =eno;
	ELSIF y between 2000 AND 3000 THEN
	UPDATE EMP SET Sal= Sal*1.05 WHERE Empno =eno;
	ELSE
	UPDATE EMP SET Sal= Sal*1.03 WHERE Empno =eno;
	END IF;
	
	Calling a Package
	Calling a package means actually referencing one of its elements. Following is the method for calling an element from a package.
	
	DECLARE
	x VARCHAR2(20);
	BEGIN
	emp_pack.update_sal (7633);
	END;

	Total Hours: 30 hours

Mode of Assessment

CA		ESE	Total
CA1	CA2		
12	13	25	50
25			

Course Code: EC302P	Course Name: Digital Communication Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

1. Analyze the Digital Data Transmission techniques and apply them to Digital Communication.
2. Apply different types of coding techniques to design the optimum receiver for AWGN channels.
3. Develop the practical skills for implementation of information theory and error detection & correction for various digital applications.

Course Outcome: After completion of the course, the student will be able to

1. Analyze various digital passband Modulation Techniques and digital data transmission.
2. Apply the knowledge of mathematics for the analysis of Digital Communication System
3. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
4. Analyze the behavior of information theory and its role in a digital communication system.
5. Apply the principles of digital communication to implement the error control coding techniques for reliable data transmission.

CO-PO Mapping (scale 1: low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	1	-	-	-	-	-	2
CO3	3	3	2	2	1	1	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2
CO5	3	3	2	2	1	1	-	-	-	-	-	2

List of Experiments:

1. Implementation and analysis of BASK modulation and demodulation.
2. Implementation and analysis of BFSK modulation and demodulation.
3. Implementation and analysis of BPSK modulation and demodulation.
4. Implementation and analysis of QPSK modulation and demodulation.
5. Generation of Square wave & Triangular periodic wave using fundamental sinusoidal wave and its harmonics.
6. To simulate the M-array Phase shift keying technique using MATLAB.
7. To study the generation and detection of DPSK using MATLAB.
8. To study ISI and EYE patterns of digital signaling using CWL MATLAB.
9. Implementation and analysis of DSSS Modulation, Demodulation & BER measurement using CWL MATLAB.
10. Implementation and analysis of FHSS Modulation, Demodulation & BER measurement using CWL MATLAB.
11. To simulate the working of the Convolution encoder using CWL MATLAB.

Total Hours: 30 hours

Mode of Assessment

CA		ESE	Total
CA1	CA2		
12	13	25	50
25			

Course Code: EC401P	Course Name: Linear Integrated Circuits Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

1. Know about the operational amplifier and its applications.
2. To familiarize about the filters and feedback topologies.
3. To know the bridge of Analog to Digital Electronics.
4. To learn about the current biasing schemes in Analog Electronics.
5. To know the concepts of OTA.

Course Outcome: After completion of the lab, the student will be able to

1. Analyze Opamp based linear and non-linear applications.
2. Analyze second order filters and feedback topologies.
3. Apply the Concept of CMOS inverter to implement various Boolean Expressions.
4. Analyze the Current mirror circuits
5. Apply the Concept of OTA.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO -PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	1	1	1
CO2	3	3	2	1	1	-	-	-	-	1	1	1
CO3	3	3	2	1	1	-	-	-	-	1	1	1
CO4	3	3	2	1	1	-	-	-	-	1	1	1
CO5	3	3	2	1	1	-	-	-	-	1	1	1

List of Experiments:

1. Design a function generator using operational amplifier (sine, triangular & square wave).
2. Design and calculation of frequency of oscillation for Wein Bridge Oscillator.
3. Design an astable multivibrator using Operational Amplifier.
4. Design and verification of Voltage Controlled Oscillator.
5. Design and verification of Universal Active filter for various filters of center frequency 1 KHz.
6. Design the following using ORCAD PSPICE:
   a) A unity gain amplifier using operational amplifier.
   b) An inverting amplifier with a gain of "10" using operational amplifier.
   c) A non-inverting amplifier with a gain of "11" using operational amplifier.
7. Designing of Second order Low pass and high pass filter of cut off frequency 1 KHz and 12 KHz respectively using ORCAD PSPICE.
8. Designing of Band pass filter with unit gain of pass band from 1 KHz to 12 KHz using ORCAD PSPICE.
9. Transient Analysis of NOR Gate inverter and implementation of XOR gate using NOR gate.
10. Transient & DC Analysis of NAND Gate using CMOS inverter.
11. Mini - Project

Total Hours: 30 hours

Mode of Assessment

CA		ESE	Total
CA1	CA2		
12	13	25	50
25			