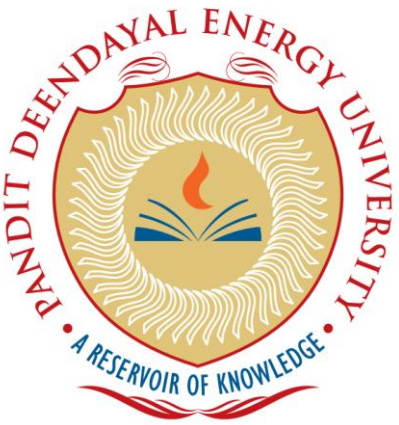
Pandit Deendayal Energy University
Gandhinagar



School of Technology

Electronics and Communication Engineering

Undergraduate Curriculum Handbook

(Academic Year 2020-24)

Vision

To become a higher learning and research pioneer and to produce creative solutions using knowledge in the domain of Electronics and Communication Engineering to meet sustainable societal and environmental needs.

Mission

- To deliver high-value education and strive for global recognition by excelling in teaching, research, and public service.
- To provide globally competent and futuristic graduates prepared for life-long engagement in the highly dynamic field of ECE.
- To develop engineering skills to meet futuristic technological challenges for sustainable environment, economy, and society.

Program Outcomes (POs)

1. **Engineering knowledge:** An ability to apply knowledge of mathematics, science, and engineering in solving/analyzing problems in industries, research and development institutions, public sector units, higher education and in academia.

2. **Problem Analysis:** An ability to design and conduct experiments, as well as to analyze and interpret data in mechanical engineering theory and practice at various industrial work-places.

3. **Design/ Development of solutions:** An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, health and safety, manufacturability, and sustainability.

4. **Multidisciplinary Approach:** An ability to function on multidisciplinary teams.

5. **Modern tool usage:** An ability to identify, formulate, and solve engineering problems using modern tools and techniques.

6. **Communication:** An ability to communicate effectively.

7. **The Engineer and Society:** The broad education necessary to understand the impact of mechanical engineering solutions in a local, global, economic, environmental, and societal context.

8. **Life-long learning:** A recognition of the need for, and an ability to engage in life-long learning.

9. **Investigations of complex problem:** Use of Applied research including design of experiments, analysis and interpretation of data, synthesis of the information to provide valid solutions with the knowledge of contemporary issues.

10. **Project Management:** An ability to apply engineering knowledge and management principles skills to manage engineering projects.

11. **Environment and Sustainability:** An ability to design sub-systems, systems, components and processes to fulfil demand of environmental sustainability.

12. **Ethics:** Apply engineering principles toward the professional values and ethics.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- Prepare professionals with futuristic skills for industry, research organizations and academia in the field of electronics and communication engineering.
- Impart knowledge and technical skills to students for contribution to the design and development in Electronics, Communication and Signal Processing, and VLSI systems.
- Motivating graduates for lifelong learning with leadership qualities, ethics and life skills to become good human beings and engineering professionals.

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PROGRAM SPECIFIC OUTCOMES (PSOs)

The graduates of Electronics and Communication Engineering will be able to

- Apply electronics and communication engineering knowledge to solve multidisciplinary problems using tools and technologies.
- Understand, analyze and evaluate the impact of electronics and communication technology on Environment, Energy, Infrastructure, Organizations and Economy.
- Contribute to the environment, society and industries by providing solutions spanning Electronics, Communication and Signal Processing, and VLSI Systems.

Semester I

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester I			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20MA101T	Mathematics- I	3	1	0	4	4	25	50	25	--	--	100
2	20CH101T	Engineering Chemistry	3	0	0	3	3	25	50	25	--	--	100
3	20CH101P	Engineering Chemistry Lab	0	0	2	1	2	--	--	--	50	50	100
4	20ME102T	Element of Mechanical Engineering	3	0	0	3	3	25	50	25	--	--	100
5	20ME102P	Element of Mechanical Engineering Lab	0	0	2	1	2	--	--	--	50	50	100
6	20IC101T	Basic Electronics	2	0	0	2	2	25	50	25	--	--	100
7	20IC101P	Basic Electronics Lab	0	0	2	1	2	--	--	--	50	50	100
8	20CP101T	Computer Programming-I	1	0	0	1	1	25	50	25	--	--	100
9	20CP101P	Computer Programming Lab-I	0	0	2	1	2	--	--	--	50	50	100
10	16HS109T	Professional Ethics and Human Values	1	0	0	1	1	25	50	25	--	--	100
11	16SP101/2/3	NCC/NSS/Sports	0	0	2	1	2	--	--	--	100		100
		TOTAL	**13**	**1**	**10**	**19**	**24**						**1100**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination.

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20MA101T					MATHEMATICS-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to evaluate problems related to differential and integral calculus of complex functions.
- To be able to obtain area, volume using integral calculus.
- To be able to formulate and solve various engineering problems using the calculus.
- To study the properties of Matrix algebra and apply them to solve system of algebraic equations.

UNIT 1 DIFFERENTIAL CALCULUS AND ITS APPLICATIONS **08 Hrs.**

Partial derivative and its application, - Euler's theorem - Total derivatives - Jacobians – Maxima and Minima of two variables using Lagrange's multipliers. Convergence of infinite series.

UNIT 2 INTEGRAL CALCULUS AND ITS APPLICATIONS **12 Hrs.**

Definition Evaluation of double integral (Cartesian – Polar form) – Change of orders - Change of variables – Evaluation of triple integral, change of variables (Cartesian to spherical – and cylindrical) – Applications, area – volume – center of mass – center of gravity by double and triple integral.

UNIT 3 MATRIX ALGEBRA AND ITS APPLICATIONS **10 Hrs.**

Solution of system of algebraic equation - Rank of a matrix, consistency of system of equation - Characteristic equation of a square matrix- Eigen values and Eigenvectors of a real matrix - Properties of eigen values and eigen vectors - Cayley-Hamilton theorem (without proof) - finding inverse of a matrix - Diagonalisation of a matrix using orthogonal transformation.

UNIT 4 VECTOR CALCULUS **10 Hrs.**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector Integration – Simple problems on line, surface and volume integrals – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (without proofs) – Simple application involving cubes and rectangular parallelepipeds.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of convergence of infinite series in engineering aspects.
CO2 – Understand the concept of Directional derivative, Irrotational and Solenoidal vector fields.
CO3 – Apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution in context with theory.
CO5 – Appraise mathematical problems from real to complex domain.
CO6 – Evaluate problems on Green's, Stokes' and Divergence theorems.

TEXT/REFERENCE BOOKS

- B. S Grewal, Higher Engineering Mathematics, (43rd Edition), Khanna Pub., Delhi (2014).
- R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science, 3rd Ed., 2007.
- Erwin Kreyszig, Advanced Engineering mathematics, John Wiley, 10th Ed., 2015.
- G. Strang, Linear Algebra and its applications, 4th Edition, Cengage Learning, 2005.
- K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 10 questions 3 marks each	30 Marks (40 min)
Part B: 5 questions 6 marks each	30 Marks (50 min)
Part C: 5 questions 8 marks each	40 Marks (90 min)

16SC101T					Engineering Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding about atomic structure and interatomic bonding.
- To provide the knowledge about structural features, synthesis, properties of various categories of materials.
- To develop the skills for phase, microstructural and elemental characterisation of materials.
- To provide the knowledge about the role of chemistry in modern engineering applications.

UNIT 1 Atomic structure and interatomic bonding **12 Hrs**

Electrons in atoms, Bohr atomic model, wave mechanical model, introduction to quantum chemistry, wave functions and probability densities, quantum numbers, orbital shapes - *s,p,d,f*- LCAO-MO of H_2, covalent, ionic and metallic bonding, bonding forces and energies, lattice energy and Madelung constant, metallic crystal structure, ceramic crystal structure and influencing factors.

UNIT 2: Chemistry of materials **10 Hrs**

Introduction and classification of materials; structural features, synthesis, properties of metallic (e.g. noble metal), polymeric (e.g. thermoplastic and thermosetting), glass-ceramic (e.g. silicates, metal oxides) carbonaceous materials (e.g. fullerene, carbon nanotube, graphene); Introduction to nanomaterials, surface area to volume ratio and aspect ratio of nanomaterials, quantum confinement, top-down and bottom up chemical/physical approaches for synthesis of nanomaterials.

UNIT 3: Chemistry of Fuels and energy devices **10 Hrs**

Fuels – Classification of fuels; Determination of calorific values of solid fuels by bomb calorimeter – Manufacture of synthetic petrol by Fischer-Tropsch method – Knocking in IC engines – Octane and cetane rating of fuels; Petrol and Diesel Engine, chemistry for alternative source and storage of energy (supercapacitor, fuel cell, battery); role of chemistry on in photo-voltaic devices (solar cell).

UNIT 4: Instrumental methods of chemical analysis **12 Hrs**

Characterization of materials using X-ray diffraction (XRD), thermal Analysis (TGA-DTA-DSC), basics and application of Microwave spectroscopy, FTIR, UV-visible spectroscopy; NMR spectroscopy; Chromatographic techniques (GC, HPLC).

Max. 44 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental concept about atomic structure and interatomic bonding.

CO2 - Acquire knowledge about metallic and ceramic crystal structure.

CO3 - Acquire knowledge about structural features, properties of different classes of materials including nanomaterials.

CO4 - Explain the methodologies for the synthesis of different categories of materials.

CO5 - Develop the skill for phase, microstructural and elemental characterisation of materials.

CO6 - Develop the knowledge on the role of chemistry in various modern engineering applications.

TEXT/REFERENCE BOOKS

- An Introduction to Materials Science & Engineering, W.D. Callister, John Wiley & Sons (2007).
- Fundamental of Ceramics, MW Barsoum, IOP publishing (2003).
- Text book of Nanoscience and Nanotechnology, T. Pradeep, Mc. Graw Hill Education (2003).
- Textbook of Nanoscience and Nanotechnology, Murty, Shankar, B Raj, Rath, Murday, Springer (2013).
- Materials Science and Engineering, V. Raghavan, Prentice-Hall of India Private Limited (2003).
- Principles of Instrumental Analysis, Douglas A. Skoog, Donald M.West, 6th Edition, Cengage (2014)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A/Question: 3 Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

16SC101P					Engineering Chemistry Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To enhance and develop scientific and analytical skills
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments.
- To demonstrate safe and proper use of standard chemistry glassware and equipment.

LIST OF EXPERIMENTS

1. **External Indicator**–To determine the strength of given solution of ferrous ammonium sulphate by titrating against standard N/40 $K_2Cr_2O_7$ using potassium ferricyanide as an external indicator
2. **Iodometry**– To determine the strength of given copper sulphate solution by titrating against N/20 sodium thiosulphate (hypo) solution
3. **Iodimetry**– To determine the strength of given ascorbic acid by titrating against standard N/10 iodine solution
4. **Complexometric Titration**– To determine the total, permanent and temporary hardness of given water by complexometric titration using standard 0.01M EDTA solution
5. **pH metric titration**– To determine the strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration
6. **Conductometric titration**– To determine the strength of given HCl solution using a standard NaOH solution by performing a conductometric titration
7. **Potentiometric titration**– To determine the strength of given HCl solution potentiometrically
8. **Chemical Kinetics**– To study the kinetics of decomposition of sodium thiosulphate by a mineral acid
9. **Chloride in Water**– Determination of Chloride in the given water sample by Mohr Method
10. **Polymerization**– To prepare a polymer (Nylon 6,10), identify the functional groups by FT-IR
11. **Spectrophotometry**– To determine the λmax and concentration of given unknown potassium permanganate using UV-Visible Spectroscopy technique

Max. 28 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the concepts learned in chemistry and engineering to the real-world situations.

CO2 - Enhanced ability to identify, analyse and interpret the results from the experiments

CO3- Carry out quantitative analysis by instrumental method using Conductometer.

CO4- Analyse compounds by titrimetric, gravimetric and instrumental methods

CO5- Determine the concentration of unknown solutions by Spectrophotometric method.

CO6- Investigate the reaction rate and predict the order and rate constant

TEXT/REFERENCE BOOKS

- College Practical Chemistry, VK Ahluwalia, S Dhingra, A Gulati, Universities Press
- Foundations of Experimental Chemistry, JB Baruah, P Gogoi, PharmaMed Press.
- A Text Book of Chemistry Practicals Vol I & II, SS Sawhney, M S Jassal, SP Mittal, APH Publishing Corp.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks

Part B : Lab Exam and Viva 50 Marks

20ME102T					Elements of Mechanical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce and define the basics concept of mechanical engineering.
- To familiarize the working principles of IC engines and industrial robotics systems.
- To enable the students to understand the details about the energy systems and its components.
- To demonstrate the various machine elements, materials and its function.
- To help the students acquire knowledge about the various manufacturing process.

UNIT 1 **10 Hrs.**

Introduction to Thermodynamics: Definition and applications, systems and control volumes, thermodynamic properties, thermodynamic systems, state and equilibrium processes and cycles, temperature and Zeroth law of thermodynamics, forms of Energy, energy transfer by work and heat, law of conservation of energy, energy conversion efficiencies.

Properties of Pure substances: Definition, examples and phases, phase change of pure substances, property diagrams and property tables. Solution of Numerical Problems through EES Software.

UNIT 2 **10 Hrs.**

Law of degradation of Energy: Limitations of First Law, Thermal Energy reservoirs, heat engines, Refrigerators and Heat pumps, Kelvin Plank and Clausius statement and their equivalence.

Internal Combustion Engines: Introduction, classification and brief description of I.C. engines mechanism, 4-Stroke and 2-Stroke cycles and engines. Otto, Diesel and dual cycles; MEP and air standard efficiencies.

UNIT 3 **10 Hrs.**

Engineering materials: Stresses, strains and material properties.

Introduction to Manufacturing Processes: Conventional manufacturing process: Lathe Machines, CNC machines, drilling machines, universal Milling machines. Non-conventional manufacturing processes: Additive Manufacturing, 3D printing.

UNIT 4 **10 Hrs.**

Introduction to industrial robotics: Introduction, Industrial and Non-industrial robots, Anatomy and configuration of Industrial Robots, Robot Components, Robot Applications.

Introduction to Industry 4.0.

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Define the "fundamentals' and "terminologies" used in Engineering Thermodynamics.
CO2: Explain the energy conservation principles applicable for ideal gas and pure substance applications
CO3: Analyse the performance of thermodynamic cycles.
CO4: Evaluate the performance of power cycles
CO5: Identify the principles of different machining techniques and material properties.
CO6: Understand the anatomy, applications of robots and introduction to industry 4.0.

TEXT/REFERENCE BOOKS

- Yunus A. Cengel& Bole, Thermodynamics- Engineering Approach by Tata Mcgraw Hill.
- Sharma PC. A Textbook of Production Enginerring. S. Chand Publishing.
- P. K. Nag, Engineering Thermodynamics, Tata Mcgraw Hill, New Delhi.
- Industrial Robotics, Mikell Groover, McGraw-Hill Education (India) Pvt Limited

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Unit 1 and 2: Two question from each unit (Total 4 question with subparts)	40 Marks
Unit 3 and 4: Two question from each unit (Total 4 question with subparts)	60 Marks

20ME102P					Elements of Mechanical Engineering Lab.		
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Practical		Total Marks
					Continuous Evaluation	End Semester LE/Viva	
0	0	2	1	2	50	50	100

COURSE OBJECTIVES:

- To Perform experiments and collect experimental data on thermal and mechanical systems to validate theoretical principles.
- **To analyse, differentiate** and **evaluate** Law of conservation of energy on thermal systems.
- **To evaluate** performance of heat engine and heat pumps.
- **To calculate and compare** the components, application of the conventional manufacturing machines, non-conventional manufacturing machines and industrial robotic systems.
- **To demonstrate** the working principle of heat engine and additive manufacturing process.

List of Experiments:

1. To understand and perform fluid property evaluation using property tables and engineering equation solver software.
2. To perform experimental study and verify 1st law of thermodynamics by energy balance of heat exchanger.
3. To evaluate thermodynamic systems using Engineering Equation Solver.
4. To determine Performance of Heat pump and evaluate its coefficient of performance.
5. To understand and demonstrate components and working cycle of Internal Combustion engine.
6. To understand and demonstrate construction and working of conventional manufacturing machine.
7. To understand and demonstrate construction and working of non-conventional manufacturing machine.
8. To study additive manufacturing process applied for 3D printing.
9. To develop a working model of a simple robotic system.

Course Outcomes (COs): On completion of the course, students will be able to

CO1 - Understand and **evaluate** conservation law of thermodynamics through experimentation.
CO2 - Understand and **analyse** thermal systems data using engineering equation solver.
CO3 – Measure the coefficient of performance of heat pump.
CO4 - Examine the internal combustion engine components and its working.
CO5 - Demonstrate the various components of convention and non-conventional manufacturing machines and elaborate their applications.
CO6 – Classify the components in industrial robots and **develop** a simple robotic system.

Resources/Text/Reference books

- Sukhatme, S.P. and Nayak, J.K., 2008. Principles of thermal collection and storage. Solar Energy, 3rd Edition, Tata McGraw Hill Publishing company, New Delhi.
- Cengel, Y.A., Klein, S. and Beckman, W., 1998. Heat transfer: a practical approach (Vol. 141). New York: McGraw-Hill.
- Industrial Robotics, Mikell Groover, McGraw-Hill Education (India) Pvt Limited

End Semester Lab Examination

Max. Marks: 50	**Exam Duration: 2 hrs**
Quiz/Experiment:	20 Marks
Viva:	30 Marks

20IC101T					Basic Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	0	0	100

COURSE OBJECTIVES

- To understand rectification through p-n junction diode and applications of diode.
- To learn different configurations and static characteristics of bipolar junction transistor and MOSFET.
- To illustrate the OPAMP application in different real life circuits.
- To introduce basic concepts of digital electronics.

UNIT 1: DIODES AND RECTIFIERS **08 Hrs.**

Review of p-n junction diode, 1-phase half wave, full wave and bridge rectifier using diode. Calculation of average & rms value, PIV, efficiency, transformer utilization factor and ripple for different diode rectifier circuit. Use of Capacitor Filter for ripple reduction, voltage multipliers, Zener diode in load and line regulation.

UNIT 2: BJT, FET AND MOSFET **07 Hrs.**

Working of a BJT, transistor biasing, different transient circuit configuration (CB, CE and CC), static characteristic for BJT, transistor as switch, amplifier, concept of feedback amplifier and oscillator. Classification of FET, static characteristics of FET, FET biasing and load line, MOSFET, static characteristic of MOSFET and biasing

UNIT 3: OPAMP **04 Hrs.**

Introduction, Block Diagram and Characteristics of Ideal Op-Amp, Parameters of an Op-Amp, Virtual Ground, Inverting and Non- Inverting Amplifier, Integrator and Differentiator, Adder, Subtractor, Comparator.

UNIT 4: DIGITAL ELECTRONICS **07 Hrs.**

Number system, Binary arithmetic, logic gates and combinational logic, Boolean algebra, DeMorgan's Theorems, Logic minimization and Karnaugh maps, full adder, multiplier, multiplexing, Flip Flops, Introductory Sequential Logic, Counters, Registers

Total 26 Hrs.

Some of the above topics would be covered through the associated laboratory course.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Demonstrate application of different diode in circuits.
CO2 – Evaluate zener diode as voltage regulator.
CO3- Apply BJT, FET and MOSFET in different circuits.
CO4–Understand static characteristics OPAMP.
CO5–Illustrate basic concepts and theorem of digital systems.
CO6–Build digital circuits using logic gates and flip flops.

TEXT/REFERENCE BOOKS

- Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI.
- N.N. Bhargava, S.C. Gupta, and D.C. Kulshreshtha, "Basic Electronics And Linear Circuits", McGraw Hill Education (India).
- R. A. Gaikwad, "Operational Amplfier and Linear Integrated Circuits", PHI.
- Morris Mano, "Digital Design", PHI.
- J. Millman, C. Halkias and C. Parikh, "Integrated Electronics", Tata McGraw Hill.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs
Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc.(10 to 20 marks each)	80 to 60 Marks

20IC101P					Basic Electronics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To understand the characteristics of PN junction diodes and their applications.
- To Observe properties of BJT, FET and MOSFET.
- To illustrate the OPAMP application in different real life circuits.
- To introduce basic concepts of digital electronics.

Experiment Sessions would be simulation based covering but not limited to following topics:

1. To study the simulation tool and its features for analog circuit simulation.
2. To study the VI characteristic of silicon and germanium diodes.
3. To study reverse characteristics of zener diode.
4. To study half wave, full wave and bridge rectifiers
5. To study BJT as switch.
6. To study common emitter amplifier.
7. To study different biasing circuits of BJT.
8. To study transfer and drain characteristic of FET and MOSFET.
9. To study the simulation of digital circuits.
10. To study and verify logic gates.
11. To implement X-OR and X-NOR gates using basic gates.
12. To study and design adder and subtracter circuits.
13. To study and design flip flops.
14. To study OPAMP and its properties.
15. To study ADC and DAC.
16. Design of mini project in a group of 4-5 students.

Some of the above topics would be covered through the associated theory course

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Study the fundamentals of electronic components.
CO2: Understand the working principle of semiconductor devices.
CO3: Apply the analog and digital concept in building real time circuits.
CO4: Analyze the behaviour of semiconductor devices, OPAMP, ADC and DAC.
CO5: Evaluate different circuit for different device parameters.
CO6: Build analog and digital sub-system.

TEXT/REFERENCE BOOKS

- Boylestad and Nashlesky, “Electronic Devices and Circuit Theory”, PHI.
- N.N. Bhargava, S.C. Gupta, and D.C. Kulshreshtha, “Basic Electronics And Linear Circuits”, McGraw Hill Education (India).
- R. A. Gaikwad, “Operational Amplfier and Linear Integrated Circuits”, PHI.
- Morris Mano, “Digital Design”, PHI.
- J. Millman, C. Halkias and C. Parikh, “Integrated Electronics”, Tata McGraw Hill.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks:50 **Exam Duration:2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming-coding/implementation/investigation/solution-development.	50 Marks

20CP101T					Computer Programming - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	25	50			100

COURSE OBJECTIVES

- To develop a greater understanding of the issues involved in programming language, design and implementation
- To inculcate functional and logical problem-solving skills through programming.
- To understand the basic concepts of C programming

UNIT 1 BASICS OF C PROGRAMMING 4 Hrs.

Input, Output constructs, different data types, types of Operators, Precedence and associativity of Operators, Control Structure and Loop Structure

UNIT 2 ARRAY AND STRINGS 4 Hrs.

1-dimensional, 2-dimensional and 3-dimensional arrays, different types of user defined functions, String operations in form of Character arrays, In-built String functions

UNIT 3 POINTERS 4 Hrs.

Basic pointer arithmetic, arrays and String using Pointer, call the functions using Call-by reference property

UNIT 4 FILE HANDLING 2 Hrs.

open the file in write mode and write the data into it, open the file in read mode and read from the file, Open the file in append mode and append the contents in the file, handle the File operations using seek function.

Max. 14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand functional and logical problem-solving skills through programming

CO2 - Write, compile and debug programs in C language

CO3 – Use basic and derived data types in C and Operators in C.

CO4 - Design programs involving decision structures, loops, and functions in C.

CO5 - Implement Programs to perform pointer arithmetic and array handling with Pointers.

CO6 - Perform File-handling operations in C.

TEXT/REFERENCE BOOKS

- E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
- Jeri R. Hanly and Elli B.Koffman, Problem Solving and Program Design in C.
- Brain W.Kernighan & Dennis Ritchie, C Programming Language, PHI

SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 10 Questions of 2 marks each-No choice	20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying	80 Marks

Pandit Deendayal Petroleum University					School of Technology					
20CP101P					**Computer Programming Lab- I**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

- To understand the basic concepts of C programming
- To understand design and implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing
- To develop understanding of Compilation process.

LIST OF EXPERIMENTS:

Practical list should be prepared based on the content of the subject and following guidelines should be useful.
- Computer Programming covering all constructs of C language.

Following list gives some programming examples. Faculty can prepare their own list in same manner keeping above guidelines and syllabus in mind.

1. Add, subtract, multiply, divide two numbers.
2. Convert hours into minutes, minute to hours.
3. Conversion related programs dollars into Rs. Where 1 $ = 48 Rs. , grams to KG, Kilobytes to Megabytes.
4. Convert Celsius into Fahrenheit. F = (9/5 * C) + 32 and Fahrenheit into Celsius. C = 5/9 * (F – 32)
5. Calculate simple and compound interest where I = PRN/100.
6. Calculate area & perimeter of a square, rectangle, circle, triangle.
7. Program to sort N numbers. (Ascending and Descending)
8. Program to calculate string length, reverse the string.
9. Program to check the string and number is palindrome or not.
10. Program to generate sine, cosine, tan series.
11. Program to generate Fibonacci series.
12. Program to calculate factorial using recursion.
13. Program to create a database using array of structures.
14. Programs related to pointers.
15. Programs related to file.

Design based Problems (DP)/Open Ended Problem:

1. Develop a game/Puzzle in C language.
2. Use interrupts to develop programs related to basic operations.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand functional and logical problem-solving skills through programming.
CO2 - Write, compile and debug programs in C language.
CO3 – Use basic and derived data types in C and Operators in C.
CO4 - Design programs involving decision structures, loops, and functions in C.
CO5 - Implement Programs to perform pointer arithmetic and array handling with Pointers.
CO6 - Perform File-handling operations in C.

TEXT/REFERENCE BOOKS

- E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
- Jeri R. Hanly and Elli B.Koffman, Problem Solving and Program Design in C.
- Brain W.Kernighan & Dennis Ritchie, C Programming Language, PHI

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 2 Hrs**

Part A/Question: <QUIZ/VIVA> <50> Marks

Part B/Question: <PRACTICAL PERFORMANCE> <50> Marks

Pandit Deendayal Petroleum University					School of Technology					
16HS109T					**Professional Ethics and Human Values**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
1	**0**	**0**	**1**	**1**	**25**	**50**	**25**	**--**	**--**	**100**

COURSE OBJECTIVES

- Identify the core values that shape the ethical behaviour of an Engineer.
- Awareness on professional ethics and human values.
- To know their role in technological development.
- To appreciate the rights of others.
- Improved communication and learn to work in group.
- Learn to understand and discuss on issues of social interest.

Unit 1: Human Values **[5 hrs]**

Morals, Values and Ethics - Integrity - work Ethic - Service Learning - Civic Virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Co-operation - Commitment - Empathy - Self-Confidence - Character - Spirituality

Unit 2: Engineering Ethics **[4 hrs]**

Sense of 'Engineering Ethics' - Variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy - Models of Professional Roles & Professionalism - theories about right action - Self-interest - customs and religion - uses of ethical theories.

Unit 3: Engineering as experimentation **[4 hrs]**

Engineers as responsible experimenters - Research ethics -Codes of ethics - Industrial Standard - Balanced outlook on law - the challenger case study.

Unit 4: Safety, risk and Global issues **[5 hrs]**

Safety and risk - assessment of safety and risk - Risk benefit analysis and reducing risk - Threat of Nuclear power - Collegiality and loyalty - respect for authority - Confidentiality - conflicts of interest - professional rights - employees' rights - Intellectual Property rights (IPR) - discrimination. Multinational corporations - Business ethics - Environmental ethics - Role in Technological Development - Weapons development - consulting engineers - engineers as expert witnesses and advisors-Ethics.

Total 18 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Find the core values that shape the ethical behaviour of an Engineer.
CO2: Students will get aware of the professional ethics and human values.
CO3: Develop and understand their role in technological development.
CO4: Simplify to the rights of others.
CO5: Perceive improved communication with activities and learning to work in group.
CO6: Discuss on issues of social interest and make opinions based on logical reasoning.

TEXT/REFERENCE BOOKS

1. A Textbook on Professional Ethics and Human Value by Prof. R. S. Nagaarazan, New Age International Limited Publisher, Chennai. 2006
2. A Text book on Professional Ethics and Human Values by M. Govindarajan, S. Natarajan, V. S. Senthilkumar, PHI Learning Pvt. Ltd., 2013.
3. A Text book on Professional Ethics and Human Values by Dinesh Babu, Firewall Media, 2007

16SP101/2/3					NCC/NSS/SPORTS					
Teaching Scheme					**Examination Scheme**					
					Theory			**Practical**		
L	**T**	**P**	**C**	**Hrs/Week**	**MS**	**ES**	**IA**	**LW**	***Participation and Attendance**	**Total Marks**
0	**0**	**2**	**1**	**2**	*** Continuous Evaluation**			**--**	**100**	**100**

COURSE OBJECTIVES

- To develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
- To develop youth leadership in the students.
- To induce social consciousness among students through various camps and 'Shibir' activities.
- To develop skills and physical fitness among students through indoor & outdoor sports, field & track events.

National Cadet Corps (NCC):

Introduction to NCC, Aims and objectives, Structure and organization, NCC Song, Incentives, National Integration and Awareness, Drill, saluting, Personality Development & Leadership, Disaster Management, Social Awareness & Community Development, Health & Hygiene, Adventure camps, Environment Awareness and Conservation, Obstacle Training, Armed forces, Map reading, Field Craft & Battle Craft, Introduction to Infantry Weapons & Equipment, Weapon Training (During camps), Participation into Republic and Independence day ceremonial parades,

National Service Scheme (NSS):

Importance and role of youth leadership, Life competencies, Youth development programmes and youth 'shibir', Health, hygiene and sanitation, Youth health, lifestyle, first aid, youth and yoga

Sports:

Importance of sports/games in life, Physical fitness, Introduction to various games and sports, field and track events, Physical training, exercises, running, walking, jogging, Teaching of different sports/games, track & field events , demonstration, practice, skills and correction, Introduction to Yoga & Meditation.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the importance of Nation building and individual contribution to the same.
CO2 – **Integrate** physical fitness and mental wellbeing
CO3 – **Discover** grassroots challenges of community
CO4 – **Creating** societal impact
CO5 – **Maintain** discipline and team spirit
CO6 – **Upholding** the value of one for all and all for one

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: --**

* All registered students will be evaluated based on his/her attendance during the NCC/NSS/Sports sessions and participation to camps and other activities.

Note: Registration to NCC course in semester 01 will be based on availability of vacancy in the unit under which NCC platoon is registered.

Once registered for any of NCC/SPORTS/NSS in first semester, student cannot change to other course in second semester.

Semester II

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester II			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20MA103T	Mathematics- II	3	1	0	4	4	25	50	25	--	--	100
2	20CE101T	Element of Civil Engineering & Solid Mechanics	4	0	0	4	4	25	50	25	--	--	100
3	20CE101P	Element of Civil Engineering & Solid Mechanics Lab	0	0	2	1	2	--	--	--	50	50	100
4	20EE101T	Elements of Electrical Engineering	3	0	0	3	3	25	50	25	--	--	100
5	20EE101P	Elements of Electrical Engineering Lab	0	0	2	1	2	--	--	--	50	50	100
6	20PH101T	Engineering Physics	3	0	0	3	3	25	50	25	--	--	100
7	20PH101P	Engineering Physics Lab	0	0	2	1	2	--	--	--	50	50	100
8	16ME103P	Workshop Practice	0	0	2	1	2	25	50	25	--	--	100
9	20ME101P	Engineering Graphics Lab	0	0	4	2	4	--	--	--	50	50	100
10	20CP102P	Computer Programming II	0	0	2	1	2	--	--	--	50	50	100
11	20HS102T	Environmental Studies	3	0	0	3	3	25	50	25	--	--	100
12	20HS101P	Communication Skills – I	0	0	2	1	2	--	--	--	50	50	100
13	16SP101/2/3	NCC/NSS/Sports	0	0	2	1	2	--	--	--	100		100
14	16TP110	Civic services and Social Internship (Summer Break)	0	0	0	1	0	--	--	--	--	--	100
		TOTAL	**16**	**1**	**18**	**27**	**35**						**1400**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination.

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20MA103T					MATHEMATICS - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to apply the calculus of complex functions to construct analytic functions.
- To be able to compute residues and apply them to evaluate contour integrals.
- To be able to formulate and solve various engineering problems using the methods of solving ODEs.
- To study the properties of Laplace transforms and apply them to solve ODEs.

UNIT 1 COMPLEX DIFFERENTIATION **10 Hrs.**

Limit, Continuity, Differentiability of function of complex variable, Analytic function, Cauchy-Euler equation (in Cartesian and polar coordinates), Harmonic function and its significance, Singularities, Taylor's series, Mapping (translation, rotation and inversion), bilinear transformation, Conformal mapping, Applications of Conformal mapping.

UNIT 2 COMPLEX INTEGRATION AND APPLICATIONS **10 Hrs.**

Definition of a Complex line integral, Contour integrals, Cauchy- Goursat theorem, Cauchy integral theorem, Cauchy Integral formula (CIF), CIF for derivatives, Calculation of residues, Cauchy Residue theorem, Applications of residues to evaluate real definite integrals.

UNIT 3 ORDINARY DIFFERENTIAL EQUATIONS WITH APPLICATIONS **10 Hrs.**

Differential equations of first order and higher degree, Higher order differential equations with constant coefficients, Rules for finding C.F. and P.I., Method of variation of parameters, Cauchy and Legendre's linear equations, Linear differential equations of second order with variable coefficients; Simultaneous linear equations with constant coefficients, Applications of higher order differential equations in solving engineering problems.

UNIT 4 LAPLACE TRANSFORMS **10 Hrs.**

Piecewise continuous functions and exponential functions, Definition, Existence and Properties of Laplace transforms, Heaviside function, Inverse Laplace transform, Properties of inverse Laplace transforms, Convolution theorem, Applications of Laplace Transforms in solving differential equations.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Identify the use of various special functions in engineering aspects.
CO2 – Illustrate the ability to handle mathematical models, to describe physical phenomena, using suitable techniques.
CO3 – Apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution in context with theory.
CO5 – Appraise mathematical problems from real to complex domain.
CO6 – Create a mathematical model of engineering interest.

TEXT/REFERENCE BOOKS

- R.V. Churchill and J. W. Brown, Complex variables and applications, McGraw-Hill, 7th Ed., 2003
- J. M. Howie, Complex analysis, Springer-Verlag, 1st Ed., 2003.
- R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science, 3rd Ed., 2007.
- Erwin Kreyszig, Advanced Engineering mathematics, John Wiley, 10th Ed., 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 10 questions 3 marks each	30 Marks (40 min)
Part B: 5 questions 6 marks each	30 Marks (50 min)
Part C: 5 questions 8 marks each	40 Marks (90 min)

Pandit Deendayal Petroleum University **School of Technology**

20CE101T					Element of Civil Engineering and Solid Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	-	-	4	4	25	50	25	--	--	100

COURSE OBJECTIVES.

- To introduce and explain the basics scope of engineering.
- To understand different types of force systems and apply them to practical engineering application.
- To develop understanding of the basic concepts related to tensile, compressive and shear stresses in engineering components.
- To discuss the basic principles of torsion in shafts, shear force and bending moment in beams, Deflection in springs, Columns and Struts.

UNIT 1 INTRODUCTION TO CIVIL ENGINEERING & MECHANICS **14 Hrs.**

Basics and scope of Civil Engineering- Introduction to Civil Engineering- Branches of Civil Engineering- Application of Civil Engineering in other domain different types residential of buildings- green building and smart building.
Introduction to Engineering Mechanics- Resolution of forces- Varignon's – couples- Lami's theorem-
Centroid and Moment of Inertia- Determination of moment of inertia of simple planar laminas like rectangle- triangle- quarter-semi-circle and circle. Theorems of perpendicular and parallel axis-polar moment of inertia- radius of gyration.

UNIT 2. SIMPLE AND COMPOUND STRESSES AND STRAIN **14 Hrs.**

Introduction to stresses and strain – Stress-strain diagram- Elastic constants -relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Strain energy – Deformation of simple and compound bars – thermal stresses. Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure

UNIT 3 SFD- BMD AND STRESSES IN BEAM **12 Hrs.**

Types of beams- Cantilever, Simply supported, Overhanging: Shear Force and Bending Moment Diagrams Theory of simple bending – bending stress and shear stress in beams. Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.

UNIT 4 TORSION AND COLUMNS **12 Hrs.**

Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends – Stresses in helical springs. Theory of columns – Long column and short column – Euler's formula – Rankine's formula - Secant formula - beam column.

Total 52 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –**Describe** the basics and scope of civil engineering, role of civil engineer and subbranches of civil engineering.
CO2 -**Compute** the stress and strain developed due to applied load in any structural member and solve the principal stress & strain at a point of stressed member.
CO3 – **Calculate** the shear force & bending moment diagram under various loading & support condition.
CO4 - **Analyze** bending and shear stresses in the different layers of the beam for various loadings.
CO5 - **Determine** the torsion equation & pure torsion
CO6 - **Explain** the loaded structural members for deflection.

TEXT/REFERENCE BOOKS

- N.H Dubey, Engineering Mechanics-Statics and Dynamics, Tata McGraw Hill Private limited
- R. S. Khurmi, Engineering Mechanics, S. Chand Publication
- S.S. Bhavikatti Elements of Civil Engineering (IV Edition) , Vikas Publishing House Pvt. Ltd., New Delhi.
- Ferdinand P Beer and E Russel Johnson , Mechanics for Engineers (Statics & Dynamics) McGraw
- Timoshenko and Gere, Mechanics of Materials, CBS Publishers, New Delhi, 1996
- S. B. Junarkar and Dr. H. J. Shah, Mechanics of Structures, 27th Revised and Enlarged, Charotar Publication.
- Beer and Johnston, Mechanics of Materials, McGraw Hill International

END SEMESTER EXAMINATION QUESTION PATTERN

Max. Marks: 100	**Exam Duration 3 Hrs.**
Part A: 4 Question from unit-1 – 5 Marks Each	20 Marks
Part B: 8 Numerical Questions from unit 2 to unit 4 – 10 Marks Each	80 Marks

20CE101P					Elements of Civil Engineering & Solid Mechanics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To conduct standard tests on construction steel under static load.
- To conduct standard tests on metals under impact load
- To conduct standard tests of flexure and compression on wooden items.
- To conduct standard tests of crushing, impact and abrasion on bricks and tiles.

LIST OF EXPERIMENTS

1. Tension test on mild steel
2. Compression test of ms bar/cost iron
3. Bending test on wooden beam / Steel bars
4. Shear test on steel bar
5. Hardness test
6. Charpy impact test
7. Izod impact test
8. Compression test of on bricks
9. Flexural test on clay roof tiles

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Define** the standard tests of mild steel under tension, compression & shear.
CO2 – **Compute** and use the Charpy impact testing machine to evaluate the performance of metal under impact load.
CO3 – **Compute** Rockwell hardness testing machine to determine the hardness of metals
CO4 – **Illustrate** modulus of rupture of timber and steel bar.
CO5 – **Determine** the compressive and bending strength of clay items.
CO6 – **Explain** the crushing, impact and abrasion values of bricks.

REFERENCES:

- S. B. Junarkar and Dr. H. J. Shah, Mechanics of Structures, 27th Revised and Enlarged, Charotar Publication.
- Beer and Johnston, Mechanics of Materials, McGraw Hill International

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks
Part B : Lab Exam and Viva 50 Marks

20EE101T					Elements of Electrical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To impart knowledge on DC and AC circuits.
- To learn construction, working principles and characteristics of transformer and induction machines.
- To introduce students to various means for electrical safety and protection of electrical installations.
- To impart knowledge on electric wiring and illumination for domestic and industrial applications.

UNIT 1: DC CIRCUITS **10 Hrs.**

Electrical circuit elements (R, L and C), voltage and current sources, dependent and independent sources, Ohms Law, temperature co-efficient of resistance, Kirchhoff current and voltage laws, voltage and current divider circuit, Thevenin and Norton Theorems and their equivalents, maximum power transfer and superposition theorems, nodal and mesh analysis, star-delta transformation, Time domain analysis/natural response of first order RL and RC Circuit

UNIT 2: AC CIRCUITS **10 Hrs.**

Generation of AC voltage, representation of sinusoidal waveforms, rms values of different sinusoidal waveforms, Rectangular and Polar representation of phasor, Sinusoid representation in time and frequency domain. of Analysis of single-phase ac series circuits consisting of R, L, C, RL, RC, RLC combinations, instantaneous, average power and reactive power, complex power and power factor. AC parallel circuit and its solution in admittance form, resonance in AC series circuit and parallel circuit. Polyphase circuits, star and delta representation of polyphase circuit, power measurement in polyphase circuit

UNIT 3: TRANSFORMERS AND INDUCTION MACHINES **10 Hrs.**

Magnetic material and its B-H characteristic, Faraday's Law of Electromagnetic Induction **Transformers:** ideal transformer, emf equation for transformer, working of practical transformer on no-load and load **Induction Machine:** Types of induction motor, production of rotating magnetic field from 3-phase supply, operation of three phase induction motor, starting and running torque, Torque-slip characteristics of induction motor, Power Stages in IM

UNIT 4: ELECTRICAL INSTALLATION, SAFETY AND PROTECTION **10 Hrs.**

Fuse, MCB, ELCB, MCCB, underground cables. Domestic and Industrial Wiring. Types of lamps, illumination schemes and lumen requirement for domestic and industrial applications, Earthing and it schemes. Electrical safety rules, electric shock and first aid, energy conservation methods, elementary calculation of energy consumptions, tariffs

Max Hrs: 40

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Analyze electrical circuits using network theorems.
CO2 – Compare the behavior of R, L and C and their combinations in AC circuits.
CO3 – Analyze balanced polyphase systems in star and delta configuration
CO4 – Understand the construction, working and basic characteristics of transformer and induction machines
CO5 – Recognize the importance of protective devices and electrical safety measures
CO6 – Carry out domestic and industrial electrification

TEXT/REFERENCE BOOKS

- J. Bird, "Electrical Circuit Theory and Technology", Routledge, Tailor and Francis Group, Sixth Edition, 2017.
- D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
- B. L. Theraja, "Electrical Technology", Vol. 1, S. Chand Publication, New Delhi
- Surjit Singh, "Electrical Estimating and Costing", Dhanpat Rai and Co.

20EE101P					Elements of Electrical Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To gain practical knowledge on DC and AC circuits
- To learn operation of electrical instruments and electrical machines
- To develop skills to implement electric wiring

LIST OF EXPERIMENTS

1. Introduction to elements of electrical engineering laboratory and to study different electrical measuring instruments.
2. To validate Ohm's law with linear resistors and find power dissipation in resistor.
3. To implement voltage divider and current divider circuit.
4. To validate Thevenin and Norton theorem for DC circuit.
5. To validate Superposition and Maximum Power Transfer theorem for DC circuit.
6. To obtain transient response of RL and RC circuit.
7. To evaluate performance of AC series circuit.
8. To evaluate performance of AC parallel circuit.
9. To analyse resonance condition in AC circuit.
10. To establish relation between line and phase quantities in star and delta connected polyphase system.
11. To measure power in polyphase system.
12. To perform load test on 1-phase transformer.
13. To perform load test on 3-phase transformer.
14. To obtain current time characteristic for domestic protective devices.
15. To carry out domestic electric wiring.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Operate basic electrical measuring instruments

CO2 – Simulate the basic electrical circuits and obtain results based on electrical laws and network theorem

CO3 – Understand the performance of AC circuit with different connection of R, L and C

CO4 – Formulate star and delta configuration of polyphase system and measure power in polyphase system

CO5 – Operate transformer and induction machines and evaluate its performance

CO6 – Understand the basic wiring and operation of protective devices for domestic application

20PH101T					Engineering Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand basic concepts of quantum mechanics and solve the Schrödinger equation for various cases.
- To understand basics concepts of electric and magnetic properties of solids.
- To develop the fundamental understanding of optoelectronic devices.
- To understand the heat transfer mechanism in solids and fluids.

UNIT 1 Introduction to Quantum Mechanics 12 Hrs.

Inadequacies in Classical Physics, Wave Nature of Matter, Heisenberg's Uncertainty Principle and its applications, zero point energy, Basic Postulates and Formalism of QM: Energy, Momentum and Hamiltonian Operators. Time-independent Schrodinger Wave Equation for Stationary States. Properties and interpretation of Wave Function. Probability Density and Probability. Conditions for Physical Acceptability of Wave Functions, Application of time-independent Schrödinger equation for various potentials.

UNIT 2 Electronic theory of Solids 10 Hrs.

Elements of crystallography; lattice vibrations of solids; Bloch Theorem and Origin of energy bands, band structure of conductors, type of semiconductors, Free Electron Theory of metals, Wiede-mann Franz Law, Kronig-Penny model, Hall effect. Magnetism and its origin, magnetization and susceptibility, dia-para-ferro-magnetism. Ferromagnetism, Nano magnets and magneto resistance, hard disk drive storage technology. Phenomenology of Superconductors, Meissner effect, BCS theory - high temperature superconductors.

UNIT 3 OPTICS, LASER AND OPTO-ELECTRONICS 08 Hrs.

Optics: Introduction, division of amplitude, thin film interference, Applications of interference, Laser: The Einstein coefficients, Spontaneous and stimulated emission, Optical amplification and population inversion, meta stable state, optical resonator, the principle of pumping scheme, laser beam characteristics. Types of LASER, Injection Laser Diode (ILD). Quantum Cascade Laser, Comparison between ILD and QCL. Applications of lasers.

UNIT 4 THERMAL PHYSICS 10 Hrs.

Laws of thermodynamics -basic concepts, closed and open systems-first law. Heat transfer-thermal expansion of solids and liquids –Conduction in solids – the rmal conductivity- Forbe's method, Lees' disc method, conduction through compound media, formation of ice on ponds, thermal insulation and its applications. Thermal Convection - properties of radiant heat, sea and land breeze. Thermal Radiation – emission and absorption radiation, emissive power, black body radiation – Kirchoff's, Stefan's laws, wien's law, Newton's law of cooling.

Max. 40 Hrs.

COURSE OUTCOMES

CO1 – identify and understand the experimental results which require conceptualization of quantum theory.
CO2 – Interpret the solution of Schrödinger equation to obtain physical information about the system.
CO3 - Identify basic concepts in semiconductors, superconductors and magnetism and apply it in engineering applications.
CO4 - To understand concepts of optical interference and LASER, analyse the lasing characteristics to apply in different laser diodes and other applications
CO5 - To understand concepts of thermal physics in terms of laws and modes of heat transfer.
CO6 - To apply knowledge of concepts of engineering physics to solve real world problems.

TEXT/REFERENCE BOOKS

- N. Zettili, Quantum Mechanics: Concepts and applications, Willey Publications
- Kittel, Charles. Introduction to Solid State Physics. John Wiley and Sons.
- W.D. Callister and David Rethwisch, Materials Science & Engineering -An Introduction, 9th edn.,
- Heat and Thermodynamics BrijLal, N. Subrahmanyam, S. Chand, Limited, 2001.
- Optics by Ajay Ghatak, Tata macgraw hill publishing.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

20PH101P					Engineering Physics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand the working of various electrical, mechanical and optical instruments in the laboratory.
- To gain practical knowledge in Physics through experiments.
- To understand basics concepts of Physics and be able to apply in performing the experiments.

List of Experiments

1. Introduction to Oscilloscope.
2. Study of Interference using Newton's Ring experiment.
3. Determination of thermal conductivity of different solids.
4. Experiment with solar collector.
5. Experimental to determine linear thermal expansion coefficient of solid bodies.
6. Experiment on reflection of Ultrasonic waves.
7. Experiments with heat pump.
8. Determining Plank's constant and Inverse square law.
9. Experiments on diffraction with He-Ne Laser Kit.
10. Study of Hall Effect.
11. Determining semiconductor energy band gap using four probe method.
12. Experiment to study forced oscillations.
13. Study of charging and discharging of capacitive plates.
14. Study of Bio-Savart's Law
15. Experiments on Fiber Optics.
16. Study of Photoconductivity.
17. Determining e/m by Thomson's method.
18. Study of Polarization of light using LASER.
19. Millikan's oil drop experiment.
20. Study of Holography.

** Any 10 experiments will be conducted relevant to theory course.

COURSE OUTCOMES

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

CO1 - Apply and analyze the concepts of electricity and magnetism.
CO2 - Understand the interaction of light waves and its propagation in different media.
CO3 - Demonstrate and implement the phenomenon of resonance
CO4 - Investigate the electrical properties of a given semiconductor device
CO5 - Examine the charge transport mechanism in different conductors
CO6 - Design and analyze the light propagation for communication application using fibre optics

TEXT/REFERENCE BOOKS

- Ghatak, Optics, 3rd edition, Tata McGraw Hill (2005).
- Kittel, Knight and Ruderman, Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill.
- Avadhanulu, A text book of engineering Physics, S. Chand & Company, Ltd.
- Brij Lal, N. Subrahmanyam, Heat and Thermodynamics, S. Chand & Company, Ltd
- Halliday, Resnick, Walker, Fundamentals of Physics (Wiley)

Evaluation

Max. Marks: 100

Continuous evaluation	50 marks
End semester examination and Viva-voce	50 marks

16ME103P					Workshop Practice		
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Practical		Total Marks
					Continuous Evaluation	End Semester	
-	-	2	1	2	50	50	100

COURSE OBJECTIVES

- To impart the machining skills in students.
- To develop a skills in precision, safety at work place, team working with right attitude.
- To prepare a job by using ability to design and model different prototypes.

UNIT-I METROLOGY

Semi-Precision tools: Rules and scales, try square. Inside/Outside Calipers, Depth gages etc. Precision Tools: Micrometers, Vernier calipers, Bevel Protractor, Dial indicator, Gage blocks, Surface plates etc.

UNIT-II CARPENTRY SHOP

Timber, Seasoning and Preservation, Plywood and Ply boards, Carpentry Tools, Engineering applications. Different Joints

UNIT-III BENCH WORK AND FITTING

Introduction to the familiarization with tools and their uses, Hammers, Hacksaws, choice of blades & sawing techniques, Files with their classification; According to their longitudinal shape & cross section, classification based on cuts; teeth; length of the file, Care of files and hand tool safety rules Vices & their classification, Other hand tools; scribers, chisels, scrapers, center, punch, surface gauge, Universal cribbing block, Trammel, Screw drivers, Drills, Spanners, Pliers, Taps, Dies, Reamers, Screw drivers etc, Fitting Processes : Marking, Chipping, Sawing, Filing, Scrapping, Drilling, Internal Threading (or Trapping), External Threading (or Dieing), Reaming, welding, soldering, brazing

UNIT-IV TIN SMITHY – SURFACE DEVELOPMENT

Shearing and Bending of sheets, Making simple products by Tin Smithy practice.

List of Experiments:

1. Introduction to Workshop and safety.
2. Experiment on measurement of linear, angular and curved dimensions of the object.
3. Fitting job: Detailed drawing of work piece, use of fitting tools and job preparation.
4. Hands on experience on welding, brazing and soldering.
5. Carpentry job: Detailed drawing of work piece, use of carpentry tools and job preparation.
6. Sheet metal job: Detailed drawing of work piece, use of sheet metal working tools and job preparation.
7. Plumbing job: Internal/External threading, piping network using Tees, Elbows, Reducer, Bends etc

COURSE OUTCOMES

CO1: Define fundamentals and principles cutting and enhance the machining skills in students.

CO2: Apply principles of machining and develop a skills in dignity of labour, precision, safety at work place, team working and development of right attitude.

CO3: Analyse the effect design and model different prototypes in carpentry.

CO4: Examine the effect and create and develop ability to design and model different basic prototypes in trade of fitting.

CO5: Determine the effect and create and develop ability to design and model different basic prototypes in trade of tin smithy.

CO6: Evaluate the performance of different machining and cutting processes such as fitting, carpentry, plumbing etc.

20ME101P					Engineering Graphics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	4	2	4	-	-	-	50	50	100

COURSE OBJECTIVES

- To learn fundamental of engineering drawing and standards used in drawing
- To enable the students with various concepts of projections and standards related to technical drawings.
- To demonstrate and communicate ideas using orthographic (2D) & isometric projection (3D) methods
- To help students to use CAD software to solve engineering problems

UNIT 1 **10 Hrs.**

Introduction to Engineering Graphics – Importance and applications, drawing instruments & accessories, lettering, types of lines, dimensioning methods, basic geometric drawing.
Computer Aided Engineering Drawing: Introduction to CAD, use of softwares in drawing, CAD software user interface, commands, menus and toolbars.

UNIT 2 **14 Hrs.**

Orthographic Projection – Introduction to projection, types of projection, 1st angle and 3rd angle projection, 2D sketch, sketch entities and tools – origin, points, lines, arcs, polygons, fillets and chamfer, trim, extend and offset, projections from pictorial view, orientation of views, sections and sectional views.

UNIT 3 **14 Hrs.**

Isometric Projection - Construction of isometric views from orthographic projections, approach to modelling, moving from 2D to 3D, creating 3D models using CAD features, assembly of components and exploded views.
Projection of Solids - Classification of solids, projections of solids like cylinder, cone, pyramid and prism with its inclination to reference plane, concept of development of lateral surfaces, intersection of solids.

UNIT 4 **14 Hrs.**

Drafting – Drafting standards, drawing views, alignment of drawing views, dimensions and tolerances, symbols, comments and annotations, computer aided drafting, drawing sheet and title block.
Tolerance - Introduction to limits, fits and tolerances, standardized representation of threads, fasteners, welds, bearings and springs, dimensional and geometric tolerances, surface finish symbols.

Total 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of engineering graphics and **remember** the basic rules of dimensioning and labelling.
CO2 - Develop the ability to learn fundamental of CAD software and its use to solve engineering problems.
CO3 - Comprehend the concept of projection and use it to **represent** the views on reference planes.
CO4 - Apply the technical communication skill for 3-dimensional geometries in the form of 3D models using isometric projection.
CO5 - Analyse the orientation of geometrical bodies with respect to reference planes and **evaluate** the intricate details of solid using sectioning and development of lateral surfaces.
CO6 - Create drawing sheet by **organizing** drawing views and **applying** necessary dimensions and tolerances.

TEXT/REFERENCE BOOKS

- R Hanifan, "Perfecting Engineering and Technical Drawing", Springer International Publishing Switzerland
- Bethune, J. D., "Engineering Design and Graphics with SolidWorks 2019, 1st edition", Macromedia Press
- K Morling, "Geometric and Engineering Drawing", Elseveir Insights
- DM Kulkarni, "Engineering Graphics with AutoCAD", Easter Economy Edition
- Agrawal, B. & Agrawal C. M., "Engineering Drawing", Tata McGraw Hill Publishers
- P.J. Shah, "Engineering Graphics", S. Chand Publishing
- David C Planchard, "Engineering Graphics with SOLIDWORKS 2019: A Step-by-Step Project Based Approach'', SDC Publications.

20CP102P					Computer Programming - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To impart the basic concepts of Python Programming language.
- To be familiar with data structures available in Python.
- To understand testing and debugging in Python.
- To draw different kinds of plots using for scientific research.

INTRODUCTION TO PYTHON

The basic elements of Python, Branching programs, Strings and Input, Iteration

FUNCTION, SCOPING AND ABSTRACTION

Functions and Scoping, Specifications, Recursion, Global variables, Modules, Files

TESTING AND DEBUGGING

Testing, Debugging

STRUCTURED TYPES, MUTABILITY AND HIGHER-ORDER FUNCTIONS

Tuples, Lists and Mutability, Functions as Objects, Strings, Tuples and Lists, Dictionaries

EXCEPTIONS AND ASSERTIONS

Handling exceptions, Exceptions as a control flow mechanism, Assertions

SOME SIMPLE ALGORITHMS AND DATA STRUCTURES

Search Algorithms, Sorting Algorithms, Hashtables

PLOTTING

Plotting using PyLab and extended examples

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand the basic concept of programming with python.
CO2- Understand the basics of creating applications.
CO3- Apply various data structures available in Python in solving computational problems.
CO4- Create robust applications for solving computational problems using the Python.
CO5- Test and debug applications written using the Python.
CO6- Draw different kinds of plots using PyLab and generating series.

TEXT/REFERENCE BOOKS

- John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
- Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 2 Hrs**
Part A/Question: <QUIZ/VIVA>	<50> Marks
Part B/Question: <PRACTICAL PERFORMANCE>	<50> Marks

20HS102T					ENVIRONMENTAISTUDIES					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding about Bird's eye view of Environment.
- Understanding of multidisciplinary aspect of environment.
- Understanding of pollutions and their effects on environment.
- Understanding about various environment pollution control strategies.

UNIT 1 Bird's Eye view to Environment 08Hrs.

Environmental Studies – Its importance and Multidisciplinary nature; Ecosystem and its various types, factors affecting the functioning of an ecosystem; Biodiversity – its importance, threats and conservation; Natural Resources – Forest, Water, Mineral, Energy, Minerals, Food; Review of State of India's Environment.

UNIT 2 Multi-scale Environmental Pollution 10 Hrs.

Concept of Clean Environment, Introduction to various environmental standards – air, water, soil, noise, heat. Causes and Effects of Air Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution; Pollution across Indian cities – case studies; Introduction to man-made disasters like floods, heat waves, landslides, etc.

UNIT 3 Environmental Pollution Control Strategies 12 Hrs.

Multi-approaches (role of research, technology, policy, planning & implementation, legislation & judiciary, incentives & business) for reducing various types of pollution; Case studies of Pollution control strategies; Review of the Central and State Government's policies and mechanisms for managing various natural resources and controlling the various types of pollutions (including Swacch Bharat Abhiyan), Global Initiatives for environmental management; Indian Culture and Traditional Wisdom for managing environment

UNIT 4 Social Issues and the Environment 09 Hrs.

Concept of sustainability and Sustainable Development, Environmental Sustainability Index, Environmental Ethics, Public awareness and people's participation (bottlenecks and solutions), Consumerism and Waste products, Introduction to Carbon Footprint & Water Footprint, Green Buildings, Green Business (profitability in managing environment)

TOTAL39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:
CO1- Understand the various facets of environment.
CO2- Understand of multidisciplinary aspects of environment.
CO3- Understand about the different types of pollutions.
CO4- Understand the effects of pollution on human health, plants, materials and environment.
CO5- Understand about the various environment pollution control strategies.
CO6- Understand about various concepts of sustainable development.

TEXT/REFERENCE BOOKS:

- Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi.
- Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmedabad 380013, India.
- Clark, R. S., Marine Pollution, Clanderson Press Oxford.
- Daniel B. Botkin & Edwards A. Keller, Environmental Science, Wiley INDIA edition.
- Hawkins R. E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay.
- Miller T. G. Jr., 2006. Environmental Science, Clengage Learning, India.
- Odum E. P. 1971. Fundamentals of Ecology, W. B. Saunders Co, USA.
- Wagner K. D., 1998. Environmental Management, W. B. Saunders Co, USA.

END SEMESTER EXAM PAPER SCHEME (Max Marks: 100)

Part A	4 Questions of 10 Marks each. 1 Question from every unit.	40
Part B	6 Questions of 10 Marks each. 3 Questions from Unit 3 & 4 each	60

Pandit Deendayal Petroleum University **School of Technology**

20HS101P					Communication Skills – I (Semester I/II) (First Year)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	0	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Understand of the fundamental elements of communication in English language.
- Know and understand different practices of verbal and non-verbal communication with inputs to improve basic language skills.
- Students are expected to be better equipped in the following areas:
  - **Listening:** Understanding basic content in lectures and common everyday situations
  - **Speaking:** Correct expression in the English language at a basic level
  - **Reading:** Understanding, retaining, and critically analyzing technical/non-technical content
  - **Writing:** Using appropriate vocabulary, grammar, effective paragraph construction, writing in day-to-day scenarios, including digital platforms

UNIT 1 **21 hrs**

Structure of English Language, Academic, Research and Technical Vocabulary, Phonetics and Accent

UNIT 2 **3 hrs**

Listening Skills, Note Taking and Note Making, Collective note-taking and note-making on digital platforms

UNIT 3 **3 hrs**

Reading, Reading Comprehension, Speed Reading

UNIT 4 **3 hrs**

The art of introducing oneself, Public speaking and articulation

Max. 30 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Confidence to listen, speak, read and write in English.
CO2 Being able to produce something new with the help of inputs.
CO3 Learning to critically analyze.
CO4 Preparing reports/critique with the help of collected data.
CO 5 Having a multi-dimensional/disciplinary perspective and approach.
CO6 Better improved and sharpened skills to present, convince and persuade to be an effective and successful professional.

TEXT/REFERENCE BOOKS

- Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
- Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
- Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
- Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.
- Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009.

Assessment Tool	Marks	Assignments
Lab Work	50	• Listening and Questionnaire – 15 • Grammar Worksheet – 20 • Short Story/Essay (750 – 1000 words) – 05 • Reading Comprehension – 10
Lab Exam/Viva	50	• Wordsworth – 10 • Narrating a Story along with Self Introduction/Speech – 15 • Reading Aloud – 05 • Vocabulary/Phonetics – 20

16SP101/2/3					NCC/NSS/SPORTS					
Teaching Scheme					Examination Scheme					
					Theory			Practical		
L	T	P	C	Hrs/Week	MS	ES	IA	LW	*Participation and Attendance	Total Marks
0	0	2	1	2	* Continuous Evaluation			--	100	100

COURSE OBJECTIVES

- To develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
- To develop youth leadership in the students.
- To induce social consciousness among students through various camps and 'Shibir' activities.
- To develop skills and physical fitness among students through indoor & outdoor sports, field & track events.

National Cadet Corps (NCC):

Introduction to NCC, Aims and objectives, Structure and organization, NCC Song, Incentives, National Integration and Awareness, Drill, saluting, Personality Development & Leadership, Disaster Management, Social Awareness & Community Development, Health & Hygiene, Adventure camps, Environment Awareness and Conservation, Obstacle Training, Armed forces, Map reading, Field Craft & Battle Craft, Introduction to Infantry Weapons & Equipment, Weapon Training (During camps), Participation into Republic and Independence day ceremonial parades,

National Service Scheme (NSS):

Importance and role of youth leadership, Life competencies, Youth development programmes and youth 'shibir', Health, hygiene and sanitation, Youth health, lifestyle, first aid, youth and yoga

Sports:

Importance of sports/games in life, Physical fitness, Introduction to various games and sports, field and track events, Physical training, exercises, running, walking, jogging, Teaching of different sports/games, track & field events , demonstration, practice, skills and correction, Introduction to Yoga & Meditation.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the importance of Nation building and individual contribution to the same.
CO2 – **Integrate** physical fitness and mental wellbeing
CO3 – **Discover** grassroots challenges of community
CO4 – **Creating** societal impact
CO5 – **Maintain** discipline and team spirit
CO6 – **Upholding** the value of one for all and all for one

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: --**

* All registered students will be evaluated based on his/her attendance during the NCC/NSS/Sports sessions and participation to camps and other activities.

16TP110					Civic Serveices and Social Internship					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			01	21 days	--	--	--	--	--	100

COURSE OBJECTIVES

- To develop a holistic view of social work and social welfare in the community, with special emphasis on the role of different agencies like Govt. departments and NGOs in human services.
- To enlighten and sensitize students on various types of problems of the people and their diversified cultural background.
- To understand the agency as an organization, its structure, functions, activities and sources of funding.
- To understand and make a commitment to the basic humanistic values and principles of social work practice in a secular democratic society.
- To develop an understanding of the application of the methods of social work practice in the field.
- To develop an understanding of the opportunities in working with diverse populations.
- To develop the self –awareness necessary to assess one's own values, attitudes, feelings, strengths, limitations, and interests and performance.
- To inspire young technocrats to become change makers

UNIT 1: Overview of Civic and Social Service Sector
UNIT 2: Understanding of NGO/Civic Body/Government Body Management and their functioning
UNIT 3: Study of Individual organizational and government projects and schemes where students are interning
UNIT 4: Field visits

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Become sensitized workforce of enlightened Engineers and Managers who are socially concerned and willing to positively contribute to the society
CO2- Acquire desired work habits and attitudes with the sense of social responsibility and think innovatively to find solutions
CO3- Understand the role of different NGO/civic/government bodies in the service of citizens
CO4- Imbibe basic humanistic values and principles of social work practice in a secular democratic society
CO5- To assess one's own values, attitudes, feelings, strengths, limitations, interests and performance through opportunities of working with diverse populations
CO6- Obtain experiential learning via internship and be sensitive towards issues of modern-day citizenship and democracy

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: NGO evaluation 50 Marks
Part B: Internal faculty 50 Marks

Semester III

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester III			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20MA203T	Mathematics- III	3	1	0	4	4	25	50	25	--	--	100
2	20ECE201T	Electromagnetics and Transmission Line	3	0	0	3	3	25	50	25	--	--	100
3	20IC204T	Digital Logic Design and HDL	3	0	0	3	3	25	50	25	--	--	100
4	20ECE205P	Digital Logic Design Lab	0	0	2	1	2	--	--	--	50	50	100
5	20ECE202T	Circuits and Systems	3	0	0	3	3	25	50	25	--	--	100
6	20ECE203T	Analog Electronics-1	3	0	0	3	3	25	50	25	--	--	100
7	20ECE203P	Analog Electronics-1 Lab	0	0	2	1	2	--	--	--	50	50	100
8	20ECE204P	Simulation and Design Tools Lab	0	0	2	1	2	--	--	--	50	50	100
9		OE-1	3	0	0	3	3	25	50	25	--	--	100
		TOTAL	**18**	**1**	**6**	**22**	**25**						**900**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination; OE – Open Elective.

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20MA203T					Mathematics – III					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	0	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn Fourier analysis for solving engineering applications.
- To learn applications of special functions to solve variety of engineering problems.
- To introduce methodologies to develop first or second order partial differential equations and their solution.

UNIT 1: FOURIER ANALYSIS **12 Hrs.**

Periodic functions, odd and even functions, Dirichlet's conditions for Fourier Series expansion, Euler's formulae for Trigonometric Fourier series, change of interval, half range Sine and Cosine series, Complex Exponential Fourier series, Parseval's theorem, Applications to periodic function analysis and harmonic distortion calculation.

Aperiodic functions, Fourier transform, Dirichlet's conditions, Formula for Fourier and Inverse Fourier transforms, Examples of some useful Fourier transform pairs, Important Properties of Fourier transform, Applications to spectral analysis of aperiodic signals, Fourier transform of singularity functions and periodic functions.

UNIT 2: SPECIAL FUNCTIONS **09 Hrs.**

Bernoulli function, Binomial function, Gaussian function, Error function and complementary error function, Bessel functions, Butterworth, Chebyshev, Elliptic and Bessel polynomial functions, Important properties and applications.

UNIT 3: PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER **09 Hrs.**

Formation of Partial Differential Equations (PDEs), Solutions of PDEs of first order, Cauchy problem for first order PDEs, Lagrange's method, Charpit and Jacobi methods for solving first order nonlinear PDEs.

UNIT 4: PARTTIAL DIFFERENTIAL EQUATIONS OF SECOND ORDER WITH APPLICATIONS **09 Hrs.**

Classification of second order PDEs, method of separation of variables, Fourier series solutions of one-dimensional wave equation, One dimensional, two dimensional and three dimensional PDEs, Applications of to wave analysis.

Max. Hrs.: 39

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify role of various mathematical functions and partial differential equations in real world problems.
CO2 - Understand properties of various mathematical functions and solution of partial differential equations.
CO3 - Apply properties of functions and solutions of partial differential equations to engineering applications.
CO4 - Analyze problems involving mathematical functions and partial derivatives.
CO5 - Evaluate physical problems involving mathematical functions and partial derivatives.
CO6 - Develop the ability to model the physical systems in terms of the methods learnt in this course and then solve accordingly.

TEXT/REFERENCE BOOKS

- E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House.
- Tai-Ran Hsu, Applied Engineering Analysis, John Wiley & Sons.
- K. S. Rao: Introduction to Partial Differential Equations, PHI Learning Pvt Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE201T					Electromagnetics and Transmission Line					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding about electromagnetic waves.
- To provide the knowledge about concepts related to electrostatics and magneto statics.
- To understand electromagnetic wave characteristics.
- To provide knowledge of transmission line theory.

UNIT 1: Vector Algebra and Electrostatics **12 Hrs.**

Introduction: Review of scalar and vector field, Dot and Cross products, Coordinate Systems-Cartesian, cylindrical and spherical. Vector representation of surface, Physical interpretation of gradient divergence and curl, Transformation of vectors in different co-ordinate systems. Electrostatics: Electric field due to point-charges, line charges and surface charges, Electrostatic potential, Solution of Laplace and Poisson's equation in one dimension, M-method of image applied to plain boundaries, field mapping and conformal transformation, Electric flux density, Boundary conditions. Capacitance: calculation of capacitance for simple rectangular, cylindrical and spherical geometries, Electrostatic energy.

UNIT 2: Magnetostatics **10 Hrs.**

Introduction, Magnetic Induction and Faraday's Law, Magnetic Flux Density, Magnetic Field Strength H, Ampere, Gauss Law in the Differential Vector Form, Permeability, Energy Stored in a Magnetic Field, Ampere's Law for a Current Element, Volume Distribution of Current , Ampere's Law Force Law, Magnetic Vector Potential, The Far Field of a Current Distribution, Maxwell's Equations: The Equation of Continuity for Time Varying Fields, Inconsistency of Ampere's Law, Maxwell's Equations, Conditions at a Boundary Surface.

UNIT 3: EM Wave Characteristics **11 Hrs.**

Introduction, Continuity equations, Displacement current, Maxwell's equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phasor notation, Phase velocity, Group velocity, Depth of penetration, Conductors and dielectrics, Impedance of conducting medium. Polarization, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem.

UNIT 4: Transmission Lines **12 Hrs.**

Introduction, Transmission line equations, Characteristic impendence, Distortion-less lines, Input impendence of a loss less line, computation of primary and secondary constants, Open and Short circuited lines, Standing wave and reflection losses, Impedance matching, Loading of lines, Input impedance of transmission lines, RF lines, Relation between reflection coefficient and voltage standing wave ratio (VSWR), Lines of different lengths – $\lambda/2$, $\lambda/4$, $\lambda/8$ lines, Losses in transmission lines, Smith chart and applications, impedance matching Single stub, Double stub.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember different laws of electromagnetics
CO2 - Understand different concepts of electromagnetics and transmission lines
CO3 - Apply different concepts of electromagnetics and transmission lines to solve problems
CO4 - Analyze the different medium under the presence of electromagnetic waves
CO5 - Evaluate the different electromagnetic and transmission line systems
CO6 – Create the application of electromagnetics and transmission lines

TEXT/REFERENCE BOOKS

- Engineering electromagnetic-, William H. Hayt Jr. and John A. Buck, 7thEd. 2006, TMH.
- Elements of electromagnetics, Matthew Sadiku, Oxford university press, 7th edition, 2018
- Electromagnetic waves and radiating systems, E.C.Jordan, K.G.Balmain, 2nd edition, 2000, PHI
- Electromagnetic Field Theory and Transmission Lines, G. S. N. Raju, Pearson Education India, 2006.
- Microwave Engineering, David M. Pozar, Wiley.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20IC204T					Digital Logic Design and HDL					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of digital logic circuits and digital number systems.
- To be able to analyze and design digital combinational-logic and sequential-logic circuits.
- To implement digital combinational-logic and sequential-logic circuits, using Verilog HDL.

UNIT-1: INTRODUCTION TO DIGITAL NUMBER SYSTEMS AND DIGITAL LOGIC/GATES 9 Hrs.

Introduction: Digital Systems; Data representation and coding; Noise Margins; Basic logic operations, truth-tables and logic gates; Number Systems and Codes: Positional number system; Binary; octal and hexadecimal number systems; Methods of base conversions; Binary; octal and hexadecimal arithmetic; Representation of signed numbers; Fixed-point numbers; Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming codes.

UNIT-2: DIGITAL COMBINATIONAL-LOGIC CIRCUITS AND VERILOG HDL 16 Hrs.

Boolean Algebra & Simplification of Boolean Algebra: Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions; The Map Method; SOP and POS forms; Simplification of Boolean functions using K-map and Quine-McCluskey tabular methods; Synthesis of combinational logic circuits. Digital Combinational-Logic modules: Decoders; encoders; multiplexers; demultiplexers, combinational shifters, and their applications; Parity circuits and comparators; Arithmetic modules- adder; sub-tractor, basic multiplier, ALU; Design examples. Introduction to Verilog Hardware Description Language (HDL): Types of modelling: Gate-level modelling, Data-flow modelling; Behavioural modelling; Basic constructs and syntax of Verilog language, related to hierarchical and modular modelling; Concept of test-bench and incorporating delays in test-bench; Verilog implementation of combinational circuits/modules.

UNIT-3: DIGITALSEQUENTIAL-LOGIC CIRCUITS 15 Hrs.

Basic sequencing elements - latches and flip-flops: SR-latch; D-latch; D flip-flop; JK flip-flop; T flip-flop;
Definitions of (synchronous) Moore and Mealy Finite State Machines (FSM) state diagram, state table, state assignment; Analysis and implementation of FSM using D flip-flops, JK flip-flops and T flip-flops; Design examples of FSM; Various Registers-and Counters; Application examples. Verilog implementation of sequencing elements (latch and flip-flops) using behavioural modelling; Verilog implementation of sequential-logic circuits and RTL structures.

UNIT 4: INTRODUCTION TO MEMORY AND PROGRAMMABLE LOGIC CIRCUITS 5 Hrs.

Introduction to basic sub-blocks of memory; Programmable Logic Devices: PLAs and their applications; Sequential PLDs.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, the student will be able to
CO1 - Understand the basics of number systems, Boolean algebra and standard digital logic gates.
CO2 - Analyze the functionality of digital combinational-logic and sequential-logic circuits.
CO3 - Design digital combinational-logic and sequential-logic circuits, at the module/schematic-level.
CO4 - Write codes in Verilog HDL, using structural, dataflow, and behavioural modelling.
CO5 - Implement digital combinational-logic circuits, using Verilog HDL.
CO6 - Build digital sequential-logic circuits and RTL structures, using Verilog HDL.

TEXT/REFERENCE BOOKS

- M. Morris Mano and Michael Ciletti Digital Design, 5 th edition, Pearson.
- Stephen Brown and Zvonko Vranesic Fundamentals of Digital Logic with Verilog Design, Tata McGraw Hill.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 10 Exam Duration: 3 Hrs.

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE205P					Digital Logic Design Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES:

- To learn the fundamentals of digital logic design and digital circuits.
- To be able to analyze and design digital combinational-logic and sequential-logic circuits.
- To be able to implement digital combinational-logic and sequential-logic circuits.

List of Experiments

1. Study of Different types logic gates.
2. Study of NAND and NOR gates as Universal gates.
3. Study of De Morgan's theorem.
4. Study of SOP and POS form reduction using Karnaugh Map and implementation using NAND/NOR logic.
5. Study of Half and full adder circuits.
6. Study of Binary and BCD parallel adder circuits.
7. Study of Decoder and Encoder circuits.
8. Study of Multiplexer and De-multiplexer circuits.
9. Study of Different types of flip flops.
10. Study of Asynchronous and synchronous binary counters.
11. Study of Various types of registers.
12. Study of Arithmetic Logic Unit (ALU).

COURSE OUTCOMES

On completion of the course, the student will be able to:
CO1 - Remember digital logic circuit functionalities
CO2 - Understand the design methodologies to utilize them practically.
CO3 - Apply design methods to realize digital circuits practically.
CO4 - Analyze functionalities of digital circuits.
CO5 - Evaluate and report performance of digital circuits.
CO6 - Design and Test elementary digital combinational-logic and sequential-logic circuits.

TEXT/REFERENCE BOOKS

- M. Morris Mano and Michael Ciletti, "Digital Design: With a Introduction to the Verilog HDL", 5th edition,Pearson.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max.Marks:50 **Exam Duration: 2Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming coding/implementation/investigation/ solution- development.	50 Marks

20ECE202T					Circuits and Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand classification of signals and systems
- To learn applications of mathematical tools like Laplace Transform and Fourier Transform in circuit analysis.
- To understand the importance of two port networks.

UNIT 1: CONTINUOUS TIME SIGNALS AND SYSTEMS **10 Hrs.**

Signal – Definition, Examples, Classifications, Continuous time signals: Energy, power, Periodicity, Signal operations, Elementary Signals, System - Definition, Classification, Continuous time LTI systems: Convolution integral and unit impulse response, Interconnections, Stability and Causality, Electrical network (R-L, R-C and R-L-C circuits) analysis in time domain.

UNIT 2: LAPLACE TRANSFORM AND APPLICATION TO CIRCUIT ANALYSIS **12 Hrs.**

Laplace transform: Definition, Elementary pairs, Basic properties, Region of convergence (ROC), Inverse Laplace transform using partial fractions, Application to LTI systems, System transfer function, poles and zeros: stability and causality, Laplace transform for solution of linear constant co-efficient differential equation, Application to transient analysis of electrical networks, Application to waveform analysis.

UNIT 3: FOURIER TRANSFORM AND APPLICATION TO CIRCUIT ANALYSIS **11 Hrs.**

Fourier Analysis: Exponential Fourier series and Fourier transform, Signal spectra, Dirichlet conditions, Important properties, Frequency analysis of LTI systems, Application to sinusoidal steady-state analysis of electrical networks, Bode plots.

UNIT 4: NETWORK THEOREMS, TWO PORT NETWORKS AND PARAMETERS **12 Hrs.**

Single port and two port electrical networks, Controlled sources, Source transformations, Driving point functions, Transformed electrical networks and analysis using Super-position, Thevenin and Norton's theorem, Two port network analysis using z, y and h parameters, Transmission line as two port network and ABCD parameters, series and parallel connections of two port electrical networks and parameters.

Max. Hrs:.45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Remember properties of continuous time signals and systems in Time domain, s-domain and frequency domain.
CO2: Understand concepts and complexity of circuit analysis techniques.
CO3: Apply concepts to analyze complicated electrical networks.
CO4: Analyze LTI systems and electrical networks using mathematical tools.
CO5: Evaluate signal values in electrical network using different techniques.
CO6: Create mathematical models for electrical networks and other LTI systems.

TEXT/REFERENCE BOOKS

- Signals & Systems, Alan V.Oppenheim, Alan S.Willsky with S. Hamid Nawab, Pearson Education.
- Network Analysis, M E Van Valkenburg, PHI.
- Circuits, Systems and Signal Processing, A Tutorials Approach, Suhash Chandra Dutta Roy, Springer.
- Circuits and Systems, K. M. Soni, S. K. Kataria & Sons.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE203T					Analog Electronics-1					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- To introduce circuit realizations with BJTs.
- To give understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers.
- To familiarize the Concept of feedback in amplifiers so as to differentiate between negative and positive feedback.
- To evolve the students as oscillator designers.

UNIT 1: BJT Amplifier **11Hrs.**

Introduction to biasing, of BJT, operating point, bias stability for different circuits, stabilization against V_{BE}, I_{CO} and β, bias compensation techniques, thermal runaway, thermal stability.

UNIT 2: Small signal Model **10Hrs.**

Two port device and Hybrid model, Analysis of CE, CC, and CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, Miller's Theorem, Dual of Miller's theorem.

UNIT 3: Multistage Amplifier **12Hrs.**

Multistage amplifier, coupling mechanism, effect of coupling and bypass capacitors, Design of single stage and multistage RC coupled amplifier, Analysis of Cascaded RC Coupled amplifiers, Cascode amplifier, Darlington pair, High frequency pi Model, high frequency analysis.

UNIT 4: : Feedback Amplifier and Oscillators **12Hrs.**

Introduction, types of amplifier, concept of feedback, feedback topology, effect on gain, bandwidth, input and output resistance, Use of positive feedback, Barkhausen criterion for oscillations, sinusoidal oscillators, phase shift, resonant circuit oscillators, crystal oscillator. Different oscillator circuits-tuned collector, Hartley Colpitts, phase shift, Wien's bridge, and crystal oscillator.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember the concepts BJT related design issues.
CO2 - Understand the analog circuit and its design.
CO3 - Apply small signal amplifier model for different circuits.
CO4 - Analyse Cascaded amplifier configurations to obtain the required overall specifications.
CO5 - Design different Amplifiers.
CO6 - Build Analog subsystem using amplifier and oscillator.

TEXT/REFERENCE BOOKS

- Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education
- Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.
- Electronic Devices Conventional and current version -Thomas L. Floyd 2015, person
- Electronic Devices and Circuits, David A. Bell – 5th Edition, Oxford.
- Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, A Vallvaraj, 5th Edition, MC GRAW HILL EDUCATION.
- Electronics circuits and applications , Md H Rashid, Cengage 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE203P					Analog Electronics-1 Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To experiment with circuit realizations with BJTs.
- To give understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers.
- To familiarize the Concept of feedback in amplifiers so as to differentiate between negative and positive feedback.
- To design different oscillator

List of Experiments

1. To study components of AE-1 lab.
2. To study common emitter amplifier.
3. To study different biasing circuits of BJT.
4. To study transfer and drain characteristic of FET and MOSFET.
5. To obtain operating point of the given circuit.
6. To study thermal stability of the given circuit.
7. To measure the hybrid parameter of BJT.
8. To obtain frequency response of single stage CE amplifier.
9. To study the effect of negative feedback with and without bypass capacitor.
10. To obtain frequency response of two stage RC coupled amplifier.
11. To study feedback amplifier.
12. To study RC phase shift oscillator.
13. To study resonant oscillator.
14. Design of mini project in a group of 4-5 students.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Remember the concepts BJT related design issues.
CO2 - Understand the analog circuit and its design.
CO3 - Apply small signal amplifier model for different circuits.
CO4 - Analyse Cascaded amplifier configurations to obtain the required overall specifications.
CO5 - Design different Amplifiers.
CO6 - Build Analog subsystem using amplifier and oscillator.

TEXT/REFERENCE BOOKS

- Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education
- Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.
- Electronic Devices Conventional and current version -Thomas L. Floyd 2015, person
- Electronic Devices and Circuits, David A. Bell – 5th Edition, Oxford.
- Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, A Vallvaraj, 5th Edition, MC GRAW HILL EDUCATION.
- Electronics circuits and applications , Md H Rashid, Cengage 2014

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming-coding/implementation/investigation/solution-development.	50 Marks

20ECE204P					Simulation and Design Tools Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES:

- To learn different electronic circuit design and simulation tools.
- To be able to analyze and design analog and digital circuits using simulation tools.
- To be able to describe digital circuits using Hardware Descriptive Language (HDL).

List of Experiments:

Simulation and design using various software tools like Multisim, Logisim, LTSpice, Verilog HDL Coder, Scilab etc.

1. Simulation of Resistive Circuits and Study of Superposition, Thevenin and Norton Theorems.
2. Simulation of AC and DC Analysis, Transient and Steady State Response of R-L, R-C, R-L-C circuits.
3. Simulation of Two Port Passive and Active Networks and determination of various parameters.
4. Simulation and Design of Feedback Amplifiers.
5. Simulation and Design of Oscillators.
6. Simulation and Design of Audio Power Amplifiers.
7. Simulation and Design of RF (Tuned) Amplifiers.
8. Simulation and HDL programming of Logic Gates and Combinational Digital Circuits.
9. Simulation and HDL programming of Encoding and Decoding Systems.
10. Simulation and HDL programming of Multiplexing and De-multiplexing Systems.
11. Simulation and HDL programming of Flip Flops and Sequential Digital Circuits (Finite State Machines).
12. Simulation and HDL programming of Synchronous and Asynchronous Counters.
13. Simulation and HDL programming of Universal Shift Register.
14. Simulation and HDL programming of Memory Sub-systems.
15. Simulation and HDL programming of Arithmetic Logic Unit (ALU).

COURSE OUTCOMES

On completion of the course, the student will be able to:

CO1 - Remember circuit design methodologies.
CO2 - Understand the design methodologies to utilize them practically.
CO3 - Apply simulation tools to realize analog and digital circuits.
CO4 - Analyze functionalities of analog and digital circuits.
CO5 - Evaluate and report performance of analog and digital circuits.
CO6 - Design amplifiers, oscillators and various digital combinational-logic and sequential-logic circuits, at the module/schematic-level using software tools.

TEXT/REFERENCE BOOKS

- Muhammad H Rashid "SPICE for Circuits and Electronics", Cengage.
- M. Morris Mano and Michael Ciletti, "Digital Design: With a Introduction to the Verilog HDL", Pearson.
- Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming- coding/implementation/investigation/solution-development.	50 Marks

Semester IV

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester IV			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20ECE207T	Analog Communication	3	0	0	3	3	25	50	25	--	--	100
2	20ECE207P	Analog Communication Lab	0	0	2	1	2	--	--	--	50	50	100
3	20ECE208T	Analog Electronics-2	3	0	0	3	3	25	50	25	--	--	100
4	20ECE208P	Analog Electronics-2 Lab	0	0	2	1	2	--	--	--	50	50	100
5	20ECE209T	Digital Signal Processing	3	0	0	3	3	25	50	25	--	--	100
6	20ECE209P	Digital Signal Processing Lab	0	0	2	1	2	--	--	--	50	50	100
7	20ECE210T	Computer Communication and Networks	2	0	0	2	2	25	50	25	--	--	100
8		OE-2	3	0	0	3	3	25	50	25	--	--	100
9	20HS201P	Communication Skills - II	0	0	2	1	2	--	--	--	50	50	100
10	20TP210	Industrial Orientation	0	0	0	1	0	--	--	--	--	--	100
		TOTAL	**14**	**0**	**8**	**19**	**22**						**1000**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination; OE – Open Elective.

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20ECE207T					Analog Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To learn the fundamentals of a communication system.
- To be able to understand, analyze, and design analog communication systems
- To implement analog transmitter-receiver modules and analyze its performance.

UNIT-1: INTRODUCTION TO AMPLITUDE MODULATION **12 Hrs.**

Introduction: General architecture of a communication system, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves, Superheterodyne Receiver, Costas loop.

UNIT-2: SINGLE SIDE-BAND AND VESTIGIAL SIDE-BAND MODULATION **11 Hrs.**

Quadrature carrier multiplexing, Hilbert transform, properties of Hilbert transform, Pre-envelope, Canonical representation of band pass signals, Single side-band modulation (SSB), Frequency-Domain description of SSB wave, Time-Domain description. Phase discrimination method for generating an SSB modulated wave. Demodulation of SSB waves. Generation of Vestigial Side Band (VSB) modulated wave, Time - Domain description, Envelop detection of VSB wave plus carrier, Applications of VSB, Comparison of amplitude modulation techniques.

UNIT-3: ANGLE MODULATION **12 Hrs.**

Introduction, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM. Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop.

UNIT-4: NOISE **10 Hrs.**

Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Noise Figure, Equivalent noise temperature. Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Noise in FM receivers, Pre-emphasis and De-emphasis in FM, Auto correlation, Cross relation , Energy spectral density, Power spectral density and their applications in communication signal/noise analysis. **Max Hrs. 45**

COURSE OUTCOMES:

On completion of the course, the student will be able to:

CO1 - Understand the basics of communication systems, analog transmitter and receiver design issues.
CO2 - Analyze the functionality of various blocks of an analog communication system.
CO3 - Design analog transmitter and receiver modules both at the block and circuit levels.
CO4 - Evaluate various design issues and possible solution methods of analog communication systems.
CO5 - Implement analog communication systems using BJT, FET and other electronic modules.
CO6 - Build analog communication circuits, find design related issues, and measure its performance.

TEXT/REFERENCE BOOKS:

- Simon Haykins & Michael Moher, *Communication Systems*, 5th Edition, John Willey, India Pvt. Ltd, 2010
- B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press., 4th edition.
- Simon Haykins & Michael Moher, *An Introduction to Analog and Digital Communication*, John Wiley India Pvt. Ltd., 2008.
- H.Taub & D.L.Schilling, Principles of Communication Systems, TMH, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE207P					Analog Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES:

- To learn the fundamentals of analog communication systems and its application for voice communications.
- To be able to analyze and design analog communication circuits.
- To be able to implement analog communication blocks using program (MATLAB) and analog circuit design simulators such as MultiSim and TINA.

List of Experiments:

Design, simulation, implementation and testing of:

1. Generation of Amplitude Modulated (AM) Signal
2. Demodulation of AM Signal
3. DSB-SC modulation
4. DSB-SC demodulation
5. SSB-SC modulation
6. SSB-SC demodulation (phase-shift method)
7. Frequency modulation
8. FM detection
9. Pre Emphasis - De Emphasis Circuits
10. Analog Mixer
11. Superheterodyne receiver
12. Phase locked loop

COURSE OUTCOMES:

On completion of the course, the student will be able to:

CO1 - Remember analog communication circuit design methodologies.
CO2 - Understand the design methodologies to utilize them practically.
CO3 - Apply design methods to realize analog communication circuits practically.
CO4 - Analyze functionalities of the basic building blocks of analog communication system.
CO5 - Evaluate and report performance of different analog communication techniques.
CO6 - Design modulator and demodulator circuits using software.

TEXT/REFERENCE BOOKS:

- Simon Haykins & Michael Moher, *Communication Systems*, 5th Edition, John Willey, India Pvt. Ltd, 2010
- B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press., 4th edition.
- Simon Haykins & Michael Moher, *An Introduction to Analog and Digital Communication*, John Wiley India Pvt. Ltd., 2008.
- H.Taub & D.L.Schilling, Principles of Communication Systems, TMH, 2011.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming- coding/implementation/investigation/ solution- development.	50 Marks

20ECE208T					Analog Electronics-2					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

Course Objectives

- To study the basic principles, configurations and practical limitations of op-AMP.
- To understand the various linear and non-linear applications of op-AMP.
- To understand and design op-AMP based active filters.
- To analyze and design op-AMP oscillators and waveform.
- To analyze and design circuits based on 555 Timer IC and OTA.

UNIT 1: Basics of OPAMP **10Hrs.**

Introduction to Op-Amp : Differential amplifier using BJT, Block diagram of op-amp, pin diagram of 741 IC, characteristics of ideal Op-Amp, equivalent circuit of Op-Amp, ideal voltage transfer curve, Op-Amp ac and dc parameters. (Revision 1 lecture)

Building blocks of Analog ICs: Differential amplifier using single and two op-amp, virtual ground, circuit for improving CMRR, Wilson & Widlar Current mirrors, Active loads, Level shifters and output stages, instrumentation amplifier using Op-Amp, Inverting and non-inverting amplifiers, voltage follower, difference amp, adders.

UNIT 2: OPAMP Applications **11Hrs.**

Linear & Non Linear Wave shaping: Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.

Active RC Filters: Idealistic & Realistic response of filters (Low pass, High pass, Band pass and Band reject), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter.

UNIT 3: Waveform generators: **12Hrs.**

Barkhausen criteria of oscillations, conditions for oscillation, crystal oscillator, Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Square and triangular waveform generators (period and frequency analysis), Schmitt Trigger, Voltage limiters, saw tooth wave generator, Astable, Monostable and Bistable Multivibrators.

UNIT 4: Advanced LICs **12Hrs.**

Introduction to 555 Timer IC: Functional and block diagram of 555 timer, Application of 555 timer as astable Bistable and monostable, multivibrators.

Operational transconductance amplifier (OTA): Introduction to OTA, OTA integrator & differentiator, Introduction to current conveyer. Applications of IC Analog Multiplier: IC phase locked loops, IC voltage regulators, IC VCO.

Max.Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember basic characteristics of OPAMP and 555 Timer.
CO2 - Understand OP-AMP properties and limitations.
CO3 - Apply the knowledge earned to design current mirrors and instrumental amplifiers.
CO4 - Analyze the circuit performance of OP-AMP based Filter circuits.
CO5 - Evaluate the design of op-AMP's linear and non-linear applications.
CO6 - Create the op-AMP based oscillators, filters, waveform generators and OTA.

TEXT/REFERENCE BOOKS

- Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015.
- Salivahanan, Bhaaskaran, "Linear Integrated Circuits," McGraw Hill Co. 2nd Ed,2017.
- Robert F. Coughlin, and Driscoll," Operational Amplifiers and Linear Integrated Circuits", 6/e,Pearson Education. Reprint 2007.
- P. R. Gray and R. G. Meyer," Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE208P					Analog Electronics-2 Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

Course Objectives

- To study the basic principles, configurations and practical limitations of op-AMP.
- To understand the various linear and non-linear applications of op-AMP.
- To understand and design op-AMP based active filters.
- To analyze and design op-AMP oscillators and waveform.
- To analyze and design circuits based on 555 Timer IC and OTA.

List of Experiments:

1. Introduction of Lab and simulation tool
2. To measure non idealities in OP-Amp such as non-infinite input impedance, non-zero output impedance, common-mode rejection ratio etc.
3. To design inverting non inverting op-amp amp amplifier.
4. To design OP-Amp based rectifiers.
5. To design OP-Amp comparators.
6. To design OP-Amp log/antilog amplifier.
7. To design Wilson & Widlar Current mirrors.
8. To design OP-Amp wave shaping Circuits.
9. To design waveform generators: using op-AMP.
10. To design 1st and 2nd order LPF and HPF.
11. To design 1st and 2nd order BPF and BRF.
12. To design and simulate IC Voltage Regulators.

*At-least 5 experiments should be performed with simulators.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember basic characteristics of OPAMP and 555 Timer.
CO2 - Understand OP-AMP properties and limitations
CO3 - Apply the knowledge earned to design current mirrors and instrumental amplifiers.
CO4 - Analyze the circuit performance of OP-AMP based Filter circuits.
CO5 - Evaluate the design of op-AMP's linear and non-linear applications.
CO6 - Create the op-AMP based oscillators, filters and waveform generators.

TEXT/REFERENCE BOOKS

- Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015.
- Salivahanan, Bhaaskaran, "Linear Integrated Circuits," McGraw Hill Co. 2nd Ed,2017.
- Robert F. Coughlin, and Driscoll," Operational Amplifiers and Linear Integrated Circuits", 6/e,Pearson Education. Reprint 2007
- P. R. Gray and R. G. Meyer," Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming- coding/implementation/investigation/solution-development.	50 Marks

20ECE209T					Digital Signal Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce mathematical ideas for analysis of discrete time signals and systems.
- Understand methodology to analyze, design and implement various digital filters.
- Understand need and development of efficient algorithms for various DSP tasks.

UNIT 1 DISCRETE TIME SIGNALS AND SYSTEMS **12 Hrs.**

Continuous Time and Discrete Time Signals, Analog and Digital Signals – Definition and Examples, Classification of Discrete Time Signals, Energy, Power, Periodicity, Signal operations, Discrete time elementary signals, Discrete Time Systems - Definition, Classification, Discrete time LTI system and unit impulse (sample) response, Convolution sum, Linear constant co-efficient difference equation representation, Block Diagram Representation, Interconnections, Stability and causality, Sampling and Sampling theorem, Reconstruction, Aliasing, Concept of quantization, A to D and D to A conversion, Discrete time vs. digital signal processing.

UNIT 2: TRANSFORMED DOMAIN ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS **12 Hrs.**

Z-transform, ROC and Properties, Poles- Zeros, Inverse z-transform, LTI System Analysis using Z-transform, Discrete Time Fourier Transform (DTFT) and Important Properties, Frequency Response of Discrete Time Systems, Correlation of Discrete Time Signals, Parseval's relation, Energy and Power Spectral Density.

UNIT 3: DIGITAL FILTERS: DESIGN AND STRUCTURES **12 Hrs.**

Ideal Digital Filters, Practical Filters: Stability and Causality, FIR and IIR Filters, Linear Phase and Implications, Filter Design Steps, Design of Linear Phase FIR Filters, Window Method, IIR Filter Design, Pole-Zero Placement Method, Overview of Laplace Transform and Analog Filter Design, Analog Filter Standard Frequency Responses and Design Equations, IIR Filter Coefficients from Analog Filter, Bilinear Transformation, Basic Structures for FIR and IIR Systems implementation, Direct, Transposed Cascade and Parallel form Structures, Effects of Co-efficient Quantization.

UNIT 4: DFT AND FFT ALGORITHMS **09 Hrs.**

Effect of periodicity and discretization on spectra of a signal, Sampling of DTFT, DFT and IDFT, Important Properties of DFT, Linear and Circular Convolution, Application of DFT in Linear Filtering, Efficient Computation of DFT, Radix2 FFT Algorithms, Geortzel Algorithm.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember properties of discrete time signals and systems in Time domain, Z-domain and frequency domain.
CO2 - Understand concepts and complexity of digital signal processing techniques.
CO3 - Apply concepts to realize discrete time systems and digital signal processing algorithms.
CO4 - Analyze discrete time systems, algorithms and digital filters.
CO5 - Evaluate performance of discrete time systems and digital signal processing algorithms.
CO6 - Design and implement practical DSP applications.

TEXT/REFERENCE BOOKS

- Digital Signal Processing: Principles, Algorithm & Application, Proakis, Manolakis, Pearson Education.
- Digital Signal processing-A Practical Approach, Emmanuel Ifeacher,, Barrie W..Jervis, Pearson Education.
- Discrete Time Signal Processing, Allen V. Oppenheim, Ronald W. Schafer, Prentice Hall.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE209P					Digital Signal Processing Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	0	2	---	---	---	50	50	100

COURSE OBJECTIVES

- To impart knowledge of flow process of digital signal processing.
- To implement digital signal processing algorithms on software and hardware platforms.
- To evaluate performance of digital signal processing systems and algorithms.

List of Experiments:

1. Introduction to simulation tool and environment: Command Window, Variables, Constants, Scalars, Matrices and Vectors, Functions, Comments, Command History, Workspace, Editor, Script file etc.
2. Discrete time signal generation.
3. Discrete time system analysis in Z-domain.
4. Discrete time system analysis in frequency domain.
5. Moving average filter analysis.
6. FIR filter design.
7. IIR filter design –I.
8. IIR filter design – II and filter design and analysis tools.
9. Overlap add method.
10. Applications: Reverberation modeling, Graphic equalizer, DTMF generator and detector etc.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember representation of discrete time signals and systems in Time domain, Z-domain and frequency domain.
CO2 - Understand the methodologies to utilize digital signal processing techniques practically.
CO3 - Apply concepts to realize discrete time systems and digital signal processing algorithms practically.
CO4 - Analyze and report the behaviour of discrete time systems and digital signal processing algorithms.
CO5 - Evaluate and report performance of discrete time systems and digital signal processing algorithms.
CO6 - Design and implement practical applications using various tools.

TEXT/REFERENCE BOOKS

- Digital Signal Processing: Principles, Algorithm & Application, Proakis, Manolakis, Pearson Education.
- Digital Signal processing-A Practical Approach, Emmanuel Ifeacher,, Barrie W..Jervis, Pearson Education.
- Discrete Time Signal Processing, Allen V. Oppenheim, Ronald W. Schafer, Prentice Hall.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming- coding/implementation/investigation/ solution- development.	50 Marks

20ECE210T					Computer Communication and Networks					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the communication network design.
- Study the state-of-the-art in network protocols, architectures.
- Learn the design and implementation of network applications.
- Understand about working of different protocols.

UNIT 1: Introduction and application layer **8 Hrs.**

Introduction: Nuts and Bolts, Performance parameters: throughput, delay, etc., Layered Architecture (OSI and TCP/IP),Applications: Network application Design, Socket Programming, Client-server applications, Echo and Chat applications, FTP,DNS, Peer to Peer file sharing application, use of computer networks and ethics

UNIT 2: Data link and physical layers **7 Hrs.**

Data link layer: Introduction, Media access protocols , Ethernet 802.3, Token, ring 802.5, Reliability Issue: sliding window, Internetworking and Routing: Best effort Service, Virtual Circuits, IP Addressing, introduction to physical layer services, different types of modulation schemes, multiplexing and demultiplexing techniques.

UNIT 3: Network layer **7 Hrs.**

Internetworking and Routing: Routing Issues, Distance Vector and Link State routing, Intra and Inter Autonomous System Routing (OSPF, RIP, BGP), Broadcast and Multicast Routing Issues

UNIT 4: Transport Layer **8 Hrs.**

Transport Layer: End to end delivery issues, Reliable data transfers, Congestion Control, Traffic engineering and Quality of service, TCP, UDP, Advanced Topics: QoS over IP, IPV6, Infrastructure-less networks: wireless ad hoc and sensor networks, and Internet of Things (IoT), Green computer networking.

Max Hrs. 30

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember concepts of protocol design at different layers.
CO2 - Understand design and implementation of different protocols.
CO3 - Apply computer networking concepts to solve problems.
CO4 - Analyze computer networking protocols at different layers.
CO5 - Evaluate performance of different Computer network protocols.
CO6 - Create computer networking applications.

TEXT/REFERENCE BOOKS

- James Kurose and Keith Rose, “Computer Networking: A Top Down Approach”, Pearson Education.
- Larry L Peterson and Bruce S Davie, “Computer Networks: A Systems Approach”, Elsevier.
- Andrew S Tanenbaum, “Computer Networks”, Pearson Education.
- Behrouz A Forouzan, “Data Communication and Networking”, McGraw Hill.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20HS201P					Communication Skills – II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	0	2	--	--	--	50	50	100

COURSE OBJECTIVES

- Understand of the fundamental elements of communication in English language.
- Know and understand different practices of verbal and non-verbal communication with inputs to improve basic language skills.
- Students are expected to be better equipped in the following areas:
  - **Listening:** Understanding basic content in lectures and common everyday situations.
  - **Speaking:** Correct expression in the English language at a basic level.
  - **Reading:** Understanding, retaining, and critically analysing technical/non-technical content.
  - **Writing:** Using appropriate vocabulary, grammar, effective paragraph construction, writing in day-to-day scenarios, including digital platforms.

UNIT 1	**7Hrs.**
Technical Writing, Report Writing, Creating Lab Journals and Manuals, Portfolio of Critical Writing and Creative Writing, Essay, Story-writing, etc.	
UNIT 2	**7Hrs.**
Summarizing, Writing Reviews (Books/Articles/Movies/websites), Reading Skills (Advanced).	
UNIT 3	**7Hrs.**
Digital Literacy, Emails, Creating e-content, Editing and proofreading online, Using grammar and spell check software, Using plagiarism checkers.	
UNIT 4	**9Hrs.**
Group Discussion, Resume Writing, Interview Skills	
	Max. Hrs.: 30

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Confidence to listen, speak, read and write in English.
CO2 - Being able to produce something new with the help of inputs.
CO3 - Learning to critically analzse.
CO4 - Preparing reports/critique with the help of collected data.
CO5 - Having a multi-dimensional/disciplinary perspective and approach.
CO6 - Better improved and sharpened skills to present, convince and persuade to be an effective and successful Professional.

TEXT/REFERENCE BOOKS

- Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
- Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
- Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
- Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.
- Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009.

Assessment Tool	Marks	Assignments
Lab Work	50	Essay/Journal Writing – 10; Report Writing – 10; Creating e-content – 10; Blog Writing – 10; Review Writing – 10.
Lab Exam/Viva	50	Mock Interview – 15; Group Discussion – 15; Cover Letter/Curriculum – 20.

20TP210					Industrial Orientation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	-	1	3 weeks summer break	--	--	--	--	--	100

COURSE OBJECTIVES

- To explore and experience the working environment of the industry.
- To learn about the different departments in an industry.
- To relate classroom learning with functioning of an industry.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember the academic concepts to solve industrial problems.
CO2 - Understand the working of different industrial departments.
CO3 - Map classroom learnings to industry processes.
CO4 - Analyse different solutions for industrial problems.
CO5 - Evaluate the impact of solution.
CO6 - Apply principles of management, teamwork, ethics, and communicate effectively in a professional environment for lifelong learning.

Semester V

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester V			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20ECE301T	Digital Communication	3	0	0	3	3	25	50	25	--	--	100
2	20ECE301P	Digital Communication Lab	0	0	2	1	2	--	--	--	50	50	100
3	20ECE302T	Computer Design and Applications	3	0	0	3	3	25	50	25	--	--	100
4	20ECE302P	Computer Design and Applications Lab	0	0	2	1	2	--	--	--	50	50	100
5	20ECE303T	Machine Learning and Applications	3	0	0	3	3	25	50	25	--	--	100
6	20ECE303P	Machine Learning and Applications Lab	0	0	2	1	2	--	--	--	50	50	100
7	20IF201T	Industry 4.0	2	0	0	2	2	25	50	25	--	--	100
8	20IF201P	Industry 4.0 Lab	0	0	2	1	2	--	--	--	50	50	100
9		CE1(Theory)	3	0	0	3	3	25	50	25	--	--	100
10		CE2 (Theory)	3	0	0	3	3	25	50	25	--	--	100
11		OE-3	3	0	0	3	3	25	50	25	--	--	100
		TOTAL	**20**	**0**	**8**	**24**	**28**						**1100**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination; OE – Open Elective, CE – Core Elective.

Core Electives for 5th semester

Course Code	**Course Name**	**Course Code**	**Course Name**
20ECE304T	Image Processing	20ECE307T	Probability and Statistics for Communication
20ECE305T	Optoelectronics and Optical Communication	20ECE309T	Control Systems
20ECE306T	Building blocks of Cyber Physical Systems	20ECE3xxT	Fundamentals of Wireless Communication

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20ECE301T					Digital Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objectives:

- To impart basic knowledge of digital modulation and demodulation techniques.
- To Understand coding and multiple access principles.
- Understand basic principles of spread spectrum communication system.

Unit-1: Digital Baseband Communication Techniques: 12 Hrs.

Review of Analog and Digital Signals, Channel Effects, Signal to Noise Ratio and Capacity, Elements of Digital Communication Systems, Historical Developments, Digital Representation of Analog Signal, Low pass sampling, Sampling Theorem and Aliasing, Interpolation and Equalization, PAM, PPM and PWM, PCM: Quantization, Uniform and non-uniform quantization, Quantization noise, Companding laws, DPCM, DM ADM, and SDM, Time division multiplexing (TDM).

Unit-2: Digital Carrier Communication Systems: 10 Hrs.

Carrier Communication Techniques: ASK, FSK, PSK, QAM, DPSK, MSK, GMSK, M-ary, Coherent and non-coherent detection, Signal Recovery, Carrier synchronization, Frequency Division Multiplexing (FDM).

Unit-3: Signal Shaping, Transmission and Optimum Reception: 13 Hrs.

Baseband transmission of binary data, Line Coding Formats and Properties, Inter Symbol Interference (ISI), Cross talk and solutions, Different Pulse Shaping and Signaling Schemes, Eye Diagram, Baseband Receiver: Equalizations, Regenerative Repeater, Optimum Receiver for AWGN channels, Matched Filter, Likelihood ratio receiver and Correlation receiver designs, Noise performance of various digital modulation schemes and comparisons.

Unit-4: Advanced Concepts and Way Forward: 10 Hrs.

Spread Spectrum Communication, Direct Sequence Spread Spectrum (DSSS), Code Division Multiple Access (CDMA), Frequency Hopping Spread Spectrum (FHSS), PN - sequences: Generation and Characteristics, Synchronization in Spread Spectrum Systems, Receiver Characteristics, Examples of Practical CDMA Systems, Introduction to multi-carrier communication systems (OFDM and MIMO), Digital communication through multipath fading channels: Adaptive equalization, Introduction to Software Defined Radio (SDR) and Model Architectures.

Max. Hrs.: 45

Course Outcomes:

CO1- Remember principles of various digital communication methods.
CO2 - Understand digital modulation, detection, coding, digital transmission and access techniques.
CO3 - Apply mathematical concepts to model digital communication system.
CO4 - Analyze digital communication systems to obtain various parameters like bandwidth, data rate etc.
CO5 - Evaluate and compare performance of digital communication systems.
CO6 - Design digital communication system at block diagram level.

Text / Reference Books:

- B.P.Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", Oxford University Press.
- P. Chakrabarti, "Analog and Digital Communication", Dhanpat Rai & Co.
- Wayne Tomasi "Electronic Communications Systems", Pearson education India.
- Taub and Schilling, "Principles of Communication Systems - Taub & Schilling", TMH.
- mitabh Bhattacharya, "Digital Communication", TMH.
- S. Haykin, "Digital Communication", John Wiley.
- John G. Proakis, "Digital Communications", McGraw Hill Education.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE301P					Digital Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

Course Objectives:

- To impart knowledge of digital modulation, demodulation and coding techniques.
- To verify performance of various baseband and carrier digital communication systems.
- To compare various digital communication systems and understand their applications.

List of Experiments:

Experiment Sessions would be based on following topics but not limited to:

1. To study PAM, PPM, PWM techniques using trainer kits.
2. To study Sampling, Quantization, PCM and variants using trainer kits.
3. To study TDM techniques and synchronization using trainer kits.
4. To study Digital carrier communication (ASK, FSK, PSK etc.) techniques using trainer kits.
5. To study M-ary PSK and QAM techniques using trainer kits.
6. To study FDM techniques using trainer kits.
7. To study Various line coding and pulse shaping techniques using trainer kits.
8. To obtain Eye diagram and interpret results.
9. To generate PN sequence using digital circuits.
10. To study and simulate Spread spectrum communication systems.

Course Outcomes:

On completion of the course, the student will be able to:

CO1 - Remember principles of various digital communication methods.

CO2 - Understand digital modulation, detection, coding, digital transmission and multiplexing techniques.

CO3 - Apply theoretical and mathematical concepts to practical digital communication system.

CO4 - Analyze and report the behavior of various modulation, demodulation, multiplexing, synchronization, coding techniques.

CO5 - Evaluate and report performance of digital communication systems.

CO6 - Design and implement small scale digital communication system using development tools.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more Questions on: designing/experimentation/programming- coding/implementation/investigation/solution-development.	50 Marks

20ECE302T					Computer Design and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Conceptualize general processor design aspects
- Demonstrate and comprehend architecture and assembly language programming of microprocessor
- Exhibit interfacing of peripheral devices with microprocessor

UNIT 1: Computer Organization **10 Hrs.**

Basic architecture of CPU, RTL, common bus system, different micro-operations, ALU design, stored program organization, instruction format, instruction set, timing and control, instruction cycle, concept of interrupt. Basic CPU design considerations.

UNIT 2: Control Unit Design **12 Hrs.**

Control unit design, micro-programmed control unit, micro instruction format, control unit design, stack organization, RISC and CISC architecture, pipe lining and vector processing, Array processing, integer arithmetic: multiplication algorithms, division algorithms.

UNIT 3: 80x86 Microprocessor Architecture **11 Hrs.**

Overview and Classification of Microprocessors, Introduction to 80x86 family, Architecture of 8086 and its operating modes, Signals, and pins of 8086 microprocessors, Interrupts

UNIT 4: Programming and Interfacing **12 Hrs.**

Instruction set of 8086. Addressing modes. Assembly directives. Memory and I/O interfacing applications.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember the fundamentals of processor
CO2 - Understand the design aspects of basic computer systems
CO3 - Apply the basic instruction set to write programs for different applications
CO4 - Analyze the working of microprocessors in terms of programming and interfacing
CO5 - Evaluate performance of processing unit
CO6 - Design microprocessor-based systems and applications

TEXT/REFERENCE BOOKS

- M. Morris Mano, "Computer systems architecture", PHI
- J. Hayes, "Computer Architecture and Organization", TMH
- Govind Rajalu, "Computer Architecture", TMH
- Douglas V. Hall, "Microprocessor and interfacing programming and hardware", McGraw Hill Education.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE302P					Computer Design and Applications Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- Conceptualise general processor design aspects
- Demonstrate and comprehend architecture and assembly language programming of microprocessor
- Exhibit interfacing of peripheral devices with microprocessor

List of Experiments:

1. To design a common bus system using Multiplexer (as per given data)
2. To design common bus system using Tristate buffer
3. To design arithmetic Unit
4. To design complete ALU for given no of bits.
5. To design and study Accumulator logic for simple microcomputer system
6. To design Booth's Multiplier
7. To demonstrate the tool for Assembly language programming of 8086
8. A. Write an ALP program to perform 8 Bit arithmetic operations.
   B. Write an ALP program to perform 16 Bit arithmetic operations
9. Write an ALP program to perform multi byte addition and subtraction.
10. Write an ALP program to perform 3*3 matrix multiplication and addition
11. Write an ALP program to perform ascending order using 8086
    Write an ALP program to perform descending order using 8086
12. Write an ALP program to find the LCM & HCF of given numbers.
13. Write an ALP program to find square and cube of a given numbers.
14. Write an ALP program to interface 8255.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember the fundamentals of processor
CO2 - Understand the design aspects of basic computer systems
CO3 - Apply the basic instruction set to write programs for different applications
CO4 - Analyze the working of microprocessors in terms of programming and interfacing
CO5 - Evaluate performance of processing unit
CO6 - Design microprocessor-based systems and applications

TEXT/REFERENCE BOOKS

- M. Morris Mano, “Computer systems architecture”, PHI
- J. Hayes, “Computer Architecture and Organization”, TMH
- Govind Rajalu, “Computer Architecture”, TMH
- Douglas V. Hall, “Microprocessor and interfacing programming and hardware”, McGraw Hill Education.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50	Exam Duration: 2 Hrs.
The laboratory exam would be conducted in the Lab, and students would be provi one or more questions on: simulation and designing/experimentation/ programmi coding/implementation/investigation/ solution-development.	50 Marks

20ECE303T					Machine Learning and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce principles, algorithms, and applications of Machine Learning from mathematically motivated perspective.
- Work with different machine learning paradigms.
- Learn tools to apply machine learning algorithms to real data and performance evaluation.

UNIT 1 FUNDAMENTALS OF MACHINE LEARNING **10 Hrs.**

Concept of Data, Dimensionality, Concept of Features, Subset selection, Curse of dimensionality, PCA, Linear Discriminant Analysis (LDA), various learning techniques, Statistical Decision Theory, Convex optimization, introduction to various applications of Machine Learning.

UNIT 2 FUNDAMENTALS REGRESSIONS AND CLASSIFICATION **11 Hrs.**

Neural Network, Back Propagation, Concept of Regression and classification, (One class classification, Multiclass Classification), KNN, , Convolutional Neural Network

UNIT 3 IMPROVING CLASSIFICATION **09 Hrs.**

Boosting, Bagging, Ensemble methods, Gradient boosting, Random Forests, HMM, Belief propagation

UNIT 4 CLUSTERING **09 Hrs.**

Clustering- Partitioning, Hierarchical, Density based, Gaussian Mixture Model, Expectation Maximization, K- Means clustering

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - List machine learning algorithm for the problem domain.
CO2 - Compare different machine learning algorithms for the problems.
CO3 - Carryout machine learning technique for classification and decision problems.
CO4 - Analyse important parameters and structure of the machine learning algorithms.
CO5 - Judge efficacy of machine learning algorithm.
CO6 - Design and apply machine learning algorithm.

TEXT/REFERENCE BOOKS

- Simon Haykin, Neural Networks and Learning Machines, Third Edition, Paper Back, Pearson India
- Ethem Alpaydin, Introduction to Machine Learning, Third edition, PHI, 2015
- Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE303P					Machine Learning and Application Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- Learn the Machine Learning
- Learn to implement various ML algorithms
- To be able to design applications using ML methods

List of Experiments:

Experiment Sessions would be based on following topics but not limited to:

1. Introduction to various Machine Learning Frameworks
2. Implement PCA to reduce high dimensional data by finding covariance matrix and their Eigen values and Eigen vectors.
3. Implement linear regression and design a solution for a real world regression problem.
4. Implementation K nearest Neighbour algorithm
5. Implement K means Clustering
6. Implement decision tree
7. Implement Random Forest algorithm and find the advantages and disadvantages of ensemble method.
8. Implement Naïve Bayes Algorithm
9. Implement gradient descent algorithm
10. Implement Neural network using gradient descent algorithm

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recognizing the applications of Machine Learning
CO2 - Understanding various methods of Machine Learning
CO3 - Implementing various algorithms of Machine learning for real life applications
CO4 - Analyse the methods machine learning and its underline working principle
CO5 - Evaluate the performance of learning methods
CO6 - Design and create AI systems to solve real world problems

TEXT/REFERENCE BOOKS

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016
- Russell, S.J. and Norvig, P., Artificial Intelligence: A Modern Approach, Pearson Education.
- Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more Questions on: designing/experimentation/programming- coding/implementation/investigation/solution-development.	50 Marks

20IF201T					Industry4.0					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To interpret the core elements and basic technologies of Industry 4.0.
- To understand how the core elements and technologies of Industry 4.0 are interconnected.
- To develop a holistic approach to improve processes and products with Industry 4.0.

UNIT I: INDUSTRY 4.0 – CONCEPTS & TERMINOLOGIES **08 Hrs.**

Industry 4.0, Smart business model, Technology road-map, Sensing & actuation, Communication, Internet of things (IoT), Cyber Physical Systems and Next Generation Sensors, Visualization, Cloud Computing.

UNIT II: SMART WORLD & SUSTAINABLE ENVIRONMENT **08 Hrs.**

Sensors and their integration, Renewable Energy System, Hybrid Energy System, Smart Grid, Smart Metering, Communication Protocols, 5G Technology, Smart Agriculture, Smart Infrastructure, Physiological Sensors, Human Machine Interface.

UNIT III: SMART MANUFACTURING **08 Hrs.**

Automation Systems, Additive Manufacturing, Micro-Electro-Mechanical Systems (MEMS), Smart Factories and Interconnection, Advanced Robotics – Autonomous and Swarm, Self-Propelled Vehicles, Drones–Unmanned Aerial Vehicle (UAV), 3d Printing, Spacecrafts.

UNIT IV: TRANSFORMING TECHNOLOGIES IN BIOENGINEERING **08 Hrs.**

Establishment of Smart Biotechnology Factory, Artificial Intelligence in Bioprocess Technology, 3D Bio Printing for Tissue Engineering, Simulation Tools, RSM and Box Model, Cyber Physical System based Telemedicine, Real Time Biosensors, Bio nanotechnology, biofuel.

Max. Hrs.: 32

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the core elements and basic technologies for Industry 4.0.
CO2 - Apply the different computational techniques and algorithms for realizing Industry 4.0.
CO3 - Transform the traditional business approach by integrating the data and intelligence.
CO4 - Develop the traditional industries with intelligent and automated machines.
CO5 - Utilize data and intelligence for the development of Smart World.
CO6 - Understand the concept, significance and means to achieve sustainable development.

TEXT/REFERENCE BOOKS

- Ustundag Alp, and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer,First Edition, 2018.
- Kaushik Kumar, Divya Zindani, and J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0., CRC Press, Taylor & Francis First Edition, 2019.
- Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
- J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012.
- Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016.
- Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0, Springer, First Edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20IF201P					Industry4.0 Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To interpret the core elements and basic technologies of Industry 4.0
- To understand how the core elements and technologies of Industry 4.0 are interconnected
- To develop a holistic approach to improve processes and products with Industry 4.0

List of Experiments

1. Basic computations using Python programming.
2. Use simulations to understand the performance/behavior of a system by (i) creating a computational environment that mimics the real world, (ii) generating (synthetic) or loading data from sources, and (iii) testing the hypothesis.
3. Introduction to MATLAB programming and SIMULINK.
4. 3D printing of Airfoil through rapid prototyping 3D printer.
5. Dynamic simulation of drone (unmanned air vehicle) through MATLAB/SIMULINK.
6. ANSYS simulation of bending of a beam in an earthquake resist-building.
7. Introduction to Arduino Embedded platform.
8. Design of line follower autonomous vehicle.
9. Design of smart meter for recording the electricity consumption.
10. Design of smart lighting with the help of proximity sensors.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the concept of Industry 4.0 and its significance.
CO2 - Understand the resource requirements for the implementation of Industry 4.0.
CO3 - Learn the Simulation Packages for Industry 4.0.
CO4 - Explore the concept of Smart Infrastructure through simulation studies.
CO5 - Inspect embedded platform applications for Industry 4.0.
CO6 - Synthesize the solution for the given Industry 4.0 related problem.

TEXT/REFERENCE BOOKS

- Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
- J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012.
- Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016.
- Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0, Springer, First Edition, 2016.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: designing/experimentation/programming- coding/implementation/investigation/ solution- development.	50 Marks

20ECE304T					Image Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce mathematical modelling and transforms for digital image processing.
- Understand methodology to analyze, design and implement images processing and analysis algorithms.
- Develop understanding for multi-dimensional signal processing.

UNIT 1 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND ANALYSIS **12 Hrs.**

Introduction, Image representation, sampling and quantization, image preprocessing, binary image analysis, Segmentation and Edge/Line Detection, Basic intensity transformations, Histogram processing, Spatial filtering: smoothing and sharpening, Basic mathematical tools in image processing, Color models.

UNIT 2 FREQUENCY DOMAIN PROCESSING **10 Hrs.**

Discrete transforms, Sampling 2D functions, Aliasing, 2D Fourier Transform and properties, Filtering in frequency domain: smoothing, sharpening, selective filtering.

UNIT 3 IMAGE RESTORATION AND MORPHOLOGICAL OPERATIONS **13 Hrs.**

Model of image degradation process, Restoration in presence of noise, Estimating degradation function, Inverse filtering, MMSE filtering, Morphological operations: Erosion and dilation, opening and closing, Basic morphological algorithms, frequency domain filters, Geometric transforms, image reconstruction.

UNIT 4 IMAGE ENHANCEMENTAND SEGMENTATION **10 Hrs.**

Point, line and edge detection, Thresholding, Basic segmentation algorithms: region based, watershed, Image representation: chain codes, polygonal approximation, Boundary and regional descriptors: textures, moments, image sharpening, smoothing, compression.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Recall and identify properties of digital images and 2D transforms.
CO2 – Explain concepts and complexity of digital image processing techniques
CO3 – Practice and use image processing algorithms.
CO4 – Examine images and applications in time domain and frequency domain.
CO5 – Design image processing algorithms.
CO6 – Evaluate image processing algorithms for real world problems.

TEXT/REFERENCE BOOKS

- Gonzalez, R. C., & Woods, R. E., "Digital image processing", Pearson, 4th Edition, 2018.
  Sonka, Milan, "Image processing, analysis and machine vision". Cengage Learning Pvt. Ltd, 4th Edition.
- Castleman, Kenneth "Digital Image Processing". Pearson Education, 1st Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE305T					Optoelectronics and Optical Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the students to various optical fiber modes, configurations, and various signal degradation factors associated with optical fiber
- To understand various optical sources and optical detectors
- To understand the optical communication system, optical amplifiers.
- To study different fiber network elements and basic optical components.

UNIT 1: Basics of Optical Fiber **9 Hrs.**

Introduction to Optical Fiber and Waveguides, TEM, TE and TM mode in wave guide, Wave Propagation in Step-Index & Graded-Index Fiber, Modes & Rays. Basic Optical Communication System, Advantage and applications of Optical Communication System.

UNIT 2: Losses in Optical Fibers **9 Hrs.**

Introduction, Absorption, Scattering, Overall Fiber Dispersion-Single Mode Fibers, Multimode Fibers, Dispersion-Shifted Fiber, Dispersion-Flattened Fiber, Polarization.

UNIT 3: Sources & Detectors **12 Hrs.**

LEDs and Semiconductor Lasers for Optical Communication, Semiconductor Photodiode Detectors, Avalanche Photodiode Detectors. Optical Amplifiers. Noise in the Optical Receiver. SNR and BER derivation and calculation.

UNIT 4: Optical Networks **10 Hrs.**

SONET/SDH, Optical Transport Network, Optical Access Network, Ethernet, Network Topologies. Advanced Multiplexing Strategies- OFDM, SDM. Subcarrier Multiplexing, WDM Network Architectures, Few Advanced Topics: Flexible Optical Networks, Optical Neural Network, Cognitive Optical Network.

Max. Hrs.: 45

COURSE OUTCOMES:

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

CO1 - Remember the basic concepts of optical fiber structure and optical communication systems.

CO2 - Understand different design aspects of optical fiber including its advantages and limitations.

CO3 - Apply optical fiber and optical communication concepts.

CO4 - Analyze the system performance of optical transmitters, receivers, and optical amplifiers.

CO5 - Evaluate the design of optical fiber communication systems.

CO6 - Create optical communication applications in the recent technological trends.

TEXT/REFERENCE BOOKS

- Gerd Keiser, “Optical Fiber Communications”, 4th Edition McGraw Hill.
- John M. Senior, “Optical Fiber Communication” PHI/Pearson.
- G. P. Agrawal, “Fiber optic Communication Systems”, John Wiley and sons.
- John Gowar, “Optical Communication Systems” Pearson.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE306T					Building Blocks of Cyber Physical Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of cyber physical systems.
- To understand concepts of cyber physical system modelling.
- To explore a wide range of engineering solutions using cyber physical systems.
- To implement applications of CPS.

UNIT 1 INTRODUCTION AND MODELING OF CPS **14 Hrs.**

Introduction to cyber physical systems, continuous dynamics, discrete dynamics, hybrid systems, computation of state machines, concurrent models of computation, introduction to hybrid equations tool box,

UNIT 2 EMBEDDED SYSTEM COMPONENTS FOR CPS **12 Hrs.**

Introduction to design of CPS, sensors and actuators, embedded processors, memory architecture, input and output, multi-tasking, scheduling.

UNIT 3 ANALYSIS OF CPS **10 Hrs.**

Invariant and temporal logic, equivalence and refinement, reachability analysis and model checking, quantitative analysis, security and privacy.

UNIT 4 CPS SIMULATIONS AND CASE STUDIES **09 Hrs.**

Simulations of CPS in communication networks, Physical systems, CPS interfaces, FSM simulations
The role of CPS in the development of smart cities, healthcare, factory automation and defense systems.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember different modeling, design, analysis techniques of CPS.
CO2 - Understand methodology to execute different real world scenarios using CPS.
CO3 - Apply modeling, simulation concepts to existing problems.
CO4 - Analyse CPS parameters for the problem.
CO5 - Evaluate different CPS models for the problem.
CO6 - Create CPS simulation for real world problems.

TEXT/REFERENCE BOOKS

- Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach", Second Edition, MIT Press, ISBN 978-0-262-53381-2, 2017, available for download.
- Derek Molloy, "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux", 2016, Wiley.
- Rajeev Alur, "Principles of Cyber-Physical Systems", 2015, MIT Press.ISBN: 9780262029117
- Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, "Cyber-Physical Systems: From Theory to Practice", 2015, CRC Press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3Hrs
Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE307T					Probability and Statistics for Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To be able to understand the basic concepts of probability and distribution.
- To be able to analyze the behavior of various discrete and continuous probability distributions.
- To provide a foundation in probability theory and statistical method in order to solve applied problems on modern communication theory.

UNIT-1: RANDOM VARIABLE and RANDOM PROCESS **14 Hrs.**

Classical and axiomatic definitions of probability, sample space, probability of an event, addition rule and conditional probability, multiplication rule, total probability, Bayes' theorem and independence. Discrete and continuous random variable: definitions and examples, Probability density function and cumulative distribution functions of continuous random variables, Probability mass function of discrete random variables, expected values and variance of discrete random variable, Random processes and their analysis (auto and cross correlation, power spectral density),

UNIT-2: PROBABILITY DISTRIBUTIONS IN COMMUNICATION THEORY **9 Hrs.**

Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Normal, Exponential and Gamma densities, Evaluation of statistical parameters for these distributions.

UNIT-3: BASIC STATISTICS **11 Hrs.**

Measure of central tendency: Moments, Expectation, dispersion, skewness, kurtosis, expected value of two-dimensional random variable, Linear Correlation, correlation coefficient, rank correlation coefficient, Regression, Bounds on probability, Chebyshev's Inequality

UNIT-4: DETECTION AND ESTIMATION FOR COMMUNICATION **11 Hrs.**

Hypothesis Testing, Neyman Pearson Lemma, UMP test, Decision Theoretic framework, Parameter Estimation - Unbiasedness, Consistency, asymptotic normality, sufficient statistics, minimax estimation, Chi square goodness of fit test and its applications.

Max Hrs.: 45

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Remember the terminologies of basic probability.
CO2 - Understand random variables and random process a
CO3 - Apply statistics for testing the significance of the given large and small sample data.
CO4 - Analyze the behavior of various discrete and continuous probability distributions
CO5 - Evaluate the probability distribution of a random variable, based on different parameters.
CO6 - Design different test models of the detection and estimation for communication.

TEXT/REFERENCE BOOKS:

- Dimitri Bertsekas and John Tsitsiklis, Introduction to Probability, 1st Edition, Athena Scientific, 2008
- Morris H. DeGroot, Probability and statistics, Pearson, 1st edition, January 2010
- Harry L. Van Trees, *Detection, estimation, and modulation theory*, Wiley, May 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE309T					Control Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objectives:

- To impart fundamental concepts of linear control theory.
- To understand the concept of stability of control system and methods of stability analysis in time and frequency domain.
- To facilitate the understanding of design of linear controllers.

Unit-1: Introduction and Mathematical Modeling of Linear Control Systems 11 Hrs.

Introduction to Linear and Non-linear control systems, Notion of feedback, Open-loop and closed-loop control systems, Examples of Control Systems, Design and Compensation of Control Systems; Block diagram and signal-flow graphs representations and simplifications; Mathematical modeling and analogy, Differential equations, Transfer Function and Impulse-Response Function, Systems with transport lag, Linearization.

Unit-2: Time domain performance and stability analysis 12 Hrs.

Time response, Transient response, Steady-state response, Responses of first- and second-order systems to standard test signals and related specifications, Error Constants and Generalized Error Series, Stability definition and meaning, Routh-Hurwitz stability criterion, Analysis of control systems using root locus plots.

Unit-3: Frequency domain analysis and design 13 Hrs.

Nyquist stability criterion – Gain and Phase margins, Bode plots, Frequency domain specifications and their correlations with time response, M-N circles and Nichols chart, Design and performance goals - Steady state, transient and robustness specifications, Introduction to P, PD, PI and PID controllers and their design, Introduction to Lag and Lead compensator design, Analogy with electronic systems analysis and design.

Unit-4: Introduction to State Space Analysis and Way Forward 09 Hrs.

Modeling in State Space, State-Space Representation and Analysis, Canonical state variable model, Equivalence to transfer function model and conversions, Solution of state equations, Concepts of Controllability and Observability, Introduction to modern control systems and way forward.

Max 45 hrs.

Course Outcomes:

On completion of the course, the student will be able to:

CO1 - Identify types of control systems.
CO2 - Understand analysis tools for linear control systems.
CO3 - Analyze linear control systems using various mathematical tools.
CO4 - Apply concepts in design of linear control systems.
CO5 - Evaluate performance of linear control systems.
CO6 - Design linear controllers and compensators.

Text / Reference Books:

- I.J. Nagrath and M. Gopal, " Control System Engineering," Wiley Eastern.
- K. Ogata, “Modern control engineering”, PHI.
- B C Kuo, “Automatic control systems”, PHI.
- Norman S. Nise, " Control Systems Engineering," John Wiley.
- G. F. Franklin, J. D. Powell, and A. E. Emami-Naeini, “Feedback Control of Dynamic Systems”, Pearson.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE3xxT					Fundamentals of Wireless Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Knowledge about mobile radio propagation, to understand its different models and associated effects such as multipath delay spread, fading.
- To understand the concept fading in wireless channel and knowledge about diversity to overcome this effect.
- Knowledge about capacity of wireless channel for different scenarios.
- Knowledge of spread spectrum systems and multiple access techniques in wireless radio.

Unit 1: LARGE SCALE FADING **11 Hrs.**

Large scale signal propagation: free space propagation model - ground reflection model, refraction, diffraction and scattering propagation mechanism; Indoor and outdoor propagation model; large scale path loss and lognormal shadowing, Combined Path Loss and Shadowing, Cell Coverage area.

UNIT 2: SMALL SCALE FADING CHANNEL **11 Hrs.**

Fading channels: multipath and small scale fading- Doppler shift, statistical multipath channel models, parameters of a mobile multipath channel; power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, fading models, average fade duration and level crossing rate.

UNIT 3: CAPACITY OF WIRELESS CHANNEL **11 Hrs.**

Capacity in AWGN, Capacity of fading channels; channel and system model, channel distribution information known, channel side distribution information at receiver, channel side distribution information at transmitter and receiver, Capacity comparison, Capacity of frequency-selective fading channels; time-invariant channels, Time-varying channels.

UNIT 4: MULTIPLE ACCESS SCHEMES AND DIVERSITY **12 Hrs.**

Fundamental concepts of spread spectrum systems - pseudo noise sequence - performance of direct sequence spread spectrum systems - analysis of direct sequence spread spectrum systems - the processing gain and anti- jamming margin - frequency hopped spread spectrum systems - synchronization of spread spectrum systems. Multiple access schemes: FDMA, TDMA, and CDMA, and OFDMA. Diversity techniques for wireless radio systems: time, frequency and space diversity, selection diversity, MRC, RAKE receiver, Interleaving.

Max. 45 Hrs.

COURSE OUTCOMES

After the completion of the course, students will be able to,

CO1: Remembering the wireless system design aspects and technical challenges.
CO2: Understanding the indoor and outdoor radio propagation models considering multipath phenomena.
CO3: Applying the different scenario to find the capacity of the wireless channel.
CO4: Analyzing about the fading, its effect, and remedy by adopting diversity techniques.
CO5: Evaluating anti-jamming margin for spread spectrum modulation techniques.
CO6: Creating a system with the different multiple access techniques and the RAKE receiver.

Text/Reference Books:

- Rapport Thoedore S., Wireless Communications, Principles and Practice, PHI,
- Lee W.C.Y., Mobile Cellular Telecommunication, MGH, 2002
- Andrea Goldsmith, Wireless Communications, Cambridge University Press.
- G. L. Stuber, Principles of mobile communications, 2nd Ed., Springer.
- Simon Haykin and Michael Moher, Modern Wireless Communication, Pearson education.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

Semester VI

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester VI			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20ECE310T	Embedded Systems	3	0	0	3	3	25	50	25	--	--	100
2	20ECE310P	Embedded Systems Lab	0	0	2	1	2	--	--	--	50	50	100
3	20ECE311T	Antenna Theory and Design	3	0	0	3	3	25	50	25	--	--	100
4	20ECE312P	Electronics System design lab	0	0	2	1	2	--	--	--	50	50	100
5	20ECE313T	Modern Semiconductor Devices &Technology	3	0	0	3	3	25	50	25	--	--	100
6		CE3 (Theory)	3	0	0	3	3	25	50	25	--	--	100
7		CE4 (Theory)	3	0	0	3	3	25	50	25	--	--	100
8		OE-4	3	0	0	3	3	25	50	25	--	--	100
9	20HS301P	Communication Skills - III	0	0	2	1	2	--	--	--	50	50	100
10	20TP310	Industrial Training/ IEP (6 weeks-summer break)	0	0	0	2	0	--	--	--	--	--	100
		TOTAL	**18**	**0**	**6**	**23**	**24**						**1000**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination; OE – Open Elective, CE – Core Elective.

Core Electives for 6th semester

Course Code	**Course Name**	**Course Code**	**Course Name**
20ECE308T	Mobile Communication	20ECE318T	Power Electronics
20ECE314T	Cognitive and Software Defined Radio	20ECE319T	Artificial Intelligence
20ECE315T	Introduction to Quantum Computing	20ECE320T	Digital Control Systems
20ECE316T	Information Theory and Coding	20ECE3xxT	Mixed Signal VLSI
20ECE317T	Wireless Sensor Networks		

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20ECE310T					Embedded Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To understand microcontroller based embedded system
- To be able to program (settings for) the on-chip modules/functionalities and GPIOs
- To be able to write programs for interfacing of external devices (sensors and actuators)

UNIT-1: INTRODUCTION TO EMBEDDED SYSTEMS 10 Hrs.

Introduction to microcontroller, and embedded system (ES): Digital sub-components; Characteristics and functionalities; Classification; Type of architectures (RISC vs. CISC) and memories (FLASH,SRAM,EEPROM); Aspects related to ES design and C selection; Programming software/IDE (tool chain); Applications of ES.

UNIT-2: MICRO-CONTROLLER ARCHITECTURE AND ASSEMBLY LANGUAGE PROGRAMMING 12 Hrs.

An example microcontroller (AVR/PIC/8051/ARM/etc.): architecture, pin diagram and basic connections – clock, reset, brown-out, etc.; General register set; Special function registers; On-chip memories; General Purpose Inputs and Outputs (GPIOs); Instruction Set and Assembly language programing: Data transfer, arithmetic, logic and branch instructions, addressing Modes; Basic programming concepts: Looping, branching, memory-access, time-delays, using assembly instructions; Stack and related operations; Subroutines and interrupts.

UNIT-3: MICRO-CONTROLLER PROGRAMMING IN EMBEDDED C 12 Hrs.

Programming the on-chip modules/capabilities of the microcontroller using Embedded C: GPIOs, Timers/Counters, Waveform generation, EEPROM, ADC, Interrupt functionalities, Watchdog timer.

Basics of parallel and serial communication; Programming the serial communication modules: USART, Serial Peripheral Interface (SPI), I2C Inter-integrated Circuit (I2C).

UNIT-4: PROGRAMMING AND INTERFACING OF SENSORS AND ACTUATORS 11 Hrs.

Interfacing of I/O devices, LED and switches, 4x4 Keypad, 16x2 LCD, Motor drivers and opto-couplers, Stepper Motor, Servo Motor, DC Motors, Relays, Buzzers, Proximity sensor, temperature sensor, DAC, RTC. Basic programming for wireless modules: Bluetooth, Wifi, Zigbee.

Max. Hrs.: 45

COURSE OUTCOMES:

On completion of the course, the student will be able to:

CO1 - Describe the basic components/functionalities, and architecture of microcontroller based embedded system.

CO2 - Write simple programs using assembly language, and summarize the instruction set architecture for microcontroller.

CO3 - Apply the syntax and constructs of the C language, to write Embedded C programs.

CO4 - Analyze the functionality of on-chip modules/capabilities of the microcontroller: timers/counters, interrupts, basic communication protocols, EEPROM, ADC, waveform generator.

CO5- Comprehend and demonstrate the working of external input-output devices (interfacing of sensors and actuators) to the microcontroller.

CO6- Develop simple embedded system, utilizing Embedded C programming for interfacing input-output devices with the microcontroller and/or the related on-chip modules.

TEXT/REFERENCE BOOKS:

- Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi. "AVR Microcontroller and Embedded Systems: Using Assembly and C", (2015), Pearson India.
- Raj Kamal, "Embedded Systems: Architecture, Programming, and Design", 2nd Edition, Tata McGraw-Hill

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE310P					Embedded Systems Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES:

- To understand microcontroller based embedded system.
- To be able to program (settings for) the on-chip modules/functionalities and GPIOs.
- To be able to write programs for interfacing of external devices (sensors and actuators).

List of Experiments:

1. Familiarization with IDE and trainer kits/boards.
2. Program for blinking LED, pattern generation.
3. Program for interfacing multi-digit 7 segment display and implementing counter.
4. Program for interfacing toggle and push button switches, simple keypad and matrix keypad.
5. Program for interfacing Buzzer, Relay, DC motor, Servo motor, Stepper motor.
6. Program for interfacing LCD and displaying text on it.
7. Program for interfacing various sensors and displaying quantity on LCD.
8. Program for interfacing speech and voice recognition modules and controlling peripherals.
9. Program for interfacing camera modules.
11. Program for interfacing RS 232 serial modules and file transfer using it.
12. Program for interfacing Ethernet module and transferring files using it.
13. Program for interfacing wireless modules: Zig bee, Bluetooth, GSM modem, GPS module, RFID etc.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

CO1 - Remember the basic components, and architecture of embedded systems.
CO2 - Understand programs using assembly language and C programming.
CO3 - Apply the concepts of interfacing for embedded systems.
CO4 - Analyze different scenarios of embedded systems.
CO5 - Evaluate the working of different embedded systems.
CO6 - Create a small-scale embedded system for real world applications.

TEXT/REFERENCE BOOKS:

- Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi. “AVR Microcontroller and Embedded Systems: Using Assembly and C”, 2015 Edition, Pearson India.

20ECE311T					Antenna Theory and Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Gain fundamental concepts of basic antenna structures and key parameters
- Understand the concepts of modern printed antenna and learn their design techniques
- Learn the basic principles of wave propagation

UNIT 1: Antenna Fundamentals **10 Hrs.**

Radiation mechanism, single wire, two wire, dipole, current distribution of thin wire antenna. Fundamental parameters of antenna: radiation pattern, isotropic, directional and Omni directional pattern, principal patterns, radiation patterns lobes, field regions, radian and steradian, Radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, beam efficiency, bandwidth efficiency, input impedance, antenna radiation efficiency, antenna aperture, effective height.

UNIT 2: Antenna Analysis **12 Hrs.**

Vector potential for an electric and magnetic current source, electric and magnetic fields for electric and magnetic current source, far field radiation, Duality theorem, reciprocity theorem. Linear wire antenna: infinitesimal dipole, radiation field (with derivation), directivity, near field, intermediate field, far field, power density, small/short dipole, half wavelength dipole. folded Dipole, image theory and monopole antenna.Introduction to Travelling wave, Broadband, Frequency independent, antennas.

UNIT 3: Printed Antenna and Array **14 Hrs.**

Introduction of Microstrip patch antenna (MPA), basic characteristics, feeding method, fringing field, cavity model, rectangular and circular patch antenna and its design using transmission line model, introduction to smart antennas and beam forming. Antenna Array: Two element arrays, N-element linear array, broadside array, ordinary end fire array, phased array.

UNIT 4: Wave Propagation **09 Hrs.**

Wave propagation: Ground wave, sky wave, space wave, ionosphere, reflection and refraction by ionosphere, critical frequency, virtual height, MUF (max. usable frequency), skip distance, troposphere and duct propagation.

Max. Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember the basic fundamentals of electromagnetics and Maxwell's equations
CO2 - Understand the concept and design aspects of the basic antenna structures
CO3 - Apply the various figure of merits for antenna
CO4 - Analyze the working of broadband, frequency independent, travelling wave antennas
CO5 - Evaluate performance of the antenna structures
CO6 - Design antenna for modern wireless applications

TEXT/REFERENCE BOOKS

- C. Balanis, Antenna Theory: Analysis and Design, 3rd Ed., Wiley, 2005.
- W. L. Stutzman and G. A. Thiele, Antenna Theory and Design, 3rd Ed., Wiley,2012.
- John D. Kraus, "Antennas and Wave Propagation" 5th Ed. Mcgraw Hill Higher Education, 2017
- A.R. Harish, M. Sachidananda "Antennas and Wave Propagation" Oxford Higher Education, 2007
- Garg, R., Bhartia, P., Bahl, I. and Ittipiboon, A., "Microstrip Antenna Design Handbook ", Artech House (2001).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc.(10 to 20 marks each)	80 to 60 Marks

20ECE312P					Electronics System Design Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To Conceptualize electronic system design aspects
- To Apply programming knowledge in system design
- Exhibit fabrication of PCB for antenna systems.

List of Experiments:

Following design case studies to be implemented using software, hardware and fabrication tools.

1. Introduction to equipment related to system design and simulation software.
2. To simulate and design traffic light controller using simulation software, FSM, digital ICs and LEDs.
3. To design traffic light controller design using microcontroller and interfacing circuits.
4. Implementation of traffic light controller design using HDL on FPGA board.
5. PCB design and implementation of the developed system.
   Above mentioned experiment methodology is to be repeated for following suggested case studies but not limited to this list.
   (a) Elevator control design
   (b) Pseudo Random sequence generation and detection
   (c) ON-OFF and hysteresis temperature controller.
   (d) DC motor speed control using close loop control system.
6. To design and fabricate antenna on single layer PCB.
7. To design and fabricate antenna on double sided PCB.
8. To design and fabricate antenna with DGS on double sided PCB.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember the electronic system design methodologies.
CO2 - Understand the electronic system design process.
CO3 - Apply programming and electronic circuit knowledge to obtain electronic systems.
CO4 - Analyze the designed system.
CO5 - Evaluate performance of designed system.
CO6 - Design electronic system for practical applications.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50	**Exam Duration: 2 Hrs.**
The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: simulation and designing/experimentation/ programming-coding/implementation/investigation/ solution-development.	50 Marks

20ECE313T					Modern Semiconductor Devices & Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To offer profound understanding of the fundamentals of semiconductor devices.
- To impart comprehensive knowledge of device technology.
- To provide a foundation in the physics and technology of semiconductor devices in order to address the challenges of modern electronic devices.

UNIT-1: FUNDAMENTALS OF SEMICONDUCTOR DEVICES **18 Hrs.**

Evolution and scope of semiconductor devices and technology, Energy bands formation in semiconductors, Types of semiconductors, Fermi-Dirac distribution, Fermi level in intrinsic/extrinsic semiconductors and dependency with temperature and doping, Carrier concentrations at equilibrium, Temperature-dependent carrier concentrations, Compensation and neutrality, Mobility and influence of temperature and doping, Drift velocity, Effective mass, Drift, and diffusion current transport, Einstein relation, Carrier generation and recombination, Continuity equation, Junctions: Metal/Semiconductor (Schottky barrier height, rectifying and ohmic contacts), Mathematical derivation of the potential barrier, depletion width, and *I-V* relation for p-n homojunction, Heterojunctions, Junction break down (Zener and avalanche effects), Tunnel diode.

UNIT-2: MOS TRANSISTOR **12 Hrs.**

MOSFET structure, Types of MOSFET and its operation, MOS Capacitor, C-V Characteristics with frequency effects, Threshold voltage, Mathematical derivation for I-V, Transconductance, Transfer and O/P characteristics, Channel length modulation, Body-effect, Subthreshold conduction, Short channel effects, Velocity saturation, Hot electron effects, DIBL, GIDL, Ballistic transport, High K dielectric, Small-signal model.

UNIT-3: DEVICE TECHNOLOGY **7 Hrs.**

Environment for device technology, Cleanroom, Wafer cleaning, Oxidation, Diffusion, Implantation, Film deposition (PVD, and CVD techniques), Lithography, Etching (wet and dry), Metallization, Packaging, Prototype fabrication of MOS transistor.

UNIT-4: MODERN SEMICONDUCTOR DEVICES **8 Hrs.**

MOS Transistor: Strained Si-FET, SOI MOSFET, FinFET, GAAFET, MBCFET.
MOS Memory Devices and Sensors: SRAM, DRAM, Flash memory, Photodetector, Chemical sensors, Electronic nose, and its applications.

Max Hrs.: 45

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Define the importance of semiconductors in modern electronic devices, and basic concepts of semiconductors.
CO2 - Understand the charge transport, operation and various fabrication steps of semiconductor devices.
CO3 - Apply the various electrical conduction mechanisms in modern semiconductor devices.
CO4 - Analyze the various issues of MOS devices with size scaling and also analyze the theoretical models of MOS transistors.
CO5 - Evaluate the performance of semiconductor devices.
CO6 - Build the device analysis framework to improve the modern semiconductor devices for specific desired real-life applications with considering issues and constraints at research and industry levels.

TEXT/REFERENCE BOOKS:

- Solid State Electronic Devices by B.G. Streetman & S. Banerjee, PHI.
- Semiconductor Physics and Devices by Donald A. Neamen, 4th Edition, MHE.
- Silicon VLSI Technology by J. D. Plummer, M. D. Deal & P. B. Griffin, Prentice-Hall, 2000.
- FinFETs and Other Multi-Gate Transistors, By P. Colinge, Springer 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as MCQ, fill-in-the-gaps, objective, or short one-line questions, match the Following, etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as problem analysis, numerical solutions, logical/analytical steps, and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20HS201P					Communication Skills – III					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	0	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To strengthen the communication skills of professionals to make them ready for the modern workplace.
- To fine tune their professional skills and expertise using communication skills.
- To participate in the lifelong learning process with confidence and certainty.

UNIT 1 **10Hrs**.

- Writing research proposals
- Writing technical projects

UNIT 2 **15Hrs.**

- The Art of Presentation

-*Sapiens: A Brief History of Humankind (2011),* Yuval Noah Harari
-*Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations (2016*), Thomas L. Friedman
- (Presentation in teams of 4 students each, not more than two from the same branch, with a view to promote cross-disciplinary research).

UNIT 3 **5Hrs.**

- Uploading portfolios on SlideShare
  - ✓ Uploading Video modules

Max. 30 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Demonstrate enhanced communications skills for enhanced team work for a better result.
CO2 - Apply critical analysis for innovative thinking and well-rounded perspectives in different settings and contexts.
CO3 - Analysis of situations to identify opportunities for professional and career growth through strong communication skills.
CO4 - High competence of oral, written and visual communication skills for a workplace ready professional.
CO5 - Realization and application of communication skills and language processes for multiple perspectives and interdisciplinary approach in profession.
CO6 - Improved communication skills for improved research, organizational, and critical thinking and perspective.

TEXT/REFERENCE BOOKS

- Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
- Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
- Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.
- Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009.

Assessment Tool	Marks	Assignments
Lab Work	50	• Business Proposal – 15 • Research Project Proposal – 15 • Reviews on the two books – 20
Lab Exam/Viva	50	• Presentation on the reviews of the two books (Intra Branch) – 15 • Presentation on a technical topic (Inter Branch) – 15 • Slideshare/Video Modules (Prescribed Texts) – 20

20TP310					Industrial Training/ International Exposure Program					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	-	2	6 weeks summer break	--	--	--	--	--	100

COURSE OBJECTIVES

- Exposure to the work culture of an organization.
- Understand verticals, products and services of an organization.
- Develop necessary technical and soft skills.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 - Remember the academic concepts to solve problems.

CO2 - Understand the functioning of different departments in an organization.

CO3 - Map classroom learnings to organization processes.

CO4 - Analyze different solutions for problems.

CO5 - Study the impact of the solutions/services of an organization towards society, environment, infrastructure, energy, and economy.

CO6 - Develop technical knowledge and apply principles of teamwork, ethics, communication effectively in a professional environment for lifelong learning.

20ECE308T					Mobile Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To know the evolution of Mobile communication and cell concept to improve capacity of the system.
- To know the fading mechanism and types of fading and effect of fading on Mobile communication.
- To know the role of equalization in Mobile communication and to study different types of Equalizers and Diversity techniques.
- To know the types of channel coding techniques, data transmission modes and services of GSM, UMTS and LTE (4G).
- To develop the concepts of emerging technologies for 5G and beyond

UNIT-1: FUNDAMENTALS OF MOBILE COMMUNICATION **11 Hrs.**

Mobile radio telephony, Examples of Wireless Communication Systems, Related design problems. Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems

UNIT-2: WIRELESS CHANNEL CHARACTERISTICS **11 Hrs.**

Channel modeling requirements, propagation scenarios and challenges in 2G to 5G, fading, diversity and equalization, Channel Models for mmWave MIMO, Systems, Channel capacity for SISO and MIMO channels with and without CSIT, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), nonorthogonal multiple accesses (NOMA), Pilot Contamination, Spatial Modulation (SM)

UNIT-3: EVOLUATION OF CELLULAR TECHNOLOGIES: 2G TO 4G **11 Hrs.**

GSM Network architecture, GSM signalling protocol architecture, identifiers used in GSM system, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures, GSM services and features
UMTS: Objectives, standardization and releases, network architecture, air interface specifications, channels, security procedure, W-CDMA air interface, attributes of W-CDMA system, W-CDMA channels.
4G System overview: Frequency bands and spectrum flexibility, network structure, protocol structure, Frames, slots, and symbols, modulation, coding, multiple-antenna techniques

UNIT-4: 5G AND BEYOND CELLULAR NETWORKS **12 Hrs.**

An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G. Network slicing architecture of 5G, Role of NFV and SDN in 5G, generalized frequency division multiplexing (GFDM), generalized frequency division multiple accesses (GFDMA), D2D, V2V, and M2M communications, interference and mobility management, Massive MIMO technologies, SDR: introduction and channel characterization, AI/ML in 5G: A move towards 6G.

Max. Hrs.: 45

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Remember the cellular fundamentals and estimate the coverage and capacity of cellular systems.
CO2 - Classify different types of propagation models and analyze the link budget.
CO3 - Demonstrate the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
CO4 - Analyze the performance of cellular protocols.
CO5 - Evaluate the performance metrices of different wireless cellular technologies (2G to 4G).
CO6 - Investigate the emerging technologies and architectures for upcoming mobile communication systems (5G and beyond).

TEXT/REFERENCE BOOKS:

- Theodore S. Rappaport, Wireless communications – principles and practice, PEARSON, Second edition.
- William C. Y. Lee, Mobile Cellular Telecommunications: Analog and Digital Systems, TMH, 2nd Ed.
- G. Stuber, Springer, Principles of Mobile Communications, 2nd ed.
- A. Goldsmith, Wireless Communications, Cambridge
- Andreas F. Molisch, Wireless communications, WILEY INDIA PVT LTD, Second edition.
- A. Paulraj, Nabar and Gore, Introduction to Space Time Wireless Communications, 1st Ed.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE314T					Cognitive and Software Defined Radio					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objectives:

- Understand the interplay of signal processing for power as well as spectrum efficient communication.
- Motivate for selecting appropriate commercial solutions for a practical transceiver design
- Facilitate the understanding of resource management in communication systems.

UNIT 1 INTRODUCTION TO SDR **12 Hrs.**

Software Defined Radio (SDR), Anatomy of SDR, Design considerations, RF aspects, Dynamic Range, RF Receiver Front End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Noise and Distortion in the RF Chain, Separation of Digital and RF, Basics of antennas, MIMO, Adaptive Modulation and Coding, Multicarrier Modulation.

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UNIT 2: SIGNAL PROCESSING FRAMEWORK FOR SDR **11 Hrs.**

Multi-Rate Signal Processing, Sample Rate Conversion , Poly-phase Filters, Digital Filter Banks, Timing Recovery in Digital Receivers, pulse Shaping, Digital signal Generation, Comparison of Direct Digital Synthesis with Analog Signal Synthesis performance, Analysis of Spurious Signals due to Periodic jitter, Hybrid DDS, PLL Systems, Applications of Direct Digital Synthesis, Generation of Random Sequences.

UNIT 3: IMPLEMENTATION FRAMEWORK FOR SDR **11 Hrs.**

Digital Hardware Choices: using DSPs, FPGAs, and ASICs, Power Management Issues, Using a mix approach, Architecture of FPGA based SDR, Advance Buses, Hardware acceleration, Resource sharing, ADC and DAC architecture, Techniques to improve data converter performance, Distortion.

UNIT 4: COGNITIVE RADIO **11 Hrs.**

Cognitive radio cycle, SDR architecture for Cognitive radio, Spectrum node sensing, Cognitive radio performance analysis, Cooperative sensing, Blind receiver design, UWB and cognitive radio, Applications in harsh and irregular environments, Applications to Ham Radio and Citizen Band Radio Services, Application of Cognitive radio in cellular wireless networks, Case studies.

Max Hrs.: 45

Text / Reference Books:

- Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall PTR.
- Di Pu, Alexander M. Wyglinski, “Digital Communication Systems Engineering with Software Defined Radio”, Artech House.
- Peter B. Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artech House.
- Walter H.W. Tuttle bee, "Software Defined Radio: Enabling Technologies," John Wiley and Sons Ltd.

Course Outcomes:

On completion of the course, student will be able to

CO1 - Identify components used in implementation of SDR.
CO2 - Understand the design principles of software defined radio.
CO3 - Apply use of digital hardware architectures and development methods to SDR design.
CO4 - Analyze the radio resource management in heterogeneous networks.
CO5 - Evaluate performance of software defined radio.
CO6 - Design simple communication system using SDR concepts.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE315T					Introduction to Quantum Computing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of quantum computing
- Learn quantum information processing
- Learn the various algorithms for quantum computing
- Know the various types of quantum computer prototypes and programming languages

UNIT 1 INTRODUCTION TO QUANTUM COMPUTING **10 Hrs.**

Introduction, information and computation, characteristics of computational system, computational complexity, Computation and algorithms, Quantum theory, The multiverse interpretation of quantum theory, Qubit, Qubit- Blotch sparse representation.

12 Hrs.

UNIT 2 QUANTUM INFORMATION PROCESSING

Qubit measurement, system with multiple qubits, Quantum Gates, Quantum circuits, Non cooling theorem and quantum teleportation, Quantum entanglement, super dense coding, Quantum optic gates, Quantum Fidelity.

UNIT 3 ALGORITHMS FOR QUANTUM COMPUTING **12 Hrs.**

Deutsch algorithm, Simon Problem, Grover's Search Algorithm, Quantum Fourier Transform, Implementing QFT, Shor's Factorization Algorithm, Quantum Error Correction,

UNIT 4 QUANTUM COMPUTER PROTOTYPE AND PROGRAMMING LANGUAGES **11 Hrs.**

Quantum computer prototypes, Quantum computer using ion traps and revisiting concept, Quantum computer using Superconducting circuits, Quantum computer using Optical lattice, Quantum computer using spin states of trapped electrons, Nuclear magnetic resonance quantum computer, Quantum supremacy,

Max Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recognizing the potential of quantum computing
CO2 - Understanding the quantum information processing
CO3 - Implementing quantum algorithm
CO4 - Analyze the characteristics of various quantum algorithm
CO5 - Evaluate the quantum architecture
CO6 - Design and create quantum algorithm

TEXT/REFERENCE BOOKS

- Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019
- Jack Hidary, Quantum Computing: An Applied Approach, Springer, 2019

20ECE316T					Information Theory and Coding					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart knowledge of information theory and source coding.
- To impart knowledge of channel coding methods.
- To impart knowledge of secure communication methods.

UNIT 1: INFORMATION THEORY & SOURCE CODING: 12 Hrs.

Concept & Measure of information, Entropy, Source Coding, Huffman and Shanon Fano coding, Uniqueness Property, Channel Models, Error Free Communication Over a noisy channel, Shannon's Theorem, Differential Entropy and Mutual information, Channel Capacity, Practical Communication System In Light of Shannon's Equation, Introduction to MIMO communication and Channel Capacity for MIMO Systems, Random Selection of Codes.

.

UNIT 2: ERROR CONTROL CODING (CHANNEL CODING): 12 Hrs.

Introduction, Linear block codes, Matrix Description, Syndrome Decoding, Error Probability, Hamming distance, Perfect codes and Hamming codes, Low Density Parity Check (LDPC) codes, Cyclic codes, Polynomial representation, Generation and Decoding of Cyclic codes, Burst Error Correcting and detecting code, Golay Codes, Cyclic Redundancy Check (CRC) Codes, Circuit Implementation of Cyclic Codes, Introduction to BCH codes, Reed-Solomon Codes.

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UNIT 3: CONVOLUTION CODES & TRELLIS CODED MODULATION: 12 Hrs.

Tree Codes and Trellis Codes, Polynomial Description, Generating Function, Matrix Descriptions, Viterbi Decoding Algorithms, Distance Bounds, Performance Bounds, Turbo Codes and Decoding, Trellis Coded Modulation, Decoder and Performance Evaluation, Space Time Trellis Codes.

UNIT 4: CODING FOR SECURE COMMUNICATIONS: 09 Hrs.

Introduction to Cryptography, An Overview of Encryption Techniques, Symmetric and Asymmetric Algorithms, Introduction to Advance Algorithms, Cryptanalysis.

Max Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember basic concepts of information theory and coding.
CO2 - Understand different types of coding techniques.
CO3 - Apply various coding techniques for different applications.
CO4 - Analyze encoding and decoding process of coding methods.
CO5 - Evaluate and compare performance of various coding techniques.
CO6 - Develop an error resilience, efficient and secure communication using coding schemes.

TEXT/REFERENCE BOOKS

- Ranjan Bose, "Information Theory, Coding and Cryptography", PHI.
- B.P.Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", Oxford University Press.
- Thomas M. Cover, Joy. A. Thomas, "Elements of Information Theory", John Wiley.
- Shu Lin and D.J. Costello Jr., "Error Control Coding", Prentice Hall.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs.
Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE317T					Wireless Sensor Networks					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objectives:

- To understand fundamentals of sensor network systems.
- To understand the concepts of layered protocols for adhoc networks.
- To facilitate the understanding of design of sensor network design.

Unit-1: Introduction **11 Hrs.**

Introduction to sensor nodes, node architecture, network architecture, protocol stack, Communication standards, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit-2: MAC Protocols **12 Hrs.**

MAC protocols and design issues for Wireless Sensor Networks, Design goals of a MAC Protocol, Classifications of MAC Protocols, Contention – Based Protocols, Contention – Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

Unit-3: Routing and Energy management **12 Hrs.**

Classification of Routing Protocols, Table – Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing, Introduction to sensor network design tools, Flat-based Routing Algorithms, Hierarchical Routing Algorithms, Localization, geographical routing, landmark based routing, data aggregation, duty cycling, energy conservation mechanisms.

Unit-4: Security for wireless sensor networks **10 Hrs.**

Transport Layer Protocol for Ad Hoc Wireless Networks, Attacks in WSN: physical and layer attacks, protection against attacks, Network Security Requirements, Key Management, Secure Routing in Ad Hoc Wireless Networks, Sensor network platforms and tools, tool based network simulations.

Max Hrs.: 45

Text / Reference Books:

- C. Siva Ram Murthy and B.S. Manoj, “Ad-Hoc Wireless Networks: Architectures and Protocols”, PHI.
- Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks.” John Wiley.
- Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications.” John Wiley
- Nandini Mukherjee, Sarmistha Neogy, Sarbani Roy. “Building Wireless Sensor Networks- Theoretical and Practical Perspectives”. CRC Press.

Course Outcomes:

On completion of the course, the student will be able to:

CO1 - Understand and explain the concept of wireless sensor networks and their applications.
CO2 - Recognize typical node and network architectures.
CO3 - Analyze energy efficient protocol designs.
CO4 - Design and simulate sensor network protocol for different environment.
CO5 - Evaluate measurements of protocol performance in wireless sensor networks.
CO6 - Understand security issues in wireless sensor networks.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE318T					Power Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To introduce basic theory of power semiconductor devices and their application in power electronics circuits and systems
- To familiarize the working principle of AC-DC, DC-DC, DC-AC, AC-AC conversion circuits and their applications.
- To provide the basis for further study of power electronics circuits and systems.

UNIT-1: Power Amplifiers and Power Semiconductor Devices **12 Hrs.**

Operation and analysis of power Amplifiers: Class A, B, C and push-pull configurations.
Introduction to power electronics and its applications; overview of power electronic circuits and Systems.
Power semiconductor devices: Diodes, SCR, GTO and transistors (BJT, MOSFET and IGBT): Ratings, static and dynamic characteristics, drive and switching aid circuits; protection and cooling of power semiconductor devices.

UNIT-2: AC-DC Converters **12 Hrs.**

Principle of phase control AC-DC converter; single phase and three phase converter circuits with different types of loads; performance parameters analysis: power factor, ripple factor, form factor, harmonics, distortion and effect of source Inductance on performance; dual converters and their operation; power factor improvement techniques; applications of AC-DC converter circuits.

UNIT-3: DC-DC and AC-AC converters **13 Hrs.**

Introduction to DC-DC converters; working principle of step up and step-down chopper circuits; Design of chopper-based Buck converter, Boost converter, Buck-Boost and Cuk converter: circuit configuration and steady state time domain Analysis with different kinds of loads; design of inductors for DC-DC converters; AC-AC converter: single phase AC Voltage controllers, AC chopper; single phase cycloconverters; applications.

UNIT-4: DC-AC Converters (Inverters): **8 Hrs.**

Classification of inverters, single phase voltage source bridge inverter; performance parameter analysis with various loads; voltage control of single-phase inverters: PWM techniques; Three- phase bridge inverter: 180^o and 120^o conduction mode of operation with various loads; applications of inverter circuits.

Max Hrs.: 45

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Identify the power devices as per the usage of energy conversion and control.
CO2 - Understand internal structure and operation of various power semiconductor devices.
CO3 - Illustrate various converter topology/configuration with different types of loads.
CO4 - Analyze the performance parameters for power electronic converters.
CO5 - Select proper converter configurations for various power applications.
CO6 - Develop a power converter topology for a specific industrial or domestic application.

TEXT/REFERENCE BOOKS:

- M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009
- N. Mohan, T. M. Undeland, W.M. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Edition, 2007.
- M. D. Singh, K. B. Khanchandani, "Power Electronics", 2nd Edn., Tata McGraw-Hill, 2007.
- P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi
- P C Sen, " Modern Power Electronics", S Chand Publisher, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE319T					Artificial Intelligence					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of Artificial Intelligence.
- Learn to represent knowledge and making inference.
- know the various methods of Artificial Intelligence and their working.
- Study the basic of planning and expert systems.

UNIT 1 INTRODUCTION TO AI AND EXPERT SYSTEMS 11 Hrs.

Introduction to AI: Definition of AI, The AI Problems, The Underlying Assumption, AI Techniques, The Level of the Model, Criteria for Success, The importance of AI, Early works in AI, AI and Related fields, The Foundations of Artificial Intelligence, The History of Artificial Intelligence. Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs.

Expert System: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition, Expert System Architectures, Rule based systems, Non production system, knowledge acquisition.

UNIT 2 SEARCH TECHNIQUES AND INFERENCE 12 Hrs.

Heuristic Search Techniques: Generate-and-Test, Hill Climbing, Best-first Search, A* algorithm, AO* algorithm, Problem Reduction, And-Or search, Constraint Satisfaction, Means-ends Analysis. Adversarial Search and Game Playing: Optimal Decision in Games, The minimax algorithm, Alpha-Beta pruning, Iterative Deepening

Using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Properties of Wff, Clausal Forms, Conversion to clausal forms, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge.

UNIT 3 PLANNING AND LEARNING 12 Hrs.

Planning: Overview, An Example Domain: The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems.

Learning: What is learning, Rote learning, Learning by taking Advice, Learning from example: Induction, Explanation based learning (EBL), Discovery, Clustering, Analogy, Introduction to Neural networks: basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks.

UNIT 4 APPLICATIONS, MODERN TRENDS AND FUTURE OF ARTIFICIAL INTELLIGENCE 10 Hrs.

Introduction, Applications of Artificial intelligence, Latest trends of Artificial intelligence, Ethics and risk for developing Artificial Intelligence, Future Trends of Artificial Intelligence Applications of AI in Data Science, Case studies on next generation of AI applications

Max Hrs.: 45

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1 - Explain the basics of artificial intelligence

CO2 - Describe different models for Agent & environment used in AI.

CO3 - Co-relate among the Knowledge and key words for Reasoning used in AI based model

CO4 - Reframe Expert system implement in AI.

CO5 - Evaluate the performance of learning methods and expert systems

CO6 - Explain the Applications, Modern Trends, and future of Artificial intelligence

TEXT/REFERENCE BOOKS

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016
- Russell, S.J. and Norvig, P., Artificial Intelligence: A Modern Approach, Pearson Education.
- Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.

20ECE320T					Digital Control Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand analysis of digital control system.
- To apply the knowledge state variable analysis in the design of control systems.
- To explain the concept of stability analysis and design of digital control systems.

UNIT 1: Introduction to Signal Processing in Control Systems 15 Hrs.

Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – Basic concepts of sampled-data systems. Sampling rate selection –various practical considerations, Modeling (transfer functions & state-space) and analysis of sampled data control systems. reconstruction of sampled signals –ZOH. Z-transform and inverse Z-transform, mapping between s-plane and z-plane, pulse transfer function, relation between G(s) and G(z) – signal flow graph method applied to digital control systems.

UNIT 2: Stability Analysis of Digital Control Systems 08 Hrs.

BIBO, asymptotic and internal stability, Stability on the z-Plane and the Jury Stability Criterion, Nyquist stability criterion, Phase and gain margins.

UNIT 3: Design of Industrial Controllers 12 Hrs.

Basic principles of industrial controllers – Process load, Process lag, parameter range, control modes etc. Basic control actions – Proportional (P), Integral (I) and derivative (D), PI, PD and PID, Tunable PID controllers, Design of Digital Controllers: The design approaches – translation of analog design (digital redesign) and Direct Digital control (DDD). Direct and Indirect synthesis for DDD, Obtaining digital PID controllers by redesign and Lag/Lead compensators by DDD using Indirect synthesis.

UNIT 4: State Variable Analysis and Design of Digital Control System 10 Hrs.

Introduction, State descriptions of digital processes and sampled data control systems, System with dead time, Solution of state difference equations, Controllability, Observability, Multivariable systems, Stability improvement by state feedback, Design of Digital controllers and compensators using state-space formulations, Introduction to system identification and adaptive control.

Max Hrs.: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember different types of digital control systems

CO2 - Understand analysis of digital control system

CO3 - Apply different concepts of digital control systems to solve problems

CO4 - Analyze different types of digital control systems

CO5 - Evaluate different responses and stability of digital control system

CO6 – Create applications of digital control systems

TEXT/REFERENCE BOOKS

- Discrete-Time Control systems , K. Ogata, Pearson Education/PHI.
- Digital Control and State Variable Methods by M. Gopal, TMH.
- Digital Control Systems, Kuo, Oxford University Press.
- Digital Control Engineering, M. Gopal.
- Computer-controlled system, K J Asrom, Wittenmark, PHI.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE3xxT					Mixed Signal VLSI					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of mixed-signal circuit design.
- Study of data converters (ADC/DAC) for interfacing of analog and digital systems.
- Know the various methods for the co-existence of analog and digital circuits on a single chip.

UNIT 1: INTRODUCTION TO MIXED-SIGNAL **12 Hrs.**

Definition of Mixed-signal ICs, Challenges, Applications, Basic to data conversion and processing, Sampling, Switched capacitors circuits: MOSFET as switches, Diode as Switch, Switched Capacitor Integrator, MOS sample-hold circuits, Simple current mirror, and Cascode current mirror circuits, Voltage-controlled Oscillators (VCO), Phase Locked Loop (PLL), non-ideal effect in PLL, Jitter and phase noise and applications.

UNIT 2: ANALOG TO DIGITAL CONVERTERS **11 Hrs.**

Performance Metric, Flash Architectures, Two-Step Architectures, Interpolative and Folding Architectures, Pipelined Architectures, Successive Approximation Architectures, Interleaved Architectures, Over sampling ADC – Noise shaping, Sigma-Delta modulator.

UNIT 3: DIGITAL TO ANALOG CONVERTERS **12 Hrs.**

Performance Metrics, Reference Multiplication and Division: Voltage Division, Current Division, Charge Division, Switching and logical Functions in DACs, Switching Functions in Resistor-Ladder DACs, Switching Functions in Current-Steering DACs, Switching Functions in Capacitor DACs, Binary-to-Thermometer Code Conversion,

Architectures: Resistor-Ladder DAC Architectures, Ladder Architecture with Switched Sub-divider, Intermeshed Ladder Architectures, Current-Steering Architectures, R-2R-Network Based Architectures, Segmented Architectures.

UNIT 4: NOISE AND TESTING OF ICs **10 Hrs.**

Noise: Types of noise: Shot, Thermal, Flicker (1/f), Burst, and avalanche noise, Noise Models of IC components: Diode, BJT, MOS transistor, Resistor, capacitors, and inductors, Noise power trade-off, Noise Bandwidth, Noise Figure, Noise Temperature, total harmonic distortion.

Testing: General Consideration, Sampling circuits, D/A converters, A/D convertors: static and dynamic testing.

Max. 45 Hrs.

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1: Define the importance of Mixed-signal circuits in IC design.

CO2: Understand the principles and mathematical concepts of different mixed-signal circuit architectures.

CO3: Apply the appropriate amplifier circuit to amplify analog and discrete signals.

CO4: Analyze and compare the performance metrics of data converters.

CO5: Evaluate the various A/D and D/A converters for a given data acquisition system.

CO6: Design the mixed-signal circuit IC for real-life applications.

TEXT/REFERENCE BOOKS

- Behzad Razavi, Design of Analog CMOS Integrated Circuits McGraw-Hill International Edition 2016.
- Behzad Razavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995
- Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Analog Integrated Circuit Design, Wiley, 2nd Edition.
- R. Jacob Baker, CMOS Mixed-signal circuit design, Wiley India, IEEE press, and reprint 2008.

End Semester Exam Question Paper Pattern: (3 Hours; 100 Marks)

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

Semester VII

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester VII			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20ECE401T	RF and Microwave	3	0	0	3	3	25	50	25	--	--	100
2	20ECE401P	RF and Microwave Lab	0	0	2	1	2	--	--	--	50	50	100
3	20IC402T	Digital CMOS VLSI Circuits	2	0	0	2	2	25	50	25	--	--	100
4	20IC402P	Digital CMOS VLSI Circuits Lab	0	0	2	1	2	--	--	--	50	50	100
5		CE5 (Theory)	3	0	0	3	3	25	50	25	--	--	100
6		CE6 (Theory)	3	0	0	3	3	25	50	25	--	--	100
7		CE7 (Theory)	3	0	0	3	3	25	50	25	--	--	100
8	20TP410	Mini Project	0	0	6	3	6	--	--	--	--	--	100
		TOTAL	**14**	**0**	**10**	**19**	**24**						**800**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination; CE – Core Elective.

Core Electives for 7th semester

Course Code	**Course Name**	**Course Code**	**Course Name**
20ECE402T	Information Security	20ECE408T	Bio-medical Electronics
20ECE403T	Energy harvesting	20ECE409T	Industrial Automation and Robotics
20ECE404T	Radar and Navigation Systems	20ECE410T	GIS and Remote Sensing
20ECE405T	Internet of Things	20ECE411T	Satellite Communication
20ECE406T	Deep and Reinforcement Learning	20ECE412T	5G Networks
20ECE407T	Process Control and Instrumentation	20ECE413T	Advanced Processors and SoCs

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20ECE401T					RF and Microwave					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basics of microwave generation
- Explain different types of waveguides and their respective modes of propagation
- Analyze Microwave components and learn microwave measurement techniques

UNIT 1: RF Sources **12Hrs.**

Limitations of conventional tubes, 2-cavity Klystron (working, velocity modulation, optimum separation), Reflex Klystron, Magnetron (working and drawback), Gunn diode, PIN diode, Read diode (IMAPATT and TRAPATT).

UNIT 2: Waveguide **14 Hrs.**

Review of Maxwell's equations, wave equation, rectangular waveguide, circular waveguide, the concept of modes and field pattern, power losses in the waveguide, waveguide resonator, and its application.

UNIT 3: Microwave Passive Components **11 Hrs.**

S-parameters, Directional coupler, circulator, Isolator, E-plane, H-plane, Hybrid Tees, impedance matching devices, introduction to strip line, microstrip line, Introduction to microwave filters, design of LPF using micro-strip.

UNIT 4: Microwave measurement **8 Hrs.**

VNA, VSWR meter, impedance, Power, frequency measurement.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember Maxwell's equations, microwave components' properties
CO2 - Understand the design basics of microwave generation and measurement
CO3 - Apply the EM concepts to understand different types of sources, measurements and microwave components
CO4 - Analyze the RF components, sources, and parameters
CO5 - Evaluate Microwave components, generation, and measurement
CO6 - Design various microwave passive components

TEXT/REFERENCE BOOKS

- David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 2008.
- Robert E Colin, "Foundations for Microwave Engineering", John Wiley & Sons Inc, 2005
- S. Y. Liao; "Microwave devices and Circuits", 3rd Ed.; Prentice Hall of India
- G.H, Bryyant, "Principles of Microwave Measurements (Materials, Circuits and Devices)", IET, 1993

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE401P					RF and Microwave Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- Conceptualise general processor design aspects
- Demonstrate and comprehend architecture and assembly language programming of microprocessor
- Exhibit interfacing of peripheral devices with microprocessor

List of Experiments:

1. To measure the frequency and wavelength using slotted line section and frequency meter.
2. To measure the Isolation and Insertion loss of Isolator and Circulator.
3. To study E-plane, H-plane and Magic Tee.
4. To measure Coupling Factor, Directivity and Isolation of a directional coupler.
5. To measure VSWR and Reflection coefficient of different loads.
6. To study the characteristics of Klystron and Gunn diode.
7. To study the behavior of Transmission line: Waveguide/Coaxial cable/microstrip line. *
8. To study the S-parameter of directional coupler. *
9. To study the S-parameter of E-plane and H-plane Tee. *
10. To design and study MIC Based LPF. *

*Experiments will be performed using EM simulation software.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Describe the properties of various microwave components.

CO2 - Understand the working of microwave sources and passive components

CO3 - Apply the EM concepts to understand different types of sources, measurements and microwave components

CO4 - Analyze the wave propagation/modes in the structure.

CO5 - Evaluate the performance of microwave sources and passive components.

CO6 - Design and simulate various microwave passive components using EM simulation tools.

TEXT/REFERENCE BOOKS

- David M. Pozar, “Microwave Engineering”, Wiley India (P) Ltd, New Delhi, 2008.
- S. Y. Liao; “Microwave devices and Circuits”, 3rd Ed.; Prentice Hall of India
- G.H, Bryyant, “Principles of Microwave Measurements (Materials, Circuits and Devices)”, IET, 1993

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 50	Exam Duration: 2 Hrs.
The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: simulation and designing/experimentation/ programming-coding/implementation/investigation/ solution-development.	50 Marks

20IC402T					Digital CMOS VLSI Circuits					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES:

- To understand the characteristics and concepts related to the design of digital CMOS VLSI circuits/gates.
- To explore various CMOS logic styles, and design CMOS VLSI circuits/gates at the transistor level and layout level.
- To analyze the performance/power of digital CMOS VLSI circuits/gates.

UNIT 1: INTRODUCTION TO DIGITAL CMOS VLSI **6 Hrs.**

Trends in VLSI/Semiconductor industry, related to technology (Moore's) scaling; ITRS Roadmap; Overview of semiconductor devices inherent in the MOSFET: Drain-Body and Source-Body PN junctions, Metal-semiconductor contacts, MOS Capacitor; IV characteristics of P-channel and N-channel planar MOSFETs; Non-ideal effects; Basic steps of CMOS fabrication process/technology.

UNIT 2: DESIGN OF DIGITAL CMOS VLSI STANDARD AND COMPOUND GATES

7 Hrs.

Static CMOS inverter and its VTC characteristics; Resistive Load NMOS inverter and its VTC characteristics; Pseudo NMOS inverter and its VTC characteristics; Design and transistor sizing of standard gates (NAND, NOR, EXOR, tri-state INV) and compound gates.

UNIT 3: PERFORMANCE AND POWER ANALYSES OF DIGITAL CMOS VLSI GATES/CIRCUITS

7 Hrs.

RC modeling and Elmore delay analysis of gates (pattern dependent delay analysis); Sutherland's logical effort method of delay estimation and sizing of cascaded paths/gates; Static and dynamic Power of gates; Euler Diagram/Paths for the layout of gates, stick diagrams, Lambda rules (DRC) and layouts of gates; Design, simulate and analyze digital CMOS VLSI gates using SPICE and EDA tools.

UNIT 4: CMOS LOGIC STYLES

6 Hrs.

Pass-transistor tree-based logic gates (and similar other logic styles – CPL, transmission gates, DPL, etc); Pseudo-NMOS logic; CVLS logic; Dynamic logic (domino, NP domino, Zipper); Hybrid logic style and examples (Full-Adder, MUX, XOR).

Max. 26 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Identify the pros and cons, and the trends related to scaling of the CMOS VLSI technology.
CO2 - Understand the characteristics, sub-parts, and regions of operation of the MOSFET, and use their I-V equations.
CO3 - Design digital CMOS VLSI standard gates and compound gates, at the transistor –level.
CO4 - Estimate the performance/power of digital CMOS VLSI standard and compound gates.
CO5 - Analyze and compare various digital CMOS logic styles and gates/circuits.
CO6 - Create layouts of digital CMOS VLSI standard gates and compound gates, based on Lambda rules.

TEXT/REFERENCE BOOKS

- Neil Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design: A circuits and systems perspective", 3rd Edition, Pearson.
- Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits", 3rd Edition, Tata McGraw Hill.
- Robert F. Pierret, "Semiconductor Device Fundamentals", 1st Edition, Pearson.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20IC402P					Digital CMOS VLSI Circuits Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To understand the characteristics and concepts related to the design of digital CMOS VLSI circuits/gates
- To explore various CMOS logic styles, and design CMOS VLSI circuits/gates at the transistor-level and layout-level
- To analyze the performance/power of digital CMOS VLSI circuits/gates

Laboratory Sessions would be based on following topics:

INTRODUCTION TO DIGITAL CMOS VLSI

- Trends in VLSI/Semiconductor industry, related to technology (Moore's) scaling; ITRS Roadmap;
- Overview of semiconductor devices inherent in the MOSFET: Drain-Body and Source-Body PN junctions, Metal-semiconductor contacts, MOS Capacitor;
- IV characteristics of P-channel and N-channel planar MOSFETs; Non-ideal effects; Basic steps of CMOS fabrication process/technology.

DESIGN OF DIGITAL CMOS VLSI STANDARD AND COMPOUND GATES

- Static CMOS inverter and its VTC characteristics; Resistive Load NMOS inverter and its VTC characteristics; Pseudo NMOS inverter and its VTC characteristics;
- Design and transistor sizing of standard gates (NAND, NOR, EXOR, tri-state INV) and compound gates.

PERFORMANCE AND POWER ANALYSES OF DIGITAL CMOS VLSI GATES/CIRCUITS

- RC modelling and Elmore delay analysis of gates (pattern dependent delay analysis); Sutherland's logical effort method of delay estimation and sizing of cascaded paths/gates;
- Static and dynamic Power of gates;
- Euler Diagram/Paths for layout of gates, stick diagrams, Lambda rules (DRC) and layouts of gates; Design, simulate and analyze digital CMOS VLSI gates using SPICE and EDA tools.

CMOS LOGIC STYLES

- Pass-transistor tree based logic gates (and similar other logic styles – CPL, transmission gates, DPL, etc);
- Pseudo-NMOS logic; CVLS logic; Dynamic logic (domino, NP domino, Zipper); Hybrid logic style and examples (Full-Adder, MUX, XOR).

Some of the above topics would be covered through the associated theory course.

COURSE OUTCOMES:

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

CO1 - Identify the pros and cons, and the trends related to scaling of the CMOS VLSI technology.
CO2 - Understand the characteristics, sub-parts, and regions of operation of the MOSFET, and use their I-V equations.
CO3 - Design digital CMOS VLSI standard gates and compound gates, at the transistor –level.
CO4 - Estimate the performance/power of digital CMOS VLSI standard and compound gates.
CO5 - Analyze and compare various digital CMOS logic styles and gates/circuits.
CO6 - Create layouts of digital CMOS VLSI standard gates and compound gates, based on Lambda rules.

TEXT/REFERENCE BOOKS

- Neil Weste, David Harris, Ayan Banerjee, "CMOS VLSI design: A circuits and systems perspective", 3rd Edition, Pearson.
- Sung-Mo Kang, Yusuf Leblebici , "CMOS Digital Integrated Circuits", 3rd Edition, Tata McGraw Hill.
- Robert F. Pierret, "Semiconductor Device Fundamentals", 1st Edition, Pearson.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 50 **Exam Duration: 2 Hrs.**

The laboratory exam would be conducted in the Lab, and students would be provided one or more questions on: simulation and designing/experimentation/ programming-coding/implementation/investigation/ solution-development.	50 Marks

20TP410					Mini Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	6	3	6	--	--	--	--	--	100

COURSE OBJECTIVES

- To provide an opportunity to solve real-world problems utilizing the knowledge accrued throughout the curriculum.
- To provide an opportunity for life and domain skill enhancement.
- To make ready the students for the academia/research/industry and for the society at large.

The scope of the Mini Project

The students are expected to work on a mini project based on the knowledge/expertise gained during 4 years of the curriculum. The mini project can be based on novel ideas and their implementation, an extensive survey of technology or methods, development of proof of concepts. Thus, students are expected to use acquired skills or develop new skills while working under the supervision of industry or academic mentor within the stipulated time frame.

COURSE OUTCOMES

At the end of this course students will be able to

CO1 - Recognize the real-world problem.
CO2 - Understand the problem and its technological significance.
CO3 - Implement and analyze existing feasible solutions using available tools.
CO4 - Design and create a solution using science, technology, engineering, and mathematical principles.
CO5 - Study the impact of the proposed solution towards, society, environment, infrastructure, energy, and economy
CO6 - Apply principles of management, finance, teamwork, ethics, and communicate effectively in a professional environment, for lifelong learning.

20ECE402T					Information Security					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the concept of security requirements, security attacks, and security policy.
- To understand the mathematical concepts for cryptographic algorithms.
- To understand the security mechanisms available to protect the data.
- To understand the security analysis of cryptographic algorithms.

UNIT 1 INTRODUCTION TO INFORMATION SECURITY **11 Hrs.**

Introduction Information Security: Confidentiality, Integrity and Availability, Authentication, Authorization and Non-Repudiation, Introduction to Plain Text, Cipher Text, Encryption and Decryption Techniques, Introduction to Select Cipher Techniques, Block Cipher, Stream Cipher, Various Types of Attacks and Vulnerabilities.

UNIT 2 SYMMETRIC ENCRYPTIONS **12 Hrs.**

Introduction to Symmetric and Asymmetric Key Encryptions, Data Encryption Standard (DES), Cipher Block Chaining (CBC), Multiple Encryption DES, International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES)

UNIT 3 ASYMMETRIC ENCRYPTION AND DIGITAL SIGNATURES **10 Hrs.**

Asymmetric key generation techniques, Applications of asymmetric encryption methods: RSA, Digital Signature and Standards, Secure One-time Signatures, Application of Digital Signatures: Diffie Hellman Key Exchange.

UNIT 4 HASH FUNCTIONS, AUTHENTICATION, AND APPLICATIONS OF CRYPTOGRAPHY **12 Hrs.**

Cryptographic Hash Functions, Applications: Simple Hash Functions and Features for Ensuring Security, Secure Hash Algorithm (SHA) and Message Digest - MD5, Authentication Systems and Standards, Applications of Cryptographic Algorithms: Smart cards, Mobile Phone Security, Secure Payment Systems and Secure Currencies.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Define the importance of security policies, basic concepts of cryptography, and cryptanalysis.
CO2 - Understand the mathematical concepts for cryptographic algorithms.
CO3 - Apply appropriate encryption techniques to secure data in transit across data networks.
CO4 - Analyze cryptography algorithms with the knowledge of security requirements and security attacks.
CO5 - Evaluate the authentication and hash algorithms as per security requirements.
CO6 - Design the security analysis of framework and policies applied in real-life applications

TEXT/REFERENCE BOOKS

- William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education
- Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw-Hill Education.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE403T					Energy Harvesting					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basic principles of different energy resources
- Study about different energy harvesting methods
- Analyze energy resources and harvesting methods

UNIT 1: Energy Resources **12 Hrs.**

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity

UNIT 2: Wind and Ocean energy and harvesting **10 Hrs.**

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

UNIT 3: Geothermal and Piezoelectric Energy and harvesting **11 Hrs.**

Geothermal Energy: Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling piezoelectric generators, Piezoelectric energy harvesting applications, Human power

UNIT 4: Electromagnetic energy harvesting **12 Hrs.**

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications, Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability and case studies related to different energy harvesting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember about different energy resources and harvesting methods
CO2 - Understand about different energy resources and harvesting methods
CO3 - Apply concepts of different energy resources and harvesting methods
CO4 - Analyze the different energy resources and harvesting methods
CO5 - Evaluate different energy resources and harvesting methods
CO6 - Create new energy harvesting models

TEXT/REFERENCE BOOKS

- Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
- Solar energy - M P Agarwal - S Chand and Co. Ltd.
- Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
- Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford
- University Press, in association with The Open University.
- Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
- J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE404T					Radar and Navigation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basic principles of different types of RADAR
- Gaining in-depth knowledge of radar transmitter and receivers
- Exhibit RADAR navigation techniques

UNIT 1: Radar Fundamentals **12 Hrs.**

Introduction to Radar: Basic Radar – The Origins of Radar, radar system (block diagrams), Radar range equation, Applications of Radar. Radar types: MTI, Doppler and Pulse, PRF, Delay, Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, Pulse Doppler Radar. Tracking with Radar-Monopulse Tracking, Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Tracking in Range, Comparison of Trackers, Automatic Tracking with Surveillance Radars.

UNIT 2: Radar Receivers **12 Hrs.**

Introduction, Superheterodyne Receiver, Receiver noise Figure, Duplexers and Receiver Protectors, Radar Displays. Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, Constant-False-Alarm Rate Receivers, The Radar operator, Signal Management, Propagation Radar Waves, Atmospheric Refraction, Standard propagation, Nonstandard Propagation, The Radar Antenna, Reflector Antennas, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency-Scan Arrays.

UNIT 3: Radar Transmitters and signal detection **11 Hrs.**

Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron -Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter. Detection of Signals in Noise –Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probability Density Functions, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar cross Section fluctuations, Transmitter Power.

UNIT 4: Navigation **10 Hrs.**

Introduction, Four methods of Navigation, Radio Direction Finding, The Loop Antenna, Loop Input Circuits, An Aural Null Direction Finder, The Goniometer, Errors in Direction Finding, Adcock Direction Finders, Direction Finding at Very High Frequencies, Automatic Direction Finders, The Commutated Aeria Direction Finder, Range and Accuracy of Direction Finders, Radio Ranges, Doppler Navigation, component, Beam Configurations, Track Stabilization, introduction to Satellite Navigation System, Global Positioning System(GPS).Instrument landing system, microwave landing system

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember the basic fundamentals of communication receiver
CO2 - Understand the different types of RADAR and their working
CO3 - Apply the basic concept to understand the detection of signal
CO4 - Analyze the working of RADAR Transmitter, receiver and RADAR Navigation
CO5 - Evaluate various RADAR and Navigation systems and components
CO6 - Design components for RADAR and Navigation system

TEXT/REFERENCE BOOKS

- Merrill I. Skolnik," Introduction to Radar Systems", Tata McGraw-Hill (3rd Edition) 2003.
- Peyton Z. Peebles, "Radar Principles", Johnwiley, 2004
- J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc.(10 to 20 marks each)	80 to 60 Marks

20ECE405T					Internet of Things					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

Course Objectives:

- To impart necessary and practical knowledge of components of Internet of Things
- To develop skills required to build real-life IoT based applications.
- To develop skills for effective data analysis for IoT.

Unit 1: Introduction **10 Hrs.**

Introduction, IoT implications, Design principles, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals, Information marketplace, IoT value chain, IoT architecture.

Unit 2: IoT Technology **10 Hrs.**

Devices and gateway, local and wide area networking, machine intelligence, data management, IoT integration with other entities, Cloud and edge computing, architecture, reference model, Hardware Components- Computing platforms, Communication, I/O interfaces, Software Components- Programming API's for Communication Protocols -MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

Unit 3: IoT Use cases **10 Hrs.**

Asset management, industrial automation, Implementation of Device integration, Data acquisition and integration, Authentication, authorization of devices. IoT case studies, Transportation, Agriculture, Healthcare, Home Automation, smart grid, smart cities, building automation, cyber physical systems.

Unit 4: Security and Analytics for IoT **9 Hrs.**

Security requirements in IoT architecture and enabler elements, security architecture, node authentication, Unified framework, secure integration framework, security analysis of IoT implementations, machine learning fundamentals for IoT,

Max 39 hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to:

CO1 - Understand and explain the concept of wireless sensor networks and their applications.
CO2 - Interpret the architecture and its relation with available resources.
CO3 - Interpret Interface I/O devices, sensors & communication modules.
CO4 - Distinguish between usage of IoT protocols.
CO5 - Compare different frameworks for implementation.
CO6 - Analyse the information extracted from data from IoT devices.

TEXT/REFERENCE BOOKS

- Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
- Adrian McEwen, "Designing the Internet of Things", Wiley publishers.
- Vijay Madisetti, Arshdeep Bahga, İnternet of Things, "A Hands on Approach", University Press.
- Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE406T					Deep Reinforcement Learning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the concepts of reinforcement learning, Multi-Armed band its problem, Finite Markov Decision Process.
- Provide approximate solutions methods for Reinforcement learning.
- Introduce Dynamic programming, Monte Carlo methods and Temporal-Difference Learning.
- Excel with Tabular Methods and Prediction with Approximation.
- Familiarize with applications and case studies of reinforcement learning

UNIT 1: INTRODUCTION TO REINFORCEMENT LEARNING **10 Hrs.**

Introduction to Reinforcement Learning (RL), Elements of Reinforcement Learning, RL framework and applications, Introduction to immediate RL, Limitations and scope, Tic-Tac-Toe example.

UNIT 2: FINITE MARKOV DECISION PROCESS **12 Hrs.**

Finite Markov Decision Process:Basics, The Agent-Environment Interface, Goals and Rewards,Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions,Optimal Policies and optimal Value Functions, Optimality and Approximation.

12 Hrs.

UNIT 3: DYNAMIC PROGRAMMING

Dynamic Programming:Definition, Policy Evaluation (Prediction), Policy Improvement, Policy Iteration,Value Iteration, Asynchronous dynamic programming, Generalized Policy Iteration, Efficiency of dynamic programming.Monte Carlo Methods:Definition,Monte Carlo Prediction, Monte Carlo Estimation of Action values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy prediction via Importance Sampling, Incremental implementation.

UNIT 4: TEMPORAL-DIFFERENCE LEARNING **11 Hrs.**

Temporal-Difference (TD): TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-policy TD control, Q-learning off-policy TD control.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the Knowledge Creation on Reinforcement Learning.
CO2 - Understand Tabular methods and Q-networks.
CO3 - Apply different policy optimization technique
CO4 - Analysis different tools and modeling techniques for problems of dynamic decision making under uncertainty
CO5 - Recognize current advanced techniques and applications using RL.
CO6 - Efficiently implement common RL and deep RL algorithms

TEXT/REFERENCE BOOKS

- Daniel Jurafsky & James H Martin,Speech and Natural Language Processing – Pearson Publications.
- Alberto Leon-Garcia, "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition,
- Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective"

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE407T					Process Control and Instrumentation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain basics of process control and instrumentation
- To understand the concepts of process modeling
- To study different models of process control

UNIT 1: Introduction **12 Hrs**

Introduction to process control, process variables, degree of freedom, Industrial measurement systems, different types of industrial variables and measurement systems elements, sensors and transducers for different industrial variables like pressure, torque, speed, temperature etc., Industrial signal conditioning systems - Amplifiers – Linearization - Filters – A/D converters for industrial measurements systems, review of general Industrial instruments - I/P and P/I converters, pneumatic and electric actuators, control valves, Servo drives, Stepper motor drives.

UNIT 2: Process Controllers **12 Hrs**

Basic control actions, characteristics of ON-OFF, P, I and D control, PI, PD and PID control modes, Response of controllers for different types of test inputs, Electronic controllers to realize various control actions, selection of control mode for different processes, optimum controller settings, tuning of controllers – different methods.

UNIT 3: Process Automation using Programmable Logic Controllers (PLC) **10 Hrs**

Architecture of a PLC, Analog and digital types of I/O modules, PLC system memories, Program and data organization inside a PLC, Ladder Diagram, Networking of multiple PLCs.

UNIT 4: Introduction to Distributed Control Systems and Way Forward **13 Hrs**

Direct Digital Control, Supervisory Digital Control, Distributed Control System (DCS), Principles of hierarchical and distributed control, Different topologies, Different aspects of designing and functioning of a typical DCS – case study, Roles of communication protocols, software and operating systems in designing DCS, AI and Soft-computing techniques for Distributed control applications, Introduction to SCADA and Industrial Internet of Things (IIoT) systems, Implementation Examples and Tools for practical implementations.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember different types of processes control mechanisms

CO2 - Understand process control modeling

CO3 - Apply different concepts of process control

CO4 - Analyze different process control models

CO5 - Evaluate the different process control algorithms

CO6 - Create models of different industrial processes

TEXT/REFERENCE BOOKS

- Curtis D. Johnson, Process Control Instrumentation Technology, Pearson Education
- Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, “Process Dynamics and Control”, Wiley Dreamtech India (P) Ltd, New Delhi
- Ernest O. Doebelin “Measurement systems application and design”, McGraw Hill International Editions, McGraw Hill Publishing Company
- B. Wayne Bequette, “Process control, modeling, Design and simulation”, Prentice Hall of India (P) Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTE

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE408T					Bio-medical Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn the fundamentals of bioelectronic devices.
- Learn to analyses bio medical signals.
- know the various methods of bio-medical electronics
- Learn to design bio-medical devices.

UNIT 1 Bioelectronic sensors and transducers **12 Hrs.**

Basic Theories of measurement (Categories of Measurement, Factors in Making Measurements, Measurement Errors, Categories of Errors, Dealing with Measurement Errors, Error Contribution Analysis), Electrodes, Bio-Sensors, and Transducers, Bio-Signal Acquisition, Transduction, Tactics and Signals Processing for Improved Sensing, Medical Surface Electrodes, Microelectrodes, Strain Gauges, Quartz Pressure Sensors, Matching Sensors to Circuits, Temperature, Capacitive, and Inductive Transducers

UNIT 2 Bioelectronic Signal Amplifier **10 Hrs.**

Multiple input circuits, Signal processing circuits, Practical OP-Amps, Isolation Amplifier, Chopper Stabilized Amplifiers,

UNIT 3 Bio-Medical signal processing **12 Hrs.**

Amperometric biomedical signals, potentiometric signals, biphotonic signals, Biomedical Signals: ECG, EEG, EMG, Digital filters: IIR and FIR, Notch filters, Optimal and adaptive filters, Weiner filters, steepest descent algorithm, LMS adaptive algorithm, Adaptive noise canceller: cancellation of 50 Hz signal in ECG Cancellation of maternal ECG in foetal electrocardiography, Case study: Biphotonic signals and their processing.

UNIT 4 Bio-medical Image processing **11 Hrs.**

Biomedical images: MRI, CT, USG, X-ray, Image processing techniques used in Medical images, Digital filters, Detection of regions of interest, segmentation, Statistical analysis, Case study: AI and ML techniques for Biomedical Image analysis

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recognizing the Biomedical system
CO2 - Understanding various methods used in biomedical signal analysis
CO3 - Implementing various filters for biomedical signal analysis
CO4 - Analyse the biomedical signal and images
CO5 - Evaluate the performance of a bioelectronics system
CO6 - Design a bioelectronics system

TEXT/REFERENCE BOOKS

- Principles of Biomedical Instrumentation and Measurements, Richard Aston, ISBN: 0-675-20943-9, Maxwell Macmillan International Publishing Company Sinha G. R, Patel, B. C., "Medical Image Processing: Concepts And Applications", Prentice-Hall, 2014.
- Gonzalez R C, Woods R E, "Digital Image Processing", Third Edition, Prentice Hall, 2007
- D. C Reddy, "Biomedical Signal Processing, Principles and Techniques", Tata McGraw Hill Publishing Company Limited, First Edition, 2005
- Willis J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall India Private Limited, First Edition, 2006

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE409T					Industrial Automation and Robotics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain basics of industrial robots and automation
- To understand the concepts of automation technology
- To study different models of robotic system for industrial applications

UNIT 1 Introduction **09 Hrs**

Introduction to industrial automation and control, industrial automation network architecture, types and challenges, Microcontroller, PLC, DCS, and basic programming.

UNIT 2: SCADA and IIoT **13 Hrs**

SCADA and its elements, Communication technology in industrial automation, integration of DCS with PLC/SCADA and its comparison, SCADA protocols, SCADA and IIoT, Fieldbus, OPC-Unified architecture, security protocols,

UNIT 3: Introduction to robotics and components **12 Hrs**

Anatomy of robotics, robot mechanisms, sensors, actuators and controllers in robots, trajectory planning of end effectors, kinematics.

UNIT 4: robot vision, dynamics and controls **11 Hrs**

Image acquisition and processing, transformation, calibration, robot dynamic equation, actuator dynamics, trajectory tracking control, Lyapunov's theorems, future trends, and Example case studies of robots.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember different types of industrial automation mechanisms
CO2 - Understand automation technology
CO3 - Apply different concepts of robot systems
CO4 - Analyze different robotic control models
CO5 - Evaluate the different robot control algorithms
CO6 – Create different robotic models for industrial automation

TEXT/REFERENCE BOOKS

- Chanchal Dey, Sunit Kumar Sen, "Industrial Automation Technologies", CRC Press.
- Ghosal A, "Robotics: fundamental concepts and analysis.Oxford University press.
- K. Fu, Gonzalez R, Lee C, "Robotics: control, sensing, vision and intelligence", McGraw Hill.
- Giacomo Veneri, Antonio Capasso, "Hands-On Industrial Internet of Things", packt publishers.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE410T					GIS and remote Sensing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basic concept of remote sensing
- Learn different components of GIS and Learning about map projection and coordinate system
- Develop knowledge on data models, sensors and satellite orbits

UNIT 1: Physics of Remote Sensing **13 Hrs.**

Definition and Overview of Remote Sensing and Remote Sensing Systems, Electromagnetic Radiation, Terms and Definitions, Laws of Radiation, EM Spectrum, Sources of EMR Interaction between EM Radiation and matter, Reflection, Absorption and Transmission, Interactions between EM Radiation and Atmosphere, Atmospheric windows, Active and Passive sensing.

UNIT 2: Spectral Signature **10 Hrs.**

Interaction with Soil, Water and Vegetation. Types of Platforms, Types of Sensors, RF and Cameras and Satellite Orbits

UNIT 3: Introduction to GIS **11 Hrs.**

Introduction to GIS – definition, concept and history of developments in the field of information systems, Computer fundamentals for GIS, Hardware and software requirements for GIS, Coordinate system and projections in GIS – conic, cylindrical and planner.

UNIT 4: GIS Data Models **11 Hrs.**

Data structure and formats, Spatial data models – raster and vector, data inputting & GIS, Spatial data quality and uncertainty Data base design - editing and topology creation in GIS, linkage between spatial and non-spatial data

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Remember the basic concepts of remote sensing and GIS.
CO2 - Understand the physics of remote sensing and GIS
CO3 - Apply the basic concepts of GIS and Remote sensing
CO4 - Analyze the different sensing mechanism, GIS models
CO5 - Evaluate performance of Models, data structures and sensing tools
CO6 - Demonstrate GIS subsystems for remote sensing and their tools

TEXT/REFERENCE BOOKS

- Joseph, G., "Fundamentals of Remote Sensing", Universities Press, 2004.
- Lillesand, T. M, "Remote Sensing and Image Interpretation", John, Wiley & Sons, 2008.
- Basudev Bhatta, "Remote Sensing and GIS" OUP India, 3rd edition, 2021.
- Heywood.I, Cornelius S, CrverSteve, "An Introduction to Geographical Information Systems" Pearson Education, 2003.
- Skidmore A., "Environmental Modeling with GIS and Remote Sensing", Taylor and Francis, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE411T					Satellite Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the basics and benefits of satellite communication.
- To understand orbital mechanics principles of satellite communication systems and solve problems related to them.
- To understand the design of a satellite link and identify ways to improve the link performance.
- To study new technologies of satellite communication systems as per given specifications.
- To examine advanced technologies of satellite launching and describe the Indian satellite system.

Unit 1. Introduction to Satellite Communication **16 Hrs.**

History, Overview of Satellite Communication, Types of Satellite, Types of Orbits, Satellite services, Advantages & Applications of Satellite communication, Satellite Life phases, Space Debris, Introduction to Geo-synchronous and Geo-stationary satellites. Orbital Mechanics, Kepler's Three Laws of Planetary Motion, Developing the Equations of the orbit, Look Angle Determination, Earth Stations, Orbital Perturbations, Orbital effects in Communication system performance.

Unit 2. Satellite Sub-systems **10 Hrs.**

Seven segments of Satellite communication, Attitude and Orbit control systems, Telemetry, Tracking and command control system, and Power supply system. Satellite Link Design: Basic transmission theory, System noise temperature and G/T ratio, Design of down-link and uplink, Design of satellite links for specified C/N.

Unit 3. Introduction to Various Satellite Systems **10 Hrs**

VSAT, Direct broadcast satellite television, and radio, Satellite navigation and the Global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.

Unit 4. Launchers & Advanced Technologies **9 Hrs**

Mechanism of Satellite launching, Launch Vehicles, Advanced launching techs like Space X, Intelligent Testing, Control and Decision making for Space, Inter Satellite Link. Indian Satellite Systems: History and Overview of Indian Satellite System, Achievements, GSLV, PSLV, Advanced Technology Vehicle.

Max: 45 HRS

COURSE OUTCOMES:

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

CO1 - Remember thorough information on the conventional and upcoming satellite communication technology.

CO2 - Understand the fundamental aspects of satellite communications.

CO3 - Apply the knowledge of satellite communication systems to solve problems.

CO4 - Analyze the system performance of satellite communication systems.

CO5 - Evaluate the design of a satellite link and suggest enhancements to improve the link performance.

CO6 - Create satellite communication applications in the recent technological trends.

TEXT/REFERENCE BOOKS

- T. Pratt, C. Bostian, and J. Allnutt, "Satellite Communications," 2nd Ed., Wiley India, 2006. 2.
- W. L. Pritchart, H. G. Suyderhoud, and R. A. Nelson, "Satellite Communication Systems Engineering," 2nd Ed., Pearson Education, 2012.
- G. Maral, M.Bousquet, and Z.Sun, "Satellite Communications Systems: systems, techniques and technology", 5th edition, by: John Willy and sons
- Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill, 2nd Edition
- D. Roddy, "Satellite Communications," 4th Ed., Tata McGraw-Hill Education, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs**

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE412T					5G Networks					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To learn 5G Technology advances and their benefits for next generation cellular networks
- To develop an intuitive understanding of various key wireless technologies unique to 5G networks.
- To know the propagation channel models and design characteristics of 5G.
- To learn 5G network architecture, enabling technologies, and supported services.
- To know the design and implementation issues of 5G networks.

UNIT-1: INTRODUCTION TO 5G BROADBAND WIRELESS COMMUNICATIONS 11 Hrs.

Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G, Network Slicing, 5G uses cases pyramid.

UNIT-2: CHANNEL MODEL AND TRANSMISSION TECHNIQUES OF 5G 13 Hrs.

Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Outage probability of 5G transmissions, Channel Models for mmWave MIMO Systems.

Basic requirements of transmission over 5G, Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA). Cognitive radio in 5G.

UNIT-3: DEVICE-TO-DEVICE AND MACHINE-TO-MACHINE COMMUNICATIONS 11 Hrs.

Introduction to D2D and M2M communications, Design challenges of D2D communications, radio resource management and power control for mobile broadband D2D, relay-assisted D2D communications, multi-hop communications, Applications of M2M communications in Internet-of-Things (IoT).

UNIT-4: 5G MILLIMETER-WAVE COMMUNICATIONS 10 Hrs.

5G spectrum regulations, various deployment scenarios for MM-wave based communications, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM). Moving towards 6G and Beyond cellular networks.

Max.: 45 Hrs.

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Remember the terminologies of cellular networks, their advances and benefits for next generation cellular networks.
CO2 - Understand the key RF, PHY, MAC layer and air interface changes required to support the requirements of 5G
CO3 - Apply various propagation channel models and design characteristics on 5G cellular architecture.
CO4 - Analyze different blocks of 5G network architecture and examine their functionalities.
CO5 - Evaluate the performance of Device-to-Device communication and millimeter wave communication in 5G.
CO6 - Design protocols and propagation models for 5G millimeter-wave communications.

TEXT/REFERENCE BOOKS:

- Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
- Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press.
- Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.
- Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

20ECE413T					Advanced Processors and SoCs					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To study the architecture of ARM series processors & DSP Processors.
- To understand the architecture and features of typical ARM7 microcontrollers and SoC devices.
- To understand memory and interconnect architecture for SoC.

UNIT 1: ARM family of processors 16Hrs.

32/64-bit processors; introduction to ARM series processors and its versions: architectures, features, advantages & suitability in SoC design; ARM instruction set; ARM 7 based Microcontroller: features, architecture (block diagram and its description),Memory Map, GPIO, Pin Connect Block, Instruction set, programming in assembly language; Real-world interfacing with ARM7-based Microcontroller; overview of Cortex-A9 and Cortex-A15.

UNIT 2: Digital signal Processors 9Hrs.

Hardware architecture of DSP Processor: desirable features of DSP processors, types of architectures, internal architecture, features, system interface and instruction set of ADSP21xx, ADSP-21xx Development tools; TMS DSP processors; Overview of OMAP and AM57x series processors.

UNIT 3: Memory Design for SoC 9Hrs.

Introduction of SoC architecture; SoC external memory; Internal Memory: size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D –Caches, Multilevel Caches, Virtual to real translation; SoC Memory System; Models of Simple Processor – memory interaction.

UNIT 4: Configuration and Interconnect Customization 11Hrs.

An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

Inter Connect Architectures: Basic Bus Architectures, Analytical Bus Models, Bus transactions and contention time; SoC Standard Buses (AMBA, Core connect).

Total: 45 Hrs.

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Define various advanced processors and their architectures.
CO2 - Understand SoC Architectural features.
CO3 - Illustrate memory and bus architecture for a SoC.
CO4 - Analyze a computational task; characterize its computational requirements for a SoC.
CO5 - Select proper processor, memory and bus architecture for SoC configuration.
CO6 - Develop an SoC framework for real world applications.

TEXT/REFERENCE BOOKS:

- Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", ELSEVIER
- Phil Lapsley et al, "DSP Processor Fundamentals: Architectures and Features" Wiely India Pvt. Ltd
- B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications" TMH.
- Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip", Wiely India Pvt. Ltd.
- Steve Furber, "ARM System on Chip Architecture", Addison Wesley Professional.
- Ricardo Reis, "Design of System on a Chip: Devices and Components" Springer.
- Jason Andrews, "Co-Verification of Hardware and Software for ARM System on Chip Design", Newnes.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

Short Questions (such as: MCQ, fill-in-the-gaps, objective or short one-line questions, match the following etc. (1 or 2 marks each)	20 to 40 Marks
Large Questions (such as: problem analysis, numerical solutions, logical/analytical steps and methods, derivations, descriptive answers, tabular solutions, graphical solutions, etc. (10 to 20 marks each)	80 to 60 Marks

Semester VIII

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRONICS & COMMUNICATION ENGINEERING													
Semester VIII			**B. Tech. in Electronics & Communication Engineering**										
Sr. No.	**Course Code**	**Course Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total Marks**
			L	**T**	**P**	**C**	**Hrs/ Wk**	**MS**	**ES**	**IA**	**LW**	**LE/ Viva**	
1	20TP420	Comprehensive /Major Project	0	0	20	10	20	--	--	--	--	--	100
		TOTAL	**0**	**0**	**20**	**10**	**20**						**100**

L – Lecture, T- Tutorial, P – Practical, C – Credits; MS – Mid semester, ES – End Semester, IA – Internal Assessment; LW – Laboratory Work, LE – Laboratory Examination.

** For examination and question paper pattern of a course, refer to the student handouts provided by the respective faculty member.

20TP420					Comprehensive/Major Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	20	10	20	--	--	--	--	--	100

COURSE OBJECTIVES

- To provide an opportunity to solve real-world problems utilizing the knowledge accrued throughout the curriculum, under the supervision of industry or academic mentor.
- To facilitate industry-academia interactions.
- To provide an opportunity for life and domain skill enhancement.
- To make ready the students for the academia/research/industry and for the society at large.

The scope of the Comprehensive/Major Project (CP/MP)

The students are expected to work on a comprehensive project based on the knowledge/expertise gained during 4 years of the curriculum. The CP/MP can be based on novel ideas and their implementation, an extensive survey of technology or methods, development of proof of concepts. Thus, students are expected to use acquired skills or develop new skills while working under the supervision of industry or academic mentor within the stipulated time frame.

Pedagogy: The student can opt for either in-house or an industry collaborative project.

COURSE OUTCOMES

At the end of this course students will be able to

CO1 - Recognize the real-world problem.
CO2 - Understand the problem and its technological significance.
CO3 - Implement and analyze existing feasible solutions using available tools.
CO4 - Design and create a solution using science, technology, engineering, and mathematical principles.
CO5 - Study the impact of the proposed solution/CP towards, society, environment, infrastructure, energy, and economy.
CO6 - Apply principles of management, finance, teamwork, ethics, and communicate effectively in a professional environment, for lifelong learning.

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