PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR

SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRICAL ENGINEERING													
Semester III			**B. Tech. in Electrical Engineering**										
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**					
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
1.	20MA203T	Mathematics-III	3	1	0	4	4	25	50	25	--	--	100
2.	20EE201T	Network Analysis	3	0	0	3	3	25	50	25	--	--	100
3.	20EE202T	Analog & Digital Electronics	3	0	0	3	3	25	50	25	--	--	100
4.	20EE202P	Analog & Digital Electronics - Lab.	0	0	2	1	2	--	--	--	50	50	100
5.	20EE203T	Transformers & Induction Machines	3	0	0	3	3	25	50	25	--	--	100
6.	20EE203P	Transformers & Induction - Machines Lab.	0	0	2	1	2	--	--	--	50	50	100
7.	20EE204T	Open Elective 1	3	0	0	3	3	25	50	25	--	--	100
8.	20HS201P	Communication Skills - II	0	0	2	1	2	--	--	--	50	50	100
		Total	**15**	**1**	**6**	**19**	**22**						**800**

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam

Department will offer Open Elective based on availability of expertise/faculty. This open elective will be offered to the students enrolled in B.Tech. programs of School of Technology other than Electrical Engineering.

Student of Electrical Engineering will have a choice for one open elective course from the basket of open electives announced by the other departments of School of Technology/other schools of university.

Subject Code	**Open Elective**
20EE204T	Climate Change: Impact and Solutions

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	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the concept of Fourier series and its application to the solution of partial differential equations.
2. To introduce the Fourier transforms and Z-transforms and understand the application part of it in electrical engineering.
3. To study the first and second order partial differential equations along with their applications in electrical engineering.
4. To study applications of advance Linear Algebra to electrical engineering.

UNIT I: FOURIER SERIES **10 Hrs**

Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier sine and cosine series, Parseval's formula, complex form of Fourier series.

UNIT II: FOURIER TRANSFORM AND Z-TRANSFORM **10 Hrs**

Fourier Transform: Integral transform, Fourier integral theorem, Fourier sine and cosine integrals, Fourier transforms, Fourier sine and cosine transforms, Properties of Fourier transform, Convolution, Parseval's identity, Relationship between Fourier and Laplace transform.

UNIT III: PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER **10 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 IV: APPLICATIONS OF ADVANCE LINEAR ALGEBRA TO ELECTRICAL ENGINEERING **10 Hrs**

Introduction to vector space, subspace, basis and dimensions, column space, null space, Field, least squares solutions, orthogonalization, Linear transformation, Symmetric matrices and positive definite matrices, computing exponential of a Matrix, Linearization of non-linear systems using Taylor series expansion

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Identify the partial differential equations of first and second order in order to model or understand the Electrical Engineering applications

CO2 – Understand the techniques of Fourier transforms and Z-transforms to understand the critical mathematical problems.

CO3 – Apply the methods of Fourier series, Fourier transform and Z-transform in understanding and solving the basic Electrical Engineering problems.

CO4 – Classify the second order partial differential equations and solve using method of separation of variables.

CO5 – Appraise the series representation of periodic functions using Fourier series.

CO6 – Formulate the first order partial differential equations and solve them using various analytical techniques.

TEXT/REFERENCE BOOKS

1. H. K.Dass, **Advanced Engineering Mathematics**, S. Chand & Company Ltd., New Delhi.
2. R.K. Jain & S.R.K. Iyenger, **Advanced Engineering Mathematics**, 3rd Ed., Narosa (2002).
3. E. Kreyszig, **Advanced Engineering Mathematics (Eighth Edition**), John Wiley & Sons.
4. Peter V. O'Neil, **Advanced Engineering Mathematics**, Cengage Learning.
5. K. Sankara Rao, **Introduction to Partial Differential Equations-Third ed.**, PHI Learning.
6. T. Amarnath, **An Elementary Course in Partial Differential Equations**, Narosa Publishing House, New Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions 4 marks each	24 Marks (40 min)
Part B: 6 questions 8 marks each	48 Marks (60 min)
Part C: 2 questions 14 marks each	28 Marks (40 min)

20EE201T					NETWORK ANALYSIS					
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

1. To provide understanding of electrical networks & its analysis using network theorems, mesh current &nodal voltage method
2. To impart knowledge about AC & DC circuits and determine their behaviour under both steady state & transient condition
3. To understand different properties of signals and linear time-invariant systems
4. To introduce the concept of two port networks and applications of graph theory in network analysis

UNIT I:NETWORK THEOREMS AND GRAPH THEORY **10 Hrs**

Network theorems & circuit analysis techniques: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's theorem. Analysis with dependent &independent current and voltage sources. Node & Mesh Analysis. Concept of duality & dual networks. Dot convention & Magnetically Coupled Circuit Analysis. **Applications of Graph theory:** Definition of Graph & Various Related Terms, Paths & Circuit Connections, Trees of a Graph, Cut Sets & Tie Sets, Non-Separable Planner & Dual Graphs, Matrices of Oriented Graphs, Properties & Inter Relationships of Incidence, Tie & Cut Set Matrices, Complete Circuit Analysis using Tie Set & Cut Set Matrices

UNIT II: SIGNALS AND LINEAR TIME-INVARIANT SYSTEMS **8 Hrs**

Introduction to signals and systems: Signal properties: periodicity, absolute integrability, determinism & stochastic character. Standard signals: the unit step, the unit impulse, the sinusoid, the complex exponential, Time-limited signals; continuous & discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples. **Behaviour of continuous LTI systems:** Impulse response and step response, convolution, correlation, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations. Concepts of complementary function, particular integral, system function. Periodic inputs to an LTI system, notion of a frequency response and its relation to the impulse response.

UNIT III: DC AND AC TRANSIENT ANALYSIS **12 Hrs**

Transient analysis using time domain approach: Solution of first & second order differential equations for Series & parallel R-L, R-C, RL-C circuits, initial & final conditions in network elements, forced and free response, time constants, steady state and transient state response for AC & DC excitation **Transient analysis using Laplace transform approach**: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions, Transfer function representation, Concept of Poles &Zeroes representation

UNIT IV:TWO PORT NETWORKS AND NETWORK FUNCTIONS **10 Hrs**

Two Port Networks: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interdependence & relationship, interconnections of two port networks. **Network functions:** Concepts of Complex Frequency, Transform Impedance, Network Functions of 1&2 Port Networks, Concept of Poles &Zeroes, Properties of Driving Point & Transfer Functions, Time Response Stability from Pole-Zero Plot

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Apply different circuit analysis techniques and network theorems for analysing an electrical circuit including a magnetically coupled circuit
CO2 – Apply graph theory to formulate network equations
CO3 – Understand concepts of signals and linear time invariant systems
CO4 – Apply differential equation & Laplace transform approaches to obtain transient response of linear time invariant system
CO5 – Analyse two port networks
CO6 – Understand concepts of network functions

TEXT/REFERENCE BOOKS

1. W.H.Hayt, J.E. Kemmerly, S.M.Durbin, "**Engineering Circuit Analysis**", Tata McGraw-Hill Education India, 8th ed., 2013
2. M.E.VanValkenburg, T.S.Rathore, "**Network Analysis**", Pearson, 3rd ed., 2013
3. F.F.Kuo, "**Network Analysis and Synthesis",** Wiley India Pvt. Ltd, 2nd ed., 2006
4. A.V.Oppenheim, A.V.Willsky, S.H.Nawab,"**Signals and systems**", Pearson, 2nd ed., 2015
5. D.R.Choudhury, "**Networks and Systems**", New Age Intl. Publishers, 2nd ed., 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: : 4 Questions, one from each unit, each carrying 10 marks 40 Marks

20EE202T					Analog & Digital 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

1. To enable the students to understand the fundamentals of analogue integrated circuits and digital electronics.
2. To provide in-depth knowledge about Digital logic ICs, Combinational and Sequential circuits.
3. To emphasize on the significance of low power, small size, reliable, high performance Operational Amplifiers.
4. In addition, the course equips them with the knowledge of basic circuit designing for various applications.

UNIT I INTRODUCTION TO ANALOG DEVICES **10 Hrs.**

Characteristics of diodes, Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: BJT Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Introduction to Operational Amplifiers (Op-Amp), Ideal Op-Amp, Op-Amp Characteristics, Differential, Inverting & Non-Inverting Amplifiers, Practical Op-Amp (Input Offset Voltage, Input Bias Current, Input Offset Current, Total Output Offset Voltage, Thermal Drift, Common Mode Configuration And CMRR), Op-Amp with Negative Feedback (Voltage-Series & Voltage-Shunt Feedback Amplifier), Frequency Response of Amplifiers.

UNIT II OP-AMP APPLICATIONS **10 Hrs.**

DC & AC Amplifiers, Peaking Amplifier, Summing, Scaling & Averaging Amplifier, Differential Input & Differential Output Amplifier, Integrator & Differentiator, Low Pass Filter, High Pass Filter, Band Reject Filter, Band Pass Filter & All Pass Filter, Basic Comparator, Zero-Crossing Detector, Schmitt Trigger, Window Detector, Voltage Limiters, Voltage to Frequency & Frequency to Voltage Converter, Analog to Digital & Digital to Analog Converters, Voltage Controlled Oscillator, Phase Locked Loop, Fixed & Adjustable Voltage Regulators, 555 Timer as Astable, Bi-Stable & Mono-Stable Multi-Vibrators.

UNIT III BOOLEAN ALGEBRA, LOGIC GATES & COMBINATIONAL CIRCUITS **10 Hrs.**

Binary Arithmetic, Binary Codes, Binary Logic, Basic Theorems & Properties of Boolean Algebra, Boolean Functions, Canonical & Standard Forms, Digital Logic Gates & Their Properties, K-Map Method, Four/Five Variable Map, POS & SOP Simplification, Don't Care Conditions, NAND & NOR Implementation, Exclusive OR Functions.

COMBINATIONAL LOGIC: Combinational Circuit – Analysis & Design, Binary Adder & Subtractor, Decimal Adder, Binary Multiplier, Decoder, Encoder, Multiplexer & De-Multiplexers.

UNIT IV SYNCHRONOUS SEQUENTIAL LOGIC **10 Hrs.**

Sequential Circuits, Latches, Flip-Flops & Excitation Tables, Analysis of Clocked Sequential Circuits, Design of Sequential Circuits, Registers, Shift registers, Ripple Counter, Synchronous Counters, Ring/Johnson Counter.

TOTAL HOURS 40 Hrs.

COURSE OUTCOMES

CO1 – Analyse basic op-amp circuits & feedback amplifiers
CO2 – Understand basic applications of op-amp for analogy & digital circuits
CO3 – Apply algebraic & mapping techniques to minimise the hardware implementation
CO4 – Design, analyse and implement sequential circuits with timing diagram
CO5 – Develop analogue & digital logic to solve real time engineering problems
CO6 – Demonstrate the ability to design practical circuits.

TEXT/REFERENCE BOOKS

1. R. A. Gaikwad, "**Operational Amplifiers and Linear Integrated Circuits**", Prentice Hall of India.
2. Morris Mano, "**Digital Design**", Prentice Hall of India.
3. Donald Leach, Albert Malvino, and GoutamSaha, "**Digital Principles and Applications**", Tata McGraw-Hill.
4. Anand Kumar, "**Switching Theory and Logic Design**", Prentice Hail of India

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: 4 Questions, one from each unit, each carrying 10 marks 40 Marks

20EE202P					Analog & Digital 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	--	--	--	50	50	100

Course Objective

1. To illustrate different electronic circuits and their practical applications.
2. To test and evaluate the performance of different analogue and digital circuits.
3. To simulate various analogue and digital circuits using software based tools and draw parallel between the simulations and hardware circuits performance.

List of Experiments:

1 Observing Open-Loop Gain of an Operational Amplifier as a function of frequency and measuring Common Mode Rejection Ratio.

2 To Study Operational Amplifier as Inverting and Non Inverting Amplifier, Voltage Comparator, Integrator and Differentiator.

3 To study Active Low Pass Filters, Active High Pass Filter, Active Band Pass Filter using Op-Amp.

4 To study Astable, Mono-stable and Free Running Multi-vibrators using IC 555.

5 To Study Laws and Theorems of Boolean algebra.

6 Study of Logic Gates and Verification of truth tables of Logic gates Using Universal gates (NAND and NOR gates).

7 To verify (A) Truth Table of Binary Half Adder, (B) Truth Table of Binary Full Adder (using two half adders) and (C) Truth Table of Binary Half Subtractor

8 Study of Parity Generator/Checker.

9 To study and verify (A)Gray to Binary Converter, (B) Binary to Gray Converter, and (C) BCD to Excess-3 code conversion circuit.

10 To verify the truth table for 4 To 1 Line Multiplexer and 1 To 4 Line De-Multiplexer

11 To study and verify the Truth Table of 8-to-3 Line Encoder and 3-to-8 Line Decoder.

12 Study of Various types of Flip Flop.

13 Study of Left Right and Programmable Shift Register.

- A. Study of 4-bit serial in serial out shift register.
- B. Study of 4-bit serial in parallel out shift register.
- C. Study of 4-bit parallel in-serial out shift register.
- D. Study of 4-bit parallel in parallel out shift register.

14 Study of 4 Bit Counters (Synchronous and Asynchronous).

- A. Study of 4-bit Synchronous Binary up Counter.
- B. Study of 4-bit Asynchronous Binary up/down counter.

15 Study and verification of Diode VI Characteristics.

16 Application of Diode as Clipper and Clamper Circuits.

17 Conversion of AC to DC using Diode Rectifier Circuits.

18 Study and verification of Transistor in CB and CE configuration (Input and Output Characteristics).

19 To study importance of biasing of Transistor.

20 Study and experimental verification of Hartley Oscillator and Colpitts Oscillator.

COURSE OUTCOMES

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

CO1 – Understand basic operation of integrated circuits of analog and digital electronic devices such op-amps, logic gates etc.
CO2 – Develop basic analogue & digital circuits for real-time applications such as ac-dc converter, logic gates etc.
CO3 – Learn software tools available for simulating analogue & digital circuits
CO4 – Select appropriate IC modules for to build hardware for given application
CO5 – Verify and compare the performance through hardware operations and simulation results
CO6 -- Demonstrate the ability to design practical circuits.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

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

20EE203T					Transformers & Induction Machines					
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

1. To understand basic principles, working, construction, classification and operating characteristics of single phase as well as three phase AC machines such as Transformers and Induction machines
2. To evaluate and analyse the performance of Transformers & Induction machines
3. To enable students to identify and solve the AC machines related problems in Transformers & Induction motor
4. To impart sound knowledge about the different applications of Transformers & Induction machines

UNIT I Single Phase Transformers **10 Hrs**

Basics of Magnetics Circuits and Electromechanical Energy Conversion, Types, Working Principle, Construction, EMF Equation, Transformer on No-Load & ON Load, Ideal Transformer, Actual Transformer, Vector Diagrams, Equivalent Resistance & Reactance, Equivalent Circuits, Losses, Efficiency & Voltage Regulation, All Day Efficiency, Direct Load Test, O.C. &S.C. Tests, Sumpner's Test, Polarity Test, Parallel Operation & Load Sharing, per unit impedance, Auto Transformers, Applications, Testing and Trouble Shooting of Single Phase Transformer

UNIT II Three Phase Transformers **10 Hrs**

Construction, Types, Vector Groups, Connections (Including Open Delta), Parallel Operation of 3-Phase Transformers, Scott Connection, Three Winding Transformer, Tertiary Winding, Voltage Regulation & Tap Changers, Magnetizing Inrush, Harmonics in Transformer, Cooling Methods, Protective & Safety Devices Fitted on Transformers, Power & Distribution Transformer, Testing and Trouble Shooting of Three Phase Transformer

UNIT III Three Phase Induction Machine **15 Hrs**

Classification of AC Motors, Construction & Types, Working Principle, Production of Rotating Magnetic Field, Synchronous Speed, Slip, Frequency of Rotor Current, rotor parameters under standstill and running condition, Torque, Torque/Slip Characteristics, Power Stages, No Load & Blocked Rotor Tests, Phasor Diagram, Equivalent Circuit, Circle Diagram & Determination of Performance Parameters, Deep Bar & Double Cage Induction Motors, Starters: Automatic and Semi - Automatic starters, Methods of Speed Control, Harmonics & its Effects, Cogging & Crawling, Induction Generators: Working, Effect of Capacitor, Voltage Build up in Self-Excited Generators, Application, Testing and Trouble Shooting of Three Phase Induction Machine

UNIT IV Single Phase Induction Motor **05 Hrs**

Types of Single Phase Motors, Double Revolving Field Theory, Methods of Starting, Equivalent Circuit, No Load & Blocked Rotor Tests, Determination of Equivalent Circuit Parameters, Performance Calculations.

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

- CO1 – Understand the construction, principle of operation and working of different kinds of single phase and three phase AC machines such as Transformers and Induction machines.
- CO2 – Analyze the performance of single phase and three phase transformers.
- CO3 – Understand the importance and application of three phase transformer connections.
- CO4 – Evaluate the performance of three phase induction machines by graphical and analytical methods.
- CO5 – Compare the different methods of starting and speed control of induction motor.
- CO6 – Determine the parameters of equivalent circuit of single phase motor and calculate its performance.

TEXT/REFERENCE BOOKS

1. B.L. Theraja& A.K. Theraja, **A text book of Electrical Technology Volume II-AC & DC Machines**, S. Chand & Co.
2. J.B.Gupta, **Theory and performance of electrical machines**, Katson Publication, S.K.Kataria& Sons.
3. Ashfaq Hussain, **Electric Machines**, Dhanpat Rai and Co.
4. D.P. Kothari and I. J. Nagrath, **Electric Machines**, Tata McGraw Hill
5. P. S. Bimbhra, **Electrical Machinery**, Khanna Publishers
6. M. G. Say, **Alternating Current Machines**, Pitman and Sons
7. J. G. Jamnani, **Electrical Machines**, Mahajan Publishing House

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks

Part B/Question: 4 Questions, one from unit I, one form unit II and 2 from unit III, each carrying 10 marks 40 Marks

20EE203P					Transformers & Induction Machines – 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

1. To impart the practical knowledge of construction and working of electrical machines like Transformers and Induction machines
2. To perform different types of tests on electrical machines like Transformers and Induction machines
3. To determine the performance characteristics of rotating electrical machines like Transformers and Induction machines
4. To understand starting and speed control methods of Induction Motors.

List of Experiments:

1. To perform polarity and voltage ratio test on Single Phase Transformer.
2. To perform load test on Single Phase Transformer.
3. To perform open circuit and short circuit test on Single Phase Transformer.
4. To determine the parameters of an equivalent circuit of a Single Phase Transformer.
5. To perform Sumpner's Test on Single Phase Transformer
6. To perform parallel operation of Single Phase Transformers.
7. To perform load test on Three Phase Transformer to find out efficiency and regulation.
8. Parallel operation of two Three Phase Transformers.
9. To understand and verify the different vector groups in Three Phase Transformer connections.
10. To obtain 2-phase supply from 3-phase supply using Scott connection.
11. To understand the construction and operation of Three Phase Induction Motor by working cut section.
12. To determine equivalent circuit parameters of Three Phase Induction Motor by No load and Blocked rotor test.
13. To determine performance characteristics of Three Phase Induction Motor using circle diagram.
14. To perform load test on a Three Phase Induction Motor.
15. To study different types of starters used for Three Phase Induction Motor.
16. To determine equivalent circuit parameters of Single Phase Induction Motor by No load and Blocked rotor test.
17. To study starting methods of a Single Phase Induction Motor.
18. To perform load test on Single Phase Induction Motor.

COURSE OUTCOMES

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

CO1 – Demonstrate the construction, working and operation of AC machines like Transformers and Induction Machine
CO2 – Verify and Analyze the performance characteristics of AC machines like Transformers and Induction Machine by conducting different tests
CO3 – Estimate the performance of Induction Machines by using circle diagram
CO4 – Understand the different configuration of Three Phase Transformers
CO5 – Understand the speed control of Induction Motors
CO6 – Understand the parallel operation of two Transformers

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

Continuous evaluation	50 marks
End semester examination and Viva-voce	50 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	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To understand communication and its process and effect on giving and receiving information.
2. To learn and apply communication skills in different public and interpersonal contexts.
3. To develop analytical, research, and organizational skills through communication skills for a fulfilling career.

UNIT I: **7 Hrs**

- Technical Writing
  - ✓ Report Writing
  - ✓ Creating Lab Journals and Manuals
- Portfolio of Critical Writing and Creative Writing
  - ✓ Essay, Story-writing, etc.

UNIT II: **7 Hrs**

- Summarizing
- Writing Reviews (Books/Articles/Movies/websites)
- Reading Skills (Advanced)

UNIT III: **7 Hrs**

- Digital Literacy
  - ✓ Emails
  - ✓ Creating e-content
  - ✓ Editing and proofreading online
  - ✓ Using grammar and spell check software
  - ✓ Using plagiarism checkers

UNIT IV: **9 Hrs**

- Group Discussion
- Resume Writing
- Interview Skills

TOTAL HOURS **30 Hrs**

COURSE OUTCOMES

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

CO1 – Apply current technology for effective communication leading to better dissemination of knowledge &expertise.

CO2 – Demonstrate relevant knowledge of communication skills in different settings to cater to different purposes & audiences.

CO3 – A sound understanding of communication theory, practice and application to optimize career opportunities.

CO4 – Dynamic communication skills to build and maintain robust and effective professional relationships.

CO5 – Augmented communication skills to prepare and present messages, reports and documents in intent and to integrate different sources of information and knowledge.

CO6 – Monitoring and critical reflection on communication skills for the adoption of appropriate strategy required in achieving the desired outcomes

TEXT/REFERENCE BOOKS

1. Harmer, Jeremy. **The Practice of English Language Teaching**. Harlow: Pearson Longman, 2007.
2. Kaul, Asha. **Business Communication**. Delhi: Prentice-Hall of India, 2006.
3. Maley, A. '**Literature in the Language Classroom'**, The Cambridge Guide to Teaching ESOL, Cambridge University Press.
4. Richards, Jack C., and Willy A. Renandya, eds. **Methodology in Language Teaching: An Anthology of Current Practice**. Cambridge University Press, 2002.
5. 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

20EE204T					Climate Change: Impact and Solutions					
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

1. To understand the concept of climate change and current status.
2. To understand the concept present generation of renewable energy sources and distributed generation of power sources.
3. To acquire knowledge of basic types of available energy sources.
4. To know the basics about energy conservation and its methodology.

UNIT I: INTRODUCTION TO THE CLIMATE CHANGE **10 Hrs**

Earth's Climate, The Greenhouse Effect, The Carbon Cycle, Natural Climate Change, The Human Impact on climate change, Human and biological waste, Heat-waves and droughts, Melting of ice caps and Warming oceans, Losses of the species, Impact on ecological system, Societal impact, Documentaries reported on energy crises and their solutions, Carbon foot prints, Future prediction and summary.

UNIT II: THE ENERGY ENGINEERING **07 Hrs**

Basics of energy, unit conversions, Trends of energy consumption, Scenario of energy consumption in case of developed and developing country, Indian energy scenario, Environmental concern importance of renewable energy, Consumption from Fossil fuel, availability and limitations, Types of Renewable Energy Sources, Need to develop new energy sources- energy.

UNIT III: ENERGY EFFICIENCY AND ENERGY CONSERVATION **08 Hrs**

Concept of energy efficiency, Green transportation, Energy conservation and its importance, energy strategy for the future. Energy Conservation Act 2001 and related policies: Energy conservation Act 2001, Methods of Energy conservation.

UNIT IV: RENEWABLE ENERGY SOURCES AT A GLANCE **15 Hrs**

Solar Energy: Concept of Harnessing Solar Energy, Solar Water Heating, Solar Cooling, Solar Thermal Electricity, Solar Collectors, Introduction to Solar Photovoltaic.

Wind Energy: Concept, Motion of wind, Conversion of wind power, Wind turbine dynamics.

Tidal Power: Concept, Tidal Turbine, Types of Tidal Power Plant.

Biomass: Definition and types of biogas plants and its design for small community.

Geothermal: Definition and Overview of geysers and geothermal power station.

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Remembering basic terms of climate change, non-renewable and renewable sources.
CO2 – Illustrate the basic terminologies related with energy engineering.
CO3 – Develop the concept of energy conservation and energy efficiency.
CO4 – Understand the energy scenario and significance of power generation from renewable energy sources.
CO5 – Understand the types of alternative energy sources.
CO6 – Distinguish the various renewable power generation sources

TEXT/REFERENCE BOOKS

1. J. Woodward, "**Eyewitness Climate Change**", DK Publishing.
2. Rao &Parulekar, **Energy Technology** - Khanna Publications, New Delhi, 2007.
3. Sawhney G. S., "**Non-conventional energy sources**", PHI Learning Pvt. Ltd.
4. G. D. Rai, "**Renewable Energy Sources**", Khanna Publishers
5. The Energy Conservation Act, 2001, Ministry of Law, Justice And Company Affairs, Legislative Department.

WEBPAGES

1. https://beeindia.gov.in/
2. https://mnre.gov.in/

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 20 marks 80 Marks
Part B/Question: 2 Questions, one from unit 1 and one from unit IV, each carrying 10 marks 20 Marks

PANDIT DEENDAYAL ENERGY UNIVERSITY, GANDHINAGAR
SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH. IN ELECTRICAL ENGINEERING

Semester IV			B. Tech. in Electrical Engineering										
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme					Examination Scheme					
								Theory			Practical		Total
			L	T	P	C	Hrs/Wk	MS	ES	IA	LW	LE/Viva	Marks
1.	20EE205T	Electric Power Generation, Transmission and Distribution	4	0	0	4	4	25	50	25	--	--	100
2.	20EE206T	Linear Control Theory	3	0	0	3	3	25	50	25	--	--	100
3.	20EE206P	Control Systems Laboratory	0	0	2	1	2	--	--	--	50	50	100
4.	20EE207T	Synchronous and DC Machines	3	0	0	3	3	25	50	25	--	--	100
5.	20EE207P	Synchronous and DC Machines Laboratory	0	0	2	1	2	--	--	--	50	50	100
6.	20EE208T	Microprocessors and Microcontrollers	3	0	0	3	3	25	50	25	--	--	100
7.	20EE208P	Microprocessors and Microcontrollers Laboratory	0	0	2	1	2	--	--	--	50	50	100
8.	20EE209T	Open Elective II	3	0	0	3	3	25	50	25	--	--	100
9.	20IF201T	Industry 4.0	2	0	0	2	2	25	50	25	--	--	100
10.	20IF201P	Industry 4.0 Laboratory	0	0	2	1	2	--	--	--	50	50	100
11.	TP210	Industrial Orientation	0	0	0	1	0	--	--	--	--	100	100
		Total	**18**	**0**	**08**	**23**	**26**						**1100**

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam

Department will offer Open Elective based on availability of expertise/faculty. This open elective will be offered to the students enrolled in B.Tech. programs of School of Technology other than Electrical Engineering.

Student of Electrical Engineering will have a choice for one open elective course from the basket of open electives announced by the other departments of School of Technology/other schools of university.

Subject Code	Open Elective II
20EE209T	Energy and Water Nexus

20EE205T					Electrical Power Generation, Transmission and Distribution					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the electrical power generation and its economics
2. To calculate parameters of transmission line and analyse its performance
3. To introduce design aspects of transmission line.
4. To understand characteristic of distribution systems

UNIT I: ELECTRICAL POWER GENERATION AND LOADS **12 Hrs**

Introduction to structure of power system. Schematic diagram for thermal, gas, hydro and nuclear power plant and associated equipment and auxiliaries. Load curves and load duration curves, associate terms and factors, importance of high load factor, different types of loads, tariffs, power factor improvement methods, derivation of most economical power factor,

UNIT II: OVERHEAD TRANSMISSION LINE **14 Hrs**

Types of conductors, resistance of transmission line. Calculation of inductance and capacitance of single phase & three phase line with different line configuration, Concepts of GMD, GMR, transposition of line. Characteristic and performance analysis of short, medium and long lines through ABCD parameters, voltage regulation and transmission efficiency of lines under different loading conditions, Surge Impedance Loading, Ferranti effect, active and reactive power flow through tine and their impact on bus voltage magnitude and phase angle, shunt and series compensation of line.

UNIT III: ELECTRICAL AND MECHANICAL DESIGN OF TRANSMISSION LINE **12 Hrs**

Mechanical Design of Overhead Lines: Choice of line insulators, voltage distribution across insulators disc, string efficiency, methods of equalizing potential across insulator. Sag and tension calculations, Effect of ice and wind, Stringing chart, Sag template, Tower design, Spacing and clearance, Vibration damper **Electrical Design of Line:** Choice of voltage level, kW-km loading, choice of conductors, their spacing and current carrying capacity, consideration of corona discharge and corona loss. Sample case study for complete design of transmission line.

UNIT IV: DESIGN OF DISTRIBUTION SYSTEM AND SUB STATIONS **14 Hrs**

Radial, loop and grid type sub-transmission, distribution substation bus schemes, location and rating of substation, AC power supply scheme, advantage of higher transmission voltage, various supply schemes in distribution systems, voltage drop and power loss calculations in distribution systems, types of cables, economics of power supply considering economic choice of conductor size and voltage level. **Power station and substation grounding:** Objectives of grounding, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, tolerable step and touch potential, actual step and touch potential, design of earthing grid.

TOTAL HOURS **52 Hrs**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand basic schematic of power plant based on conventional energy sources and understand different terms to study economics of power generation
CO2 – Derive transmission line parameters with different configurations of transmission line
CO3 – Analyse the performance of short, medium and long transmission lines and compute its voltage regulation, power transfer capability, efficiency, compensation methods
CO4 – Perform electrical and mechanical design of transmission line
CO5 – Understand design of distribution supply systems
CO6 – Understand the design concepts of substations and its grounding practices

TEXT/REFERENCE BOOKS

1. Sivanagaraju and Satyanarayana, **"*Electrical Power Transmission and Distribution*", Pearson Education**
2. Glover, Sarma, Overbye, "***Power System Analysis and Design***", Cengage Publication.
3. M.V. Deshpande, "***Electrical Power Stations***", PHI Publications
4. V. K. Mehta, Rohit Mehta, ***"Principles of Power System",*** S Chand Publications.
5. Dr. S.L. Uppal and S. Rao, **"*Electrical Power Systems*", Khanna Publishers.**
6. Kothari &Nagrath***, "Power System Engineering,"*** Tata McGraw-Hill Education, 2008**.**
7. Hadi Saadat, **"Power System Analysis",**Tata McGraw-Hill

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: 4 Questions, one from each unit, each carrying 10 marks 40 Marks

20EE206T					Linear Control Theory					
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

1. To teach the basic concepts of control theory and feedback systems.
2. To start thinking on the concepts of mathematical modelling and to model simple physical systems.
3. Introduce to concept of state, state space and state space models of a system
4. To teach students the characteristics of closed-loop control systems, including steady-state and transient response.
5. To understand and analyze the concepts of stability through time and frequency domain methods.

UNIT I: INTRODUCTION TO CONTROL SYSTEM **5 Hrs**

Definition, Open loop and closed loop systems, Examples, Components of control systems, Types of control systems, Concept of feedback, positive and negative feedback. Types of processes and its characteristics, linear, non-linear, time-varying, time-invariant, continuous, discrete process, lumped parameter, distributed parameter processes.

UNIT II: MATHEMATICAL MODELLING OF PHYSICAL SYSTEMS **15 Hrs**

First principle modelling, Modelling of physical systems such as electrical, mechanical, electro-mechanical systems, analogous systems, concept of transfer function, poles, zeroes, 'order' and 'type' of the system, computation of overall transfer function, block diagram reduction techniques, signal flow graphs, Introduction to state, state space and state variables, state space models, conversion of state space models to transfer function models, solution of state equation, Homogeneous and Non-homogeneous state equations, State transition matrix, concept of controllability and observability.

UNIT III: TIME RESPONSE ANALYSIS **05 Hrs**

System dynamics, Standard test signals, Step, Impulse, Ramp, Parabolic, Sinusoidal signals, Transient and steady state response of first and second order systems, Time response specifications, Steady state error, Concept of dominant poles for higher order systems.

UNIT IV: STABILITY ANALYSIS OF CONTROL SYSTEMS **15 Hrs**

Notations of stability, Asymptotic and BIBO stability, Necessary conditions for stability, Routh-Hurwitz stability criterion, Relative stability, Introduction to root locus, definition, rules to construct root locus, Stability analysis and control system design using root locus, Introduction to frequency response, Frequency response specifications, Stability analysis using Bode plots, Polar and Nyquist plots.

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Understand the basic concepts of control theory and feedback control systems.
CO2 – Apply the first principle laws to model (Mathematically) the simple physical processes.
CO3 – Analyze the time response of continuous systems.
CO4 – Evaluate the stability of control systems using Routh array test and Evans root locus technique.
CO5 – Analyze the performance characteristics and stability of a control system using frequency response methods.
CO6 – Understand the concept of state, state variables and state space modelling

TEXT/REFERENCE BOOKS

1. I.J. Nagrath and M.Gopal, **Control system Engineering**, New Age International Limited.
2. Katsuhiko Ogata, Modern **Control Engineering**, PHI Learning Pvt. Ltd., New Delhi.
3. Gene F. Frankline, J. David Powell, Abbas Emami-Naeini, **Feedback Control of Dynamic Systems**, Pearson Education Inc.
4. I.J. Nagrath and M. Gopal,**Systems Modelling and Analysis**, Tata McGraw-Hill Publishing Company Limited.
5. Norman N. Nise, **Control system engineering**, Wiley International Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 10 marks 40 Marks
Part B/Question: 4 Questions, 2 from unit II and 2 from unit IV, each carrying 15marks 60 Marks

20EE206P					Control Systems Laboratory					
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

1. To make the students acquainted with the use of computational software such as MATLAB and its programming.
2. Students will able to perform simulation exercise on control theory using Simulink environment.
3. Students will be able to identify model parameters using open loop experimental runs.
4. To study stability analysis using time and frequency response methods using MATLAB.
5. To do transient and steady state response analysis of processes for standard test signals.

LIST OF EXPERIMENTS

1. Introduction to MATLAB (Mathematical Computational & Simulation Software) - Applications in Control Theory.
2. To study mathematical modelling of Electrical Systems & Simulate using MATLAB.
3. To study mathematical modelling of Mechanical Systems & Simulate using MATLAB.
4. Transient response analysis of first order systems (Simulation Exercise using MATLAB).
5. Transient response analysis of second order systems (Simulation Exercise using MATLAB).
6. To solve ordinary differential equations (state space models) using solvers in MATLAB.
7. To solve ordinary differential equations (state space models) using Simulink in MATLAB.
8. To study transient and steady state response of liquid level system using open loop experimental runs and verify them using open loop simulations.
9. To find time constant and steady state gain of Single Board Heater System (SBHS).
10. To study stability analysis using Root Locus (verifying using MATLAB).
11. To study stability analysis using Bode Plots (verifying using MATLAB).
12. To check controllability and observability of the system using state space models (verifying using MATLAB).

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the use of various commands and functions used in control theory using MATLAB Computational Software.

CO2 – Analyze the transfer function and differential equation models (state space models) using MATLAB simulation environment.

CO3 – Perform hands-on experiments to analyze the dynamics of the system.

CO4 – Evaluate the stability of a system using Root Locus and Bode plots in MATLAB environment.

CO5 – Analyze the time response of continuous systems using MATLAB simulation environment.

CO6 – Model the process using time response data.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

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

20EE207T					Synchronous and DC Machines					
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

1. To understand basic principles, working, construction, classification and operating characteristics of rotating machines such as Synchronous and DC machines
2. To evaluate and analyse the performance of Synchronous and DC machines
3. To enable students to identify and solve the related problems in Synchronous and DC machines
4. To impart sound knowledge about the different applications of Synchronous and DC machines

UNIT I: THREE PHASE SYNCHRONOUS GENERATOR **18 Hrs**

Construction, Types, Operating Principle, Terms Related to AC Armature Winding, Pitch & Distribution Factors, Generated EMF, Effect of Harmonics on Induced EMF, Operation on Load – Standalone operation of an Alternator, Phasor Diagrams, Power Output Equation, Armature Reaction, SCR of an Alternator, Voltage Regulation, Determination of Voltage Regulation by Direct Loading, Synchronous Impedance, MMF & ZPF Methods, Two Reaction Theory, Condition of Parallel Operation, Synchronizing of Alternators & Methods of Synchronization, House Diagram, Operation of two or more machines, load sharing, Operation on Infinite Bus, F-P, Q-V Characteristics, Effect of change in excitation, Effect of change in prime mover speed, Slip Test, Hunting of Synchronous Machines & Its Prevention, Capability Curves, Short Circuit Transients, Short Circuit on Generator, Constant Flux Linkage Theorem, Mathematical Solution of series RL circuit, Transient, Sub-transient, Steady state
Single Phase Generator Short Circuit, Testing and Trouble Shooting of Three Phase Alternator

UNIT II: THREE PHASE SYNCHRONOUS MOTOR **06 Hrs**

Construction, Operating Principle, Phasor Diagrams, Starting Methods, Effect of Varying Field Current at Different Loads, V-Curves, Hunting & Damping, Synchronous Condenser, Power Developed by Synchronous Motor.

UNIT III: DC GENERATOR **10 Hrs**

Principle & Construction of a DC Machine, Types of DC Generators, DC Machine Armature Winding, Characteristics of DC Generators, EMF Equation, Voltage Build-Up in a Shunt Generator, Critical Resistance & Speed, Losses in DC Machine, Power Stages & Efficiency, Armature Reaction & its Effects, Inter Poles & Compensating Winding, Commutation & Methods to Improve Commutation, Applications.

UNIT IV: DC MOTOR **06 Hrs**

Working Principle, Back EMF, Voltage & Power Equations, Types, and Torque of a DC Motor, Power Stages, Efficiency, Performance Characteristics, Necessity of Starter, Three & Four Point Starters, Speed Control of DC Motors, Applications, **Efficiency and Testing of DC Machines:** Methods of Testing, Brake Test, Swinburne's Test, Hopkinson's Test, Field Test, Retardation Test, and Trouble Shooting of DC Machines.

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Understand the construction, principle of operation and working of different kind of rotating machines
CO2 – Understand operation and performance of three phase alternator in isolated & grid connected mode
CO3 – Calculate the voltage regulation of alternator by different methods
CO4 – Appraise the purpose for parallel operation of generators and learn the process of synchronization
CO5 – Analyze the performance of DC machines by various tests
CO6 – Compare the different methods of starting and speed control of DC motors

TEXT/REFERENCE BOOKS

1. B.L. Theraja & A.K. Theraja, **A Text Book of Electrical Technology Volume II-AC & DC Machines**, S. Chand & Co.
2. J.B.Gupta, **Theory and performance of electrical machines**, Katson Publication, S.K.Kataria& Sons.
3. Ashfaq Hussain, **Electric Machines**, DhanpatRaiand Co.
4. P. S. Bimbhra, **Electrical Machinery**, Khanna Publishers
5. M. G. Say, **Alternating Current Machines**, Pitman and Sons
6. J. G. Jamnani, **Electrical Machines**, Mahajan Publishing House.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: 4 Questions, 3 form unit I and 1 form unit III, each carrying 10 marks 40 Marks

20EE207P					Synchronous and DC Machines Laboratory					
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

1. To impart the practical knowledge of construction and working of rotating electrical machines
2. To determine the performance characteristics of rotating electrical machines by different tests
3. To determine the voltage regulation of alternator by different methods
4. To learn the synchronization procedure for alternators

List of Experiments:

1. To determine the voltage regulation of an alternator by direct loading method.
2. To determine the voltage regulation of an alternator by synchronous impedance method.
3. To determine the voltage regulation of an alternator by MMF method.
4. To determine the voltage regulation of an alternator by Z.P.F. method.
5. Synchronization of two 3-phase alternators with common bus bars by various methods.
6. To plot `V' curve of three phase synchronous motor.
7. To determine direct and quadrature axis reactance of a salient pole alternator by slip test.
8. To understand the construction and operation of DC machine by working cut section.
9. To obtain the efficiency and load characteristics of a DC shunt motor by direct load test.
10. To determine external and internal characteristics of a DC shunt generator.
11. To determine external and internal characteristics of a DC series generator.
12. To determine external and internal characteristics of a DC compound generator.
13. To control speed of a DC shunt motor by armature control and field control methods.
14. To find the efficiency of a DC machine by Swinburne's test.
15. To perform Hopkinson's Test on a pair of two identical DC machines to find the efficiency of each machine.
16. To perform Field test on a pair of two identical DC series machines to find the efficiency

COURSE OUTCOMES

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

CO1 – Demonstrate construction, working and operating of rotating machines such as Synchronous and DC machines
CO2 – Analyze the performance parameters and characteristics of DC machines
CO3 – Measure and compare the voltage regulation of Alternator by different method
CO4 – Understand the speed control of DC motors
CO5 – Understand the parallel operation of Alternators
CO6 – Verify and Analyze the performance characteristics of rotating machines by conducting different tests.

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

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

20EE208T					Microprocessors and Microcontrollers					
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

1. To get familiar with microprocessors and microcontrollers and their role in designing embedded systems.
2. To understand the architecture, assembly programming and timing diagram for a microprocessor and microcontroller
3. To write basic programs in C to explore the functionalities of microcontrollers for real-world applications

UNIT I:FUNDAMENTALS OF MICROPROCESSORS **10 Hrs**

Introduction to Microprocessors:8-bit microprocessor and microcontroller architecture, Comparison of 8-bit, 16-bit and 32-bit microcontrollers, Definition, classification and examples of Embedded systems

Internal architecture of Intel 8085 microprocessor: Block diagram, Registers, Internal Bus Organization, Functional details of pins, Registers, ALU

UNIT II:8085 MICROPROCESSOR **10 Hrs**

Memory Interfacing: Interfacing external RAM and ROM, Bus System, Control signals, Address / Data bus multiplexing and de-multiplexing.

Assembly language programming: 8085 instruction set: Instructions, Classifications, Addressing modes, Decision Making, Looping, Stack and Subroutines etc. and Programming examples. Timing Diagrams of various instructions, Interrupts.

UNIT III:8051 MICROCONTROLLER **10 Hrs**

Introduction to 8051 microcontroller: Introduction, Architecture of 8051 Microcontroller, 8051 microcontroller hardware, Pin diagram of 8051, input/output pins, ports and circuits. Internal RAM and ROM, SFR's

On-board Peripherals: GPIO, Timers and Counters, Interrupt, Serial data communication (UART)

UNIT IV:8051 C PROGRAMMING **10 Hrs**

Basics of C programming, programming examples for GPIO, Timers, Round-robin with interrupts, PWM, LCD, UART

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 – Understand microprocessor & microcontroller and their applications
CO2 – Learn the architecture, assembly language programming and timing diagram for a microprocessor & microcontroller
CO3 – Understand structure of embedded C programming
CO4 – Explore the functionalities of microcontrollers for real-time applications
CO5 – Illustrate the functionalities of different peripherals and their interfacing with microprocessor
CO6 – Develop the embedded solution for real time applications

TEXT/REFERENCE BOOKS

1. Ramesh S. Gaonkar, "**Microprocessor Architecture, Programming, and Applications with the 8085**", Penram International.
2. David E. Simon, "**An Embedded Software Primer**", Addison-Wesley Professional
3. William Kleitz, "**Microprocessor and Microcontroller fundamentals: The 8085 and 8051 Hardware and Software**"
4. Douglas V. Hall , "**Microprocessors, Interfacing and Peripherals**", Tata McGraw Hill,
5. Ajoy Ray, K Bhurchandi, "**Advanced Microprocessors and Peripherals**", Tata McGraw Hill
6. Muhammad Ali Mazidi, Janice GillispieMazidi and RolinMcKinley, "**The 8051 Microcontroller and Embedded Systems Using Assembly and C**", Pearson Education.
7. K. J Ayala, D. V. Gadre, "**The 8051 Microcontroller and Embedded Systems using Assembly and C**", Cengage Learning, India Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: 4 Questions, one from each unit, each carrying 10 marks 40 Marks

20EE208P					Microprocessors and Microcontrollers Laboratory					
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

1. To introduce 8085 architecture and programming assembly language.
2. To introduce basic concepts of interfacing memory and peripheral devices to microprocessor.
3. To introduce 8051 microcontroller.
4. To write basic programs in C to explore the functionalities of microcontrollers for real-world applications

List of Experiments:

1. Tabulate Instruction Set for 8085 microprocessors
2. Write a program to move a data block starting at Memory Location X to Location Y without overlap. X, Y and block length are to be specified
3. Write a program to move a data block starting at Memory Location X to Location Y with overlap. X, Y and block length are to be specified
4. Write a program to perform an addition of two 8 bit numbers stored at locations X and Y.
5. Write a program to perform subtraction of two 8 bit numbers stored at location X and Y.
6. Find the product of two unsigned binary numbers stored at location X and X+1
7. Write a program division of two Binary Numbers stored at location X and X+1. Display the quotient in address field and remainder in data field
8. Write a program to find the smallest of N one byte numbers. Value of N is stored at location X and the numbers from location X+1. Display the smallest number in the data field and its address in the address field
9. Write a program to display a MOD N binary up counter and down counter. Display the count in address/data field. Generate a 0.5 sec delay between the counts. If clock frequency is 3 MHz
10. Configure ports A, B, C in the output mode in 8155 without timer operation and observe the output with the help of LEDs
11. Configure ports A, B, C in the input mode in 8155 with the help of LEDs without timer operation and observe the output.
12. Configure ports A, B, C in the output mode in 8255 without timer operation and observe the output with the help of LEDs
13. Configure ports A, B, C in the input mode in 8255 with the help of LEDs without timer operation and observe the output
14. Configure ports A, B, C in the output mode in 8255 without timer operation and code for getting square signal & observe the output with the help of LEDs
15. Stepper motor Interfacing/Speed Control & Direction Control using 8085 and 8051
16. Write the Embedded C Program and Assembly Program to Display "EMBEDDED LAB" on LCD and compare Output of both program and draw the conclusion
17. Write the Embedded C Program and Assembly Program for Wave Drive Stepper Motor System. And observe the output in the Proteus
18. Write the Embedded C Program and Assembly Program for Half Wave Drive Stepper Motor System. And observe the output in the Proteus.

COURSE OUTCOMES

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

CO1 – Understand the internal architecture of 8085 microprocessor and 8051 microcontroller thoroughly.
CO2 – program assembly language codes for 8085 microprocessor and 8051 microcontroller.
CO3 – apply C language based coding on different problems involving 8051 microcontrollers
CO4 – understand the interfacing of 8085 microprocessor and 8051 microcontroller with different peripherals
CO5 – understand the application of basic concepts of 8085 microprocessor and 8051 microcontroller related to timers, counters, interrupts.
CO6 – engage the students in formulating practical solutions from the theoretical knowledge gained into electrical engineering domain applications

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

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

20IF201T					Industry 4.0					
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

1. To interpret the core elements and basic technologies of Industry 4.0
2. To understand how the core elements and technologies of Industry 4.0 are interconnected
3. 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.

Total Hours 32 Hrs.

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

1. Ustundag Alp, and EmreCevikcan, Industry 4.0: Managing the Digital Transformation, Springer,First Edition, 2018
2. Kaushik Kumar, DivyaZindani, and J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0., CRC Press, Taylor & Francis First Edition, 2019.
3. Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
4. J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012
5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016
6. 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**

Part A/Question: 4 Questions, one from each unit, each carrying 15 marks 60 Marks
Part B/Question: 4 Questions, one from each unit, each carrying 10 marks 40 Marks

20IF201P					Industry 4.0 Laboratory					
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

1. To comprehend the concept and significance of Industry 4.0
2. To understand core elements and technologies of Industry 4.0 through simulation and experimental studies
3. To explore different software packages and hardware elements involved in realization of 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 – Synthesise the solution for the given Industry 4.0 related problem

END SEMESTER LABORATORY EXAMINATION PATTERN

Max. Marks: 100

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

TP210					Industrial Orientation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	-	2	--	--	--	--	--	100	100

COURSE OBJECTIVES

1. To introduce students to the working environment of the industry
2. To understand the different departments involved in an industry for developing a product or offering a service
3. To learn about the significance of the theoretical knowledge being imparted in the lecture sessions in working of an industry

Students are required to visit industries to observe the working of an industry. The students will have the opportunity to understand various industrial processes, departments involved and manufacturing process. Moreover, the students will get an opportunity to see the theoretical knowledge acquired being put into practice in industry.

COURSE OUTCOMES

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

CO1 – Understand the working of industry
CO2 – Acquire knowledge about the different departments involved in the functioning of an industry
CO3 – Learn about the products being developed or services being offered by the industry
CO4 – Understand the safety procedures followed by industry while working on shop floor
CO5 – Learn how the theoretical knowledge is utilized for product development or for services being offered
CO6 – Acquire the necessary skills for technical report writing

END SEMESTER EXAMINATION PATTERN

Max. Marks: 100

End semester examination and Viva-voce 100 marks

20EE209T					Energy and Water Nexus					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the significance of water and energy efficiency.
2. To gather knowledge about interdependency of energy and water use.
3. To identify the processes requiring energy for water use and water for energy generation.

UNIT I:INTRODUCTION TO ENERGY-WATER NEXUS **08 Hrs**

What is Energy-Water nexus?, Energy-Water flow diagram, Unsustainable and sustainable development, Energy and water challenges, Need for integrating energy and water, Population, Hunger and Millennium Development Goals (MDGs), UN sustainable development goals (SDGs), Climate change and its impact, Electricity consumption in the water sector by process, Societal aspects: rural livelihood scenario, urban scenario,

UNIT II:ENERGY FOR WATER: ENERGY USE FOR WATER DEMAND **10 Hrs**

Energy and its measurement, Drivers of water demand, Characteristics and Properties of Water: Abundance, Thermal Properties, Phase Transitions, Other Properties, Regional and Temporal Variability in Water Accessibility, Linkages between the Fuels Life Cycle and Water Quality. Energy consumption for drinking water supply and wastewater treatments, Energy for ground-water pumping, Energy for desalination, Energy pricing and costs

UNIT III:WATER FOR ENERGY: WATER USE FOR ELECTRICITY GENERATION **13 Hrs**

Drivers of energy demand, Sectoral energy demand: domestic, commercial, industrial, agricultural

fossil-fuel based power generation processes: Coal fuel cycle, Thermoelectric Cooling, Oil and Natural gas, Nuclear power,

renewable power sources: Geothermal, Hydroelectricity, Solar thermal power generation, solar photovoltaic, wind energy

Transportation Fuels Production: Water Life Cycle Management in Fossil Fuels Production, Water Consumption Intensity for Fuels Production, Water Pricing and Costs

UNIT IV: CASE STUDIES AND FUTURISTIC INNOVATIONS **09 Hrs**

Case studies, Circular economy, Challenges and opportunities, Data, Modelling, and Analysis, thinking to enhance energy-water nexus thinking, Sector-Specific Water-Energy Landscape for Decision Making, Challenges and opportunities

TOTAL HOURS 40 Hrs

COURSE OUTCOMES

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

CO1 - Examine the concept of Water and Energy usage.
CO2 - Analyse behaviour of energy consumption for water demand.
CO3 - Analyse behaviour of water usage for energy demand.
CO4 - Understand the concept of interlinkage of Energy and Water.
CO5 - Gather knowledge through national case studies.
CO6 - Gather knowledge through international case studies.

TEXT/REFERENCE BOOKS

1. Ernest J. Moniz (2014), "**The Water-Energy Nexus: Challenges and Opportunities**", U.S. Department of Energy.
2. Gleick, P. H. (1994). "**Water and Energy**." Annual Review of Energy and the Environment, 19(1), 267–299.
3. Khatavkar, P., & Mays, L. W. (2017 a) "**Model for the Real-Time Operation of Water Distribution Systems under Limited Power Availability**". In World Environmental and Water Resources Congress 2017 (pp. 171–183).
4. Khatavkar, P., & Mays, L. W. (2017). Testing an Optimization/Simulation Model for the Real-Time Operations of Water Distribution Systems under Limited Power Availability. In Congress on Technical Advancement 2017 (pp. 1–9).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A/Question: 4 Questions, one from each unit, each carrying 20 marks 80 Marks
Part B/Question: 2 Questions, one each from unit II and III, each carrying 10 marks 20 Marks