Course Name: Analog Electronic Circuits
Course Code: EC- 401
Course Type: PC
(Semester IV)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Basic Electronics
   Electrical technology
   Semiconductor Devices
2. **Course Learning Objectives:**

i. The goal of this course is to introduce and verify basic principles, operation and applications of the various analog electronic circuits and devices like: Diode, BJT, MOSFET, OPAMP, regulator IC for various functions.

ii. To make students understand and analyze the design and working of amplifiers, oscillators, and their configurations with circuit models.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology– Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I - (40 marks)
   B. Continuous Internal Assessment II - (40 marks)
   C. End-Semester Exam (60 Marks)
4. **Course Content:**
   Course Name: ANALOG ELECTRONIC CIRCUITS
   Course Code: EC-401
   Hours per Week: 3L: 0T:0P
   Credits: 3

Module	Topic	36L
1	**Diode circuits**: Clipping, clamping, Voltage Multipliers	3L
2	**Amplifier Models:** Load Line, operating point, Need of biasing & methods of biasing, BJT, JFET and MOSFET amplifiers, small signal analysis, low & high frequency response. High frequency transistor models, frequency response of single stage and multistage amplifiers, cascade amplifier.	4L
3	**Power amplifiers:** Various classes of operation (Class A, B, AB, C etc.), Characterization: Output Power, Gain, Efficiency, Linearity, Spurious, and Ruggedness. noise, distortion etc.	4L
4	**Differential amplifier:** Concept of Differential Amplifiers (Dual Input and Balanced and Unbalanced Output), Constant Current Bias, calculation of differential gain, common mode gain, CMRR and ICMR. Current Mirror using PMOS, NMOS & CMOS, Cascaded Differential Amplifier Stages with Concept of Level Transistor.	3L
5	**Operational amplifier:** Ideal Op-Amp and its Characteristics, Block Diagram of Op-Amp (IC 741), Deviations for a Real Op-Amp from Ideal Behavior. Op-Amp Parameters, Op-Amp Circuits and Applications, DAC & ADC	4L
6	**Active Filters:** Low pass, high pass, band pass and band stop, all pass design analysis.	3L
7	**Feedback Amplifier:** Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc. Types of feedback amplifiers.	3L

8	**Oscillators:** Basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Multivibrators (Monostable, Astable and Bistable).	4L
9	**Fixed and Variable IC Regulators:** IC 78xx and IC 79xx (Concepts only), IC LM317, Output Voltage Equation, SMPS, Principle of DC-to-DC Conversion, Block Diagram Representation of SMPS Module	3L
10	**Circuit Modeling:** PSpice Solution of Simple Series Circuit, Diode Models, Diode Circuits, Clipping & clamping, MOSFET, Small-Signal Model, Common-Source Amplifier, Source-Follower, Input and Output Impedance, Bipolar Junction Transistors, Hybrid-pi Model, Common Emitter Amplifier, Emitter Follower, Input and output Impedance, Op-Amps, Analysis using Sub circuits.	5L

5. References:

Text Books:

- J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
- Electronics Devices & Circuit Theory–Boyelstad&Nashelsky-PHI9. Bell- Linear IC&OPAMP—Oxford
- J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
- Microelectronics Engineering–Sedra&Smith-Oxford.

Reference Books:

- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11 Publishing, Edition IV
- A.K. Maini, Analog Electronics, Khanna Publishing House, New Delhi, AICTE Recommended2018
- G.Nagrath, Analog Electronics,PHI
- P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
- Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition
- Rashid, SPICE for Circuits and Electronics Using PSPICE, Pearson Education.
- Roberts and Sedra, SPICE, Oxford University Press

6. Course Outcomes (COs):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level of revised Bloom's Taxonomy
EC-401.1	Explain the applications of diodes, transistors & MOSFET	Explain	Understanding (Level II)
EC-401.2	Derive and analyze various amplifier circuits	Derive	Creating (Level VI)
EC-401.3.	Analysis of sinusoidal and non-sinusoidal oscillators	Analysis	Analyzing (Level IV)
EC-401.4	Apply the functioning of OP-AMP to design OP-AMP based circuits	Apply	Applying (Level III)
EC-401.5	Illustrate the regular circuits	Illustrate	Understanding (Level II)
EC-401.6	Design circuit models with software	Design	Creating (Level VI)

7. Mapping of Course Outcomes (COs) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3					
2		3	2			
3		3	2			
4				3		
5				3		
6				3		
7			3			
8			3			
9					3	
10						3

8. Mapping of the Course Outcomes (COs) to Program Outcomes (POs)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	-	-	2	1	2	1	2
CO2	3	1	3	2	1	-	-	2	2	2	1	1
CO3	1	3	2	3	3	1	1	3	2	1	2	1
CO4	2	2	3	2	2	1	1	2	1	2	1	2
CO5	1	3	2	2	1	1	1	3	2	2	2	1
CO6	1	2	3	2	3	2	1	2	1	2	1	2

9. Mapping of the Course Outcomes (COs) to Program Specific Outcomes (PSOs)

COs	PS01	PSO2	PSO3
CO1	3	3	2
CO2	3	2	3
CO3	3	2	3
CO4	2	3	2
CO5	2	3	2
CO6	3	1	2

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Analog Communication
Course Code: EC- 402
Course Type: PC
(Semester IV)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Engineering Mathematics
   Signals and Systems.
2. **Course Learning Objectives:**
   i. Emphasize on the study of principles of communication theory.
   ii. Focus on the fundamentals of communication system.
   iii. Introduce the techniques of transmitting and receiving information signal using analog carrier modulation techniques (AM, FM, PM) and evaluate their performance level (SNR) in the presence of channel noise.
   iv. Establish foundation for understanding the relationship among various technical factors useful in designing & operating communication system.
3. **Teaching methodology and evaluation system for the course:**

Teaching methodology – Lectures and Presentations, Interactive Discussions.

Evaluation System –

A. Continuous Internal Assessment I - (40 marks)
B. Continuous Internal Assessment II - (40 marks)
C. End-Semester Exam (60 Marks)

4. **Course Content:**

Course Name: ANALOG COMMUNICATION
Course Code: EC-402
Hours per Week: 3L: 0T:0P
Credits: 3

Module	Contents	36L
1	**Basic blocks in a communication system:** Transmitter, channel and receiver; baseband and pass-band signals and their representations; concept of modulation and demodulation, Need for modulation, Amplitude modulation (AM): - Time domain expression of baseband signal; modulation index, frequency domain (spectral) representations, phasor diagram, AM transmission bandwidth; AM for a single tone message- carrier and side band components; Transmission requirements for AM, normalized power, side band power and transmission power efficiency. Square law modulators, switching modulators. Double side band suppressed carrier modulation (DSB-SC) - time and frequency domain expressions; Transmission requirements for DSB, bandwidth and transmission power for DSB-SC; Generation of DSB-SC, Balanced modulators, Ring modulators, Single side band modulation (SSB):-Frequency domain description, Frequency discrimination method for generation of AM- SSB Modulated wave, Time domain description, Phase discrimination method for generating of AM SSB Modulated waves, transmit band width and power, side band filter examples; Vestigial side band modulation (VSB)	10L
2	**Demodulation of AM signals-square law and envelope detectors:** The super heterodyne receiver for standard AM radio; Synchronous demodulation of AM, DSB and SSB using synchronous detection, Effects of frequency and phase errors in the local oscillator in DSB and SSB Demodulation, SSB with pilot carrier, Phase-Locked Loop (PLL):- Carrier recovery circuits, Basic operation of PLL, mathematical analysis, applications	8L

3	**Angle Modulation (FM/PM):** Instantaneous frequency instantaneous phase, time domain representation for FM and PM; Narrow band angle modulation with frequency and phase, modulation index, Phasor diagram; FM and PM signals for a single tone message, spectral representation, power and effective bandwidth; Generation of wide band FM using Armstrong method, commercial FM requirements. Detection of FM and PM signals, limiter discriminator; Demodulation of PM using PLL; FM broadcasting and stereo FM radio	8L
4	**Types of Noise:** Resistive (Thermal) Noise source, shot noise, Extraterrestrial Noise, Arbitrary noise sources, white noise, Narrowband Noise-In phase and quadrature phase components and its properties, Noise Performance of Analog Communication Systems: Signal to-noise ratio (SNR) in linear modulation, synchronous detection of DSB; SNR for AM, DSB, SSB and FM; comparison of DSB, SSB and AM,	5L
5	Types of pulse modulation PAM, Generation and Demodulation of PWM, PPM, Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing	5L

5. References:

Text books

- Taub and Schilling, Principles of Communication Systems, Tata McGraw Hill
- B.P.Lathi, Communication Systems- BS Publications
  S. Haykin, Communication Systems, John Wiley & Sons

Reference books

- Carlson, Communication System, Mc-Graw Hill
- Proakis & Salehi, Fundamentals of Communication Systems, Pearson
- Singh & Sapre, Communication Systems, Tata McGraw Hill
- L.W.Couch Ii, Digital and Analog Communication Systems, Macmillan Publishing
- Blake, Electronic Communication Systems, Cengage Learning

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC402.1	Able to remember and understand basic concepts in analog communication systems	Explain	Understand
EC402.2	Able to analyse and evaluate different modulation and demodulation analog systems	Identify, Select	Analyse
EC402.3	Able to apply the concepts of modulation schemes in the design of communication systems	Implement	Apply
EC402.4	Able to evaluate signal to Noise Ratio (SNR) performance of various Analog Communication systems	Design	Evaluate
EC402.5	Able to understand and analyse the concepts of Multiplexing: Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM).	Recognize	Understand
EC402.6	Able to analyse and apply the various Pulse Modulation Systems	Identify, Select	Analyze

7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	3	-	-	-
3	-	3	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	3

8. Mapping of the Course outcomes to Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	-	-	-	-	1	-	2
CO2	3	3	3	3	3	-	-	-	-	1	-	2
CO3	3	3	3	3	3	-	-	-	-	1	-	2
CO4	3	3	3	3	2	-	-	-	-	1	-	2
CO5	3	2	2	2	2	-	-	-	-	1	-	2
CO6	3	3	2	2	2	-	-	-	-	1	-	2

9. Mapping to PSO

COs	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	2	-
CO3	3	2	-
CO4	3	2	-
CO5	2	2	-
CO6	3	1	-

***** End of Syllabus*****

Course Name: Electromagnetic Waves and Transmission Lines
Course Code: EC- 403
Course Type: PC
(Semester IV)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   The course prerequisites for Electromagnetic Waves and Transmission Lines typically include foundational knowledge in Physics, Mathematics and Electrical Engineering such as Classical Physics, proficiency in Calculus (including Partial Derivatives and Vector Calculus)
   Basic electrical circuits and AC circuit analysis.
2. **Course Learning Objectives:**
   i. Understand the Fundamentals of Electromagnetic Theory.
   ii. Study Wave Propagation and Transmission.
   iii. Analyze Transmission Lines.
   iv. Study the Concept of radiating devices and basic Antenna.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology– Lectures and Presentations, Interactive Discussions and Practical Experimentation and Electromagnetic simulation.
   Evaluation System –
   A. Continuous Internal Assessment I - (40 marks)
   B. Continuous Internal Assessment II - (40 marks)
   C. End-Semester Exam (60 Marks)
4. **Course Content:**
   Course Name: ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
   Course Code: EC-403
   Hours per Week: 3L: 0T:0P
   Credits: 3

Module	Topics	36L
1	**Vector calculus:** orthogonal Coordinate System, Transformations of coordinate systems; Del operator; Gradient, Divergence, Curl - their physical interpretations; Divergence's theorem and Stokes' theorem; Laplacian operator, Uniqueness theorem.	6L
2	**Electrostatic and magneto static fields:** Coulomb's law, electric field intensity, Different types of charge distribution; Gauss' law, flux density. Biot-Savart law, Current Densities, Conductors, Ampere's law, Relation between J & H, Poisson's & Laplace's equations, Electric and Vector magnetic Potential.	8L
3	**Time varying fields:** Faraday's law & Lenz's law. Displacement Current, Jc - JD Relation, Maxwell's equations, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance; Reflection and Transmission for normal incidence.	8L
4	**Transmission lines:** Telegrapher's equation; Concept of Lumped parameters and Distributed parameters. Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Loss-less Line and Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching	8L

Module	Topics	36L
	Techniques / Quarter wave transformers, Bandwidth problem; Low loss RF transmission lines, basic concepts of waveguides.	
5	**Working principle of Antenna:** Different Antenna Characteristic; Hertzian dipole antenna, Yagi-UDA antenna, Horn antenna, Microstrip antenna and Array Antennas.	6L

5. References:

Text Book:

- Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
- Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education
- Electromagnetic Waves, Shevgaonkar, Tata-McGaw-Hills –R K

Reference Books:

- Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India
- Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery& T. Van Duzer, John
- Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
- Electromagnetics, 2ed Edition – J A Edminister, Tata-McGraw-Hill.
  Engineering Electromagnetics, 7thEdition-W.H.Hayt& J.A.Buck, Tata-McGraw-Hill
- Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-403.1	Understanding the basics of vector mathematics and principles of Electromagnetic waves	Understand	Understand
EC-403.2	Evaluating the concepts of uniform plane waves and application in boundaries and media interfaces	Evaluate and application	Evaluate
EC-403.3	Realization of equivalent circuit model of transmission line sections	Realize	Create
EC-403.4	Calculate reflection and transmission of waves at media interface	Derive	Apply
EC-403.5	Characterizing of wave propagation on metallic waveguides in modal form	Characterize	Analyze
EC-403.6	Understand principle of radiation and radiation characteristics of an antenna	Analyze	Analyze

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	2	2	2
2	3	2	2	2	2	2
3	3	3	2	2	2	2
4	2	3	3	3	3	2
5	3	2	2	2	2	3

8. Mapping of the Course outcomes to Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	1	-	-	-	1	1	1	2
CO2	3	3	2	2	1	-	-	-	1	1	1	2
CO3	3	3	2	2	2	-	-	-	1	1	1	2
CO4	3	3	2	2	2	-	-	-	1	1	1	2
CO5	3	3	2	2	2	-	-	-	1	1	1	2
CO6	3	3	2	2	2	-	-	-	1	1	1	2

9. Mapping to PSO

COs	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
CO6	3	3	1

***** End of Syllabus*****

Course Name: Digital System Design
Course Code: EC- 404
Course Type: PC
(Semester – IV)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Fundamental concepts on Basic Electronics, Digital Electronics and Mathematics.

2. **Course Learning Objectives:**
   i. The course introduces different Modeling styles of digital circuit design using Verilog HDL.
   ii. Student will learn about Finite Sate Machine and its Application to Design Digital Systems.
   iii. Students will learn how to Analyze and Troubleshoot Timing Issues in Digital Systems.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks)
   B. Continuous Internal Assessment II (40 Marks)
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: DIGITAL SYSTEM DESIGN
   Course Code: EC- 404
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	40L
1	**Introduction to FPGA:** FPGA- Internal Structure, LUT & CLB, Verilog Module**,** Port Declaration, Scalar Port & Vectors Port, Internal wires, Numeric Constants (bin, dec & hex form) etc. Boolean & Logical Operators in Verilog. **Gate Level Modeling with Verilog-HDL:** Gate Level Primitives. Tristate Gates. Gate Delays. Gate Level Modeling of Combinational Block like Adder, Subtractor, Multiplexer, Decoder etc.	8L
2.	**Data-flow with Verilog-HDL:** Continuous Assignment, Conditional Operator (?:). Data Flow-Modeling of Combinational Block like Adder, Subtractor, Multiplexer, Decoder etc. Delays: Inertial Delays and Transport Delays. **Behavioral Modeling with Verilog-HDL:** Always Block, Sensitivity List, Conditional Statements: if, else, case. Behavioral Modeling of Combinational Block like Adder, Subtractor, Multiplexer, Decoder etc. Flip-Flops, Registers, Counters, Sequence Generator, Clock Divider, Memories, Blocking and Non-Blocking Assignment.	10L
3.	**Structural Modeling with Verilog-HDL:** Introduction to structural Modeling, Module Instantiation, 4-bit Parallel Adder using 1-bit Full-Adder, Module Instantiation using generate-for loop, Flexible Parameterized Blocks, **Test Bench Design with Verilog-HDL:** Test Bench introduction, Design Instantiation**,** Applying Stimulus, Clock Generation, Initial block, sequential block (begin end), parallel block (fork-join), Use of loop to create stimulus. Delay Control, Inter-assignment and Intra-assignment Delay, Task and Function.	10L

Module	Topics	40L
4.	**Design and Verilog Modeling of FSM:** Introduction, State Diagram, Structure, Moore and Mealy Model, FSM State Minimization, Practical FSM: Sequence Detector, Arbiter etc.	6L
5.	**Static Timing Analysis (STA) :** Clocking Issues, Setup Time and Hold Time of Flip-Flops, Data Arrival Time, Data Required Time, Slack, Critical Path, Maximum Operating Frequency, Input Delay, Output Delay. **Analysis of STA Violations:** Calculation of Setup Time Violation & Hold Time Violation from Circuits. Remedies of Setup Time & Hold Time Violation. Effects of Clock Skew on Timing Violation. **Register Pipelining:** Concept, Merits, Latency, Throughput, Speed-Up and Efficiency	6L

6. **References:**

Text Books:

- T.R Padmanabhan and B. B. Tripura Sundari - Design through Verilog HDL – Wiley Publishers.
- Michael D. Ciletti – Advance Digital System Design with Verilog HDL – PearsonPublishers.
- Sneh Saurabh - Introduction to VLSI Design Flow - Oxford Publishers.

Reference Books:

- Samir Palnitkar - Verilog HDL: A Guide to Digital Design & Synthesis – PearsonPublishers.
- S. Brown & Z. Vransic - Fundamentals of Digital Logic with Verilog Design – McGraw HillPublishers.

7. **Course Outcomes (CO):**

After going through this course, the students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-404.1	Explain and construct the gate-level model of Digital circuit using Verilog-HDL	Model, Explain, construct	Apply, Understand, create
EC-404.2	Explain and construct the data-flow model of Digital circuit using Verilog-HDL	Model, Explain, construct	Apply, Understand, create
EC-404.3	Explain and construct the behavioral model of Digital circuit using Verilog-HDL	Model, Explain, construct	Apply, Understand, create
EC-404.4	Explain and construct the structural model of Digital circuit using Verilog-HDL	Model, Explain, construct	Apply, Understand, create
EC-404.5	Design and Model Finite State Machine (FSM) using Verilog-HDL	Design, Model	Create, Apply
EC-404.6	Examine Timing Issues of digital system and Apply Remedial measures	Examine	Analyze

8. **Mapping of Course Outcomes (CO) to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	1	1	1	1	1	1
2	3	3	3	3	-	-
3	-	-	-	-	3	-

4	-	-	-	-	-	3

9. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	-	-	1	-	-	1	-	1
CO2	1	1	1	2	-	-	1	-	-	1	-	1
CO3	1	1	1	2	-	-	1	-	-	1	-	1
CO4	1	1	1	2	-	-	1	-	-	1	-	1
CO5	1	1	1	2	-	-	1	-	-	1	-	1
CO6	1	1	1	2	-	-	1	-	-	1	-	1

10. Mapping to Program Specific Outcome(PSO)

COs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-
CO6	3	-	-

***** End of Syllabus*****

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Course Name: Numerical Methods
Course Code: EC- 405
Course Type: ES
(Semester IV)
Course Broad Category: (Ability Enhancement)

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1. **Course Prerequisite:**
   Concept of Mathematics in 10+2 standard
2. **Course Learning Objectives:**
   i) To build Fundamental Mathematical skills, apply Mathematical Techniques to Engineering Problems
   ii) To equip students with the essential tools and methodologies
   iii) To analyze and interpret data, make informed decisions under uncertainty, and develop a strong foundation for applications in various fields
   iv) To promote critical thinking, encourage collaborative learning.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.
   Evaluation System –

A. Continuous Internal Assessment I - (40 marks)
B. Continuous Internal Assessment II - (40 marks)
C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: NUMERICAL METHODS
   Course Code: EC- 405
   Hours per Week: 3L: 1T:0P
   Credits: 3

Module	Topics	36L
1.	**Introduction to Python:** **Approximation in numerical computation:** Motivation and application, Rounding off a number, Different types of error (Significant, inherent, Truncation etc.), Different kinds of difference operators, Fundamental theorem of difference calculas (statement only) with applications.	6L
2.	**Interpolation:** Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. **Numerical integration:** Degree of precision, General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Geometrical interpretation, Corresponding error terms.	10L
3.	**Numerical solution of a system of linear equations:** Direct and indirect/iterative method, Gauss elimination method, Matrix inversion, Crout's LU Factorization method, diagonally dominant of a matrix, Gauss-Seidel iterative method.	6L
4.	**Numerical solution of algebraic and transcendental equation:** Algebraic and transcendental equation, Bisection method, Regula-Falsi method, Newton-Raphson method, Geometrical interpretation, Corresponding convergence.	8L

5.	**Numerical solution of ordinary differential equation:** Euler's method, Runge-Kutta methods (II and IVth order), Milne's Predictor-Corrector methods and Finite Difference method.	6L

5. References:

Text Books:

- S. A. Mollah: Numerical analysis and computational procedures.
- R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House.
- Dutta & Jana: Introductory Numerical Analysis.
- Jain, lyengar, & Jain: Numerical Methods (Problems and Solution).
- Srimanta Pal: Numerical Methods, OUP.

Reference Books:

- J.B.Scarborough: Numerical Mathematical Analysis.
- Balagurusamy: Numerical Methods, Scitech.
- Baburam: Numerical Methods, Pearson Education.
- N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC- 405.1	Ability to analyze error and to understand numerical computation.	Identify	Remember
EC- 405.2	Ability to apply numerical methods in integration and concept of interpolation.	Explain	Understand
EC- 405.3	Ability to apply numerical methods to solve system of linear equations.	Implement	Apply
EC- 405.4	Ability to apply numerical methods to solve algebraic equations.	Organize	Analyze
EC- 405.5	Ability to apply numerical methods to solve ordinary differential equations.	Assess	Evaluate
EC- 405.6	Design and implement mathematical investigations and projects, including data collection, analysis, and interpretation, and apply appropriate mathematical communication and presentation skills.	Construct	Create

7. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes:

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

CO4	1	2	1	1	2	-	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO):

COs	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				
CO6				

***** End of Syllabus *****

Course Name: Biology for Engineers
Course Code: EC-406
Course Type: BS
(Semester – IV)
Course Broad Category: (Minor)

……

1. **Course Prerequisite:**
   Class-X-XII level knowledge of Biology and Bio-Environmental Science.
   Under graduate level introductory knowledge of Bio- Engineering.

2. **Course Learning Objectives:**
   i. This course imparts basic knowledge of biology, evolution, general awareness of environmental pollution effects and bio-engineering's aspects with cancer biology that provides the basic ideas among the engineering students for a better foundation of technical education.
   ii. To provide fundamentals among the upcoming young engineers and to carry out advanced technical and machinery research projects in biology and allied domains.

3. **Teaching methodology for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Guest Lectures, Field Visits and Case Studies.

   Evaluation System for the course:
   Evaluation System –
   A. Continuous Internal Assessment I (40 Marks)
   B. Continuous Internal Assessment II (40 Marks)
   C. End-Semester Exam (60 Marks)

4. **Course Content:**
   Course Name: BIOLOGY FOR ENGINEERS
   Course Code: EC- 406
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	36L
1.	**Introduction to Biology in Engineering** Science & Engineering Biology in Engineering Instruments inspired by Biology (Camera and Aeroplane) Major Biological discoveries of 18^{th} to 21^{th} Century. CO Explain that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	3L
2.	**Cell Biology** Cell types (Unicellular & Multicellular, Prokaryotic & Eukaryotic, Plant & Animal Cell) Cell organelles and their function (Cell Wall, Cell Membrane, Nucleus, Ribosome, Mitochondria and other cellular organelles) **Cell Division** Biomolecules- Carbohydrates, Proteins, Lipids and Nucleic Acids, Biochemical qualitative tests for macromolecules CO Identify that Cell is a basic material of life, required biomolecules are valuable for Cell, i.e. living organisms.	5L

Module	Topics	36L
3.	**Microbiology** Classification of microorganisms, Bacteria, viruses, fungi, and protozoa. Hierarchy classification of living organisms. Growth curves and factors affecting growth. Applications in Engineering (Industrial microbiology and Environmental Microbiology, Soil Engineering) CO Demonstrate that hierarchy classification of living organisms and their growth factors and also economic engineering application.	3L
4.	**Genetical Engineering** Laws of inheritance, Monohybrid and dihybrid crosses, Extensions to Mendelism Molecular basis of Inheritance (DNA replication, transcription, and translation, Genetic code and mutations) Concept of Gene, Gene mapping, Concept of operon, Genetic disorders CO Develop that Genetics is the main part of bio-engineering.	4L
5.	**Biochemistry and Biophysical techniques** Thermodynamics in Biology, Enzyme Kinetics and Regulation Metabolic Pathways (Glycolysis, Krebs cycle, oxidative phosphorylation: Cell surface receptors, signaling through G-protein coupled receptors, Phosphatidyl inositol pathway, second messengers, cellular transport- Na+-K+ ATPase pump.) Hormones Biophysical techniques (Chromatography, Electrophoresis, Spectroscopy, Centrifugation, Microscopy, PCR) CO Explain that biochemistry and biophysics gives us details knowledges about all bio-metabolisms of living organisms.	5L
6.	**Environmental Bio-Engineering** Origin of Life and theories of Evolution, Natural selection and adaptation, Phylogenetic Tree Patterns and Mechanism of Evolution (Genetic Grift, Mutation, Genetic Variation, Gene Flow,) Evolution in Human Genome CO Remember that Evolution is a very important part of human genetic mutation, which can keeping pace with evolution. Ecosystems, Biodiversity and its importance, Pollution and its effects Bioremediation (Principles and techniques, Applications in environmental engineering) Engineering technology in Wildlife Sciences and Conservation CO Design that there is a relationship between environment and bio engineering.	6L
7.	**Biotechnology & Bioinformatics** Principles and processes of Biotechnology Application of Biotechnology in health and agriculture Recombinant DNA Technology, Tissue Culture Bioinformatics tools and databases, Sequence alignment and analysis, Applications CO Demonstrate applications of Bioinformatics and biotechnology in your daily life.	5L
8.	**Immunology & Cancer Biology** Innate and adaptive immunity, Cells and organs of the immune system, Humeral and cell-mediated immunity Immunological Disorders and treatment Types and stages of cancer, Genetic and environmental factors	5L

	Molecular Mechanisms (Oncogenes and tumor suppressor genes, Cell cycle regulation and apoptosis) and Treatment. CO Presenting the details information of bio engineering applications in medical field according to diseases and its treatments.	

5. References:

Text Books:

- Biology of Engineers, McGraw Hill (ISBN: 978-11-21439-931)
- Biology For Engineers: Dr. Sandhimita Mondal & Dr. Arnab Ganguli : Aryan Publishing House
- Lehninger's Principles of Biochemistry by David L Nelson; A.L. Lehninger and Michael M. Cox, 5th edition, Worth Publishing.
- Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
- Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.
- Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers
- Principles Of Cancer Biology : Lewis J. Kleinsmith : Pearson Education Limited Edinburgh Gate, Harlow,
  Essex CM20 2JE ISBN 10:1-292-02788-6 ISBN 13: 978-1-292-02788-3 Pearson Education India.
- Fundamentals of Biochemistry : J.L Jain : S CHAND & Company Limited

Reference Books:

- Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher.
- Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- Smith &Vanness, Thermodynamics for Chemical Engineers, MGH
- Shuler and Kargi, Bioprocess engineering: Basic concepts, 2nd edition, Prentice Hall publisher
- Electron Microscopy in Biology: J. R. Harris (ed).
- Biochemistry by Lubert Stryer, John L Tymoczko, Jerry M. Berg, 5th edition, W.H. Freeman Company.
- Principles of Fluorescence Spectroscopy, J.R. Lakowicz; (Springer)
- Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata- McGraw-Hill)
- Biological Spectroscopy-I.D. Cambell & R.A. Durk, (Benjamin Cummings)
- Biophysics-V. Pattabhi & N. Gautham (Narosa, New Delhi)
- Introduction to Electron Microscopy: S. Wischnitzer.
- Text book of soil and water conservation, AUTHORS: RAJIV DUBEY, VINAY KUMAR GAUTAM, DEEPAK SHARMA, LAXMI L. SOMANI AND R.C. DADHEECH PUBLISHING YEAR: 2020 ISBN: 978818321535

6. Course Outcomes(CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-406.1	Explain that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	Explain	Understand
EC-406.2	Identify that the cell is a basic material of life, required biomolecules are valuable for Cell, i.e. living	Identify	Understand

EC-406.3	Demonstrate the hierarchy classification of living organisms and their growth factors and also economic engineering application	Demonstrate	Apply
EC-406.4	Develop that Genetics is the main part of bio-engineering.	Develop	Create
EC-406.5	Explain that biochemistry and biophysics gives us details knowledges about all bio-metabolisms of living organisms.	Explain	Understand
EC-406.6	Remember that Evolution, is a very important part of human genetic mutation, which can keeping pace with evolution. Design that there is a relationship between environment and bio engineering.	Remember Design	Understand Create
EC-406.7	Demonstrate applications of Bioinformatics and biotechnology in your daily life.	Demonstrate	Apply
EC-406.8	Presenting the details information of bio engineering applications in medical field according to diseases and its treatments.	Presenting	Analyze

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8
1	3	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-
3	-	-	3	2	-	-	3	-
4	-	-	2	3	-	-	-	3
5	-	-	-	-	3	-	-	-
6	-	-	-	-	-	3	-	-
7	3	-	-	-	2	-	2	-
8	-	3	2	-	-	-	-	-

8. Mapping of the Course outcomes to Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	2	-	-	-	-	-
CO2	1	2	3		2	-	2	-	-	-	-	1
CO3	1	2	3	2	2	-	2	-	-	-	-	1
CO4	1	2	3	3	2	-	2	-	-	-	-	2
CO5	1	2	2	2	-	-	2	-	-	-	-	-
CO6	1	2	-	-	-	-	2	-	-	-	-	-
CO7												
CO8												

9. Mapping to PSO

COs	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	1
CO3	3	2	1
CO4	3	2	1
CO5	2	2	1
CO6	3	1	1
CO7			
CO8			

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Analog Electronic Circuits Laboratory
Course Code: EC - 491
Course Type: PC
(Semester IV)
Course Broad Category: (Major)

……

1. **Course Prerequisite:**
   Knowledge of Physics and basic electronics practical
2. **Course Learning Objectives:**

i. Expose students to experimental skills on electronic circuit design and analysis
ii. To gain practical knowledge by applying experimental methods to design different practical circuit for project work.
iii. To apply the analytical techniques and graphical analysis to the experimental data.
iv. To gain the simulation concept & apply the knowledge for design different device.

3. **Teaching methodology and evaluation system for the course:**

Teaching methodology - This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. **Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
B. **End-Semester Exam (40 Marks)-** Summative Assessment.

4. **Course Content:**

Course Name: ANALOG ELECTRONIC CIRCUITS LAB
Course Code: EC-491
Hours per Week: 0L: 0T: 2P
Credits: 1

Module	Topics	
1	Conduct experiment to test diode clipping (positive, negative & bised) and clamping circuits(positive, negative & bised)	2P
2	Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances	2P
3	Design, setup and plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth	2P
4	Set-up and study the working of class A & complementary symmetry class B push pull power amplifier and calculate the efficiency	1P
5	Design an inverting, non-inverting, adder, Subtractor circuits using Operational Amplifiers.	2P
6	Realization of current mirror & level shifter circuit.	2P
7	Design a simple function generator using IC.	1P
8	Study of timer circuit using NE555 & configuration for monostable & as table multi vibrator. Design a Schmitt Trigger circuit using NE 555.	2P
9	Design and set-up the following tuned oscillator circuits and determine the frequency of oscillation. R-C Phase shift Oscillator/Wien Bridge Oscillator	2P
10	Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.	1P
11	Overview of PSpice & circuit modeling	2P

Module	Topics	
12	One innovative experiment	1P

6. Course Outcomes (COs):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC- 491.1	Design and test rectifiers, clipping circuits, clamping circuits using hardware & software and design of voltage regulators.	Design, test	Create , Analyze
EC- 491.2	Demonstrate the parameters from the characteristics of BJT, JFET and MOSFET devices.	Demonstrate	Apply
EC- 491.3	Design, test and evaluate BJT amplifiers in CE configuration , JFET/MOSFET amplifiers	Design, test	Create , Analyze
EC-491.4	Design and test parameters & applications of OPAMP	Design, test	Create , Analyze
EC- 491.5	Design different power amplifier & verify the different configurations of IC555	Design	Create
EC- 491.6	Design and test various types of oscillators & SMPS	Design, test	Create , Analyze

7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3					
2		3				
3		3				
4					3	
5				3		
6				3		
7				3		
8					3	
9						3
10	3					
11	3					
12	3	3	3	3	3	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3				2				2	
CO2	1	2			3							
CO3			3	2							2	
CO4				3	2							2
CO5	1	2		3							2	
CO6			3	2					2	2	2	1

9. Mapping of the Course Outcomes (COs) to Program Specific Outcomes (PSOs)

COs	PS01	PSO2	PSO3
CO1	3	3	
CO2	3		
CO3	3		
CO4	3		
CO5	3		
CO6	3		

***** End of Syllabus*****

Course Name: Analog Communication Laboratory
Course Code: EC- 492
Course Type: PC
(Semester – IV)
Course Broad Category: (Major)

……

1. **Course Prerequisite:**
   Knowledge of Signal and System Laboratory
2. **Course Learning Objectives:**
   i. Develop a strong foundational understanding of analog communication principles, including amplitude and frequency modulation, demodulation techniques, and their practical applications.
   ii. To gain practical knowledge by applying experimental methods to correlate with the analog communication theory.
   iii. To apply the analytical techniques and graphical analysis to compute the experimental data.
   iv. Develop the ability to analyze analog communication systems using MATLAB to simulate modulation, demodulation, and multiplexing techniques, enhancing problem-solving skills.
3. **Teaching methodology and evaluation system for the course:**

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. Internal Assessment (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Exam (40 Marks)- Summative Assessment.

4. **Course Content:**

Course Name: ANALOG COMMUNICATION LAB
Course Code: EC-492
Hours per Week: 0L: 0T: 2P
Credits: 1

Module	Topic	
1.	AM modulation and Demodulation	2P
2.	AM transmitting power variation for different modulation index	2P
3.	Frequency modulation and demodulation	2P
4.	DSB-SC Modulator & Detector FM modulation	2P
5	PAM generation and Detection	2P
6	TDM generation and Detection	2P
7	Pulse Width Modulation & Demodulation	2P
8	Verify AM modulation and demodulation in MATLAB.	2P
9	Verify DSB-SC modulation and demodulation in MATLAB.	2P
10	Verify SSB-SC modulation and demodulation in MATLAB.	2P
11	Verify FM modulation and demodulation in MATLAB.	2P
12	Verify FDM and TDM in MATLAB.	2P
13	Verify PAM, PWM, PPM modulation and demodulation in MATLAB.	2P

6. References:

Text Books:

- Taub and Schilling, Principles of Communication Systems, Tata McGraw Hill
- B.P.Lathi, Communication Systems- BS Publications
  S. Haykin, Communication Systems, John Wiley & Sons

Reference Books:

- Carlson, Communication System, Mc-Graw Hill
- Proakis & Salehi, Fundamentals of Communication Systems, Pearson
- Blake, Electronic Communication Systems, Cengage Learning

7. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC 492.1	Understand and analyze the basic theories of analog communication system.	Identify, select	Understand, Analyse
EC 492.2	Analyse and apply the concept of Amplitude Modulation and Demodulation technique.	Execute	Analyse, Apply
EC 492.3	Analyse and Implement the concept of Angle modulation technique.	Implement	Analyse, Apply
EC 492.4	Examine concept of PAM, PWM technique.	Implement	Analyse, Apply
EC 492.5	Compute different types of parameters associated with the process of computation (concept of Measurement of power, Modulation index, etc.)	Implement	Evaluate
EC 492.6	Create Matlab programing to carry out different experiments as it is a key analysis tool of engineering design	Execute	Analyze

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	3	-	-	2
CO2	3	3	3	2	2	-	-	-	3	-	-	2
CO3	3	3	3	2	2	-	-	-	3	-	-	2
CO4	3	3	3	2	2	-	-	-	3	-	-	2
CO5	3	3	3	2	2	-	-	-	3	-	-	2
CO6	3	3	3	2	2	-	-	-	3	-	-	2

9. Mapping to Program Specific Outcome (PSO)

COs	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	2	-
CO4	3	2	-
CO5	3	2	-
CO6	3	2	-

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Electromagnetic Waves Laboratory
Course Code: EC- 493
Course Type: ES
(Semester – IV)
Course Broad Category: (Major)

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1. **Course Prerequisite:**
   Class-XII level knowledge of Physics Practical
2. **Course Learning Objectives:**

i. Expose students to experimental skills on electronic circuit design and analysis
ii. To gain practical knowledge by applying experimental methods to correlate with the basic electronic theory.
iii. To apply the analytical techniques and graphical analysis to the experimental data.

3. **Teaching methodology and evaluation system for the course:**

Teaching methodology- This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. **Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
B. **End-Semester Exam (40 Marks)-** Summative Assessment.

4. **Course Content:**

Course Name: ELECTROMAGNETIC WAVES AND TRANSMISSION LINE LAB
Course Code: EC-493
Hours per Week: 0L: 0T: 2P
Credits: 1

A minimum of THREE experiments from Module-I and FOUR from Module-II

Module	Topics	
1	**Plotting and analysis of Standing Wave Pattern along a transmission line**: 1. when the line is open-circuited short-circuited and terminated by a resistive load at the load-end. 2. Input Impedance of a terminated coaxial line using shift in minima technique. 3. Study of Smith chart on Matlab platform. 4. Simulation study of Smith chart - Single and double stub matching.	5P
2	**Radiation Pattern:** 1. Study of Radiation Pattern of λ/2 simple dipole antenna. 2. Study of Radiation Pattern of a λ/2 folded-dipole antenna. 3. Study of Beam width, gain and radiation pattern of a 3-element Yagi-Uda Antenna. 4. Study of Beam width, gain and radiation pattern of a 5-element Yagi-Uda Antenna. 5. Study of Beam width, gain and radiation pattern of a 7-element Yagi-Uda Antenna. 6. Comparative study of Beam width, gain and radiation pattern Beam width, gain and radiation pattern of a simple dipole, 3-element, 5-element and 7-element. Yagi-Uda antenna. 7. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.	8P

5. **References:**

Text Books:

- Principles of Electromagnetic, by Matthew N.O. Sadiku, S.V. Kulkarni,Oxford University Press
- E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India

Reference Books

- Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall
- David Cheng, Electromagnetics, Prentice Hall

6. **Course Outcomes (CO):**

After going through this course, the students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-493.1	Understanding the basics of vector mathematics and principles of Electromagnetic waves	Understand	Understand
EC-493.2	Evaluating the concepts of uniform plane waves and application in boundaries and media interfaces	Evaluate and application	Evaluate
EC-493.3	Realization of equivalent circuit model of transmission line sections	Realize	Analyze
EC-493.4	Calculate reflection and transmission of waves at media interface	Derive	Analyze
EC-493.5	Characterizing of wave propagation on metallic waveguides in modal form	Characterize	Apply
EC-493.6	Understand principle of radiation and radiation characteristics of an antenna	Analyze	Understand

7. **Mapping of Course Outcomes (CO) to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	2	2	3	2	1	-
2	2	2	-	-	-	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	1	1	0	1	2	1	2
CO2	3	3	3	3	1	1	1	0	1	2	1	2
CO3	3	3	3	2	1	1	1	0	1	2	1	2
CO4	3	3	3	3	2	1	1	0	1	2	1	2
CO5	3	3	3	3	2	1	1	0	1	2	1	2
CO6	3	3	3	3	2	1	1	0	1	2	1	2
Average	**3**	3	**3**	**2.83**	**1.5**	**1**	**1**	**0**	**1**	**2**	**1**	**2**

9. Mapping to Program Specific Outcome (PSO)

COs	PSO1	PSO2	PSO3
CO1	2	3	-
CO2	2	3	-
CO3	2	3	-
CO4	2	3	-
CO5	2	3	-
CO6	2	3	-

***** End of Syllabus*****

DR. B.C. ROY SOCIETY ENGINEERING
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Course Name: Digital System Design Laboratory
Course Code: EC-494
Course Type: PC
(Semester – IV)
Category: Course Broad Category: (Major)

……

1. **Course Prerequisite:**
   Fundamental Concept on Basic Electronics, Digital electronic circuit design, Mathematics.
2. **Course Learning Objectives:**
   i. Expose Students to experimental skill on design and test the Digital Circuits using Various Modeling Techniques available in Verilog HDL.
   ii. To gain practical knowledge on Finite State Machine through experimental method for digital system design.
   iii. To apply the analytical techniques and graphical analysis to the experimental data
3. **Teaching methodology and evaluation system for the course:**

Teaching methodology: Instruction: This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

Evaluation System –

A. **Internal Assessment (60 Marks)-** Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]
B. **End-Semester Exam (40 Marks)-** Summative Assessment.

4. **Course Content:**
   Course Name: DIGITAL SYSTEM DESIGN LAB
   Course Code: EC- 494
   Hours per Week: 0L: 0T: 2P
   Credits: 1

Module	Topic	
1.	**Gate Level Modeling:** 1. Write verilog code for a given AOI/OAI combinational Circuit using gate-level Modeling, simulate, synthesize and implement on target FPGA. 2. Write verilog code for Binary-to-Grey and Grey-to-Binary Converter using gate-level Modeling, simulate, synthesize and implement on target FPGA.	2P
2.	**Dataflow Modeling:** 1. Write verilog code for Full-Adder circuit using data-flow modeling, simulate, synthesize and implement on target FPGA. 2. Write verilog code for 4:1-Multiplexer using data-flow Modeling, simulate, synthesize and implement on target FPGA. 3. Write verilog code for magnitude comparator using data-flow Modeling, simulate, synthesize and implement on target FPGA. 4. Write verilog code for unsigned multiplier using data-flow Modeling, simulate, synthesize and implement on target FPGA.	4P
3.	**Behavioral Modeling:** 1. Write verilog code for 4-bit Adder/Subtractor with mode control using behavioral Modeling, simulate, synthesize and implement on target FPGA. 2. Write verilog code for D-f/f and T-f/f using behavioral Modeling, simulate, synthesize and implement on target FPGA. 3. Write verilog code for 4-bit up/down counter using behavioral Modeling, simulate, synthesize and implement on target FPGA.	3P

4.	**Structural Modeling:** 1. Write verilog code for Ripple Carry Adder Using structural-Modeling, simulate, synthesize and implement on target FPGA. 2. Write verilog code for Barrel Shifter using structural-Modeling, simulate, synthesize and implement on target FPGA.	2P
5.	**Finite State Machines (FSM):** 1. Write verilog code for sequence detector using FSM, simulate, synthesize and implement on target FPGA. 2. Write verilog code for Arbiter using FSM, simulate, synthesize and implement on target FPGA.	2P
6.	**Static Timing Analysis (STA):** **1.** Analysis of timing violations of a practical digital system using suitable EDA tool.	1P

5. References:

Text Books:

- T.R Padmanabhan and B. B. Tripura Sundari - Design through Verilog HDL – Wiley Publishers.
- Michael D. Ciletti – Advance Digital System Design with Verilog HDL – Pearson Publishers.

Reference Books:

- Samir Palnitkar - Verilog HDL: A Guide to Digital Design & Synthesis – Pearson Publishers.
- S. Brown & Z. Vransic - Fundamentals of Digital Logic with Verilog Design – McGraw Hill Publishers.

6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC494.1	Explain and experiment with the Gate Level Model of Digital Circuits using Verilog-HDL	Explain, Experiment with	Understand, Apply, Evaluate
EC494.2	Explain and experiment with the dataflow Model of Digital Circuits using Verilog-HDL	Explain, Experiment with	Understand, Apply, Evaluate
EC494.3	Explain and experiment with the behavioral Model of Digital Circuits using Verilog-HDL	Explain, Experiment with	Understand, Apply, Evaluate
EC494.4	Explain and experiment with the structural Model of Digital Circuits using Verilog-HDL	Explain, Experiment with	Understand, Apply, Evaluate
EC494.5	Develop Synthesizable RTLs to model Finite State Machine (FSM) using Verilog HDL and test for verification.	Develop, test for	Create, Analyze
EC494.6	Examine Timing Reports to Check for STA Violations in Digital Systems.	Examine	Analyze

7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	3	-	-	-
7	-	-	-	-	-	3

8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	-	1	-	-	1	2	2
CO2	2	3	2	3	3	-	1	-	-	1	2	2
CO3	2	3	2	3	3	-	1	-	-	1	2	2
CO4	2	3	2	3	3	-	1	-	-	1	2	2
CO5	2	3	2	3	3	-	1	-	-	1	2	2
CO6	2	3	2	3	3	-	1	-	-	1	2	2

9. Mapping of Course Outcomes (CO) to Program Specific Outcome (PSO)

COs	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
CO6	3	3	1

***** End of Syllabus*****

Course Name: Numerical Methods Laboratory
Course Code: EC-495
Course Type: ES
(Semester IV)
Course Broad Category: (Skill Enhancement)

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1. **Course Prerequisite:**
   Theoretical concepts of Numerical Methods
   Programming knowledge learned in B.Tech
2. **Course Learning Objectives:**
   i. Expose students to various experimental skills and tools
   ii. To gain practical knowledge by applying experimental methods to correlate with the theory. Apply the analytical techniques and numerical analysis to the experimental data.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.
   Evaluation System –

A. Internal Assessment (60 Marks)- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. End-Semester Exam (40 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Numerical Methods Lab
   Course Code: EC- 495
   Hours per Week: 0L: 0T:2P
   Credits: 1

Module	Topics	
1	Write down and execute the following programs using **C++/ Python**. **Interpolation:** Newton forward/backward interpolation, Lagrange's Interpolation. **Numerical integration:** Trapezoidal rule, Simpson's 1/3 rule. **Numerical solution of a system of linear equations:** Gauss elimination method, Matrix inversion, Gauss-Seidel iterative method. **Numerical solution of algebraic and transcendental equation:** Bisection method, Regula-Falsi method, Newton-Raphson method. **Numerical solution of ordinary differential equation:** Euler's method, Runge-Kutta methods (IVth order).	24P
2	**Introduction to software packages:** Matlab, Mathematica, Scilab, Lab view.	8P

5. **References:**

Text Books:

- S.S. Sastry: Numerical Methods, PHI Learning Pvt. Ltd.
- N. Krishna Raju and K. U. Muthu: Numerical Analysis and Computational Procedures, New Age International Publishers.
- Gowrishankar S. and Veena A: Introduction to Python Programming,CRC Press.
- E. Balagurusamy: Problem Solving and Python Programming, McGraw Hill Education. Analysis, Universities Press.

Reference Books:

- E. Balagurusamy: Numerical Methods, McGraw Hill Education.

- Sheetal Taneja and Naveen Kumar: Python Programming: A Modular Approach, Pearson Education.
- T. Veerarajan and T. Ramachandran: Numerical Methods with Programming in C, McGraw Hill Education.
- P. B. Patil and U. P. Verma: Numerical Methods and Computational Techniques using C, Narosa Publishing House.
- R.S. Salaria: Numerical Methods using C and C++, Khanna Book Publishing Co.
- N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC- 495.1	Ability to understand numerical computation, Interpolation and Numerical integration.	Identify	Remember
EC- 495.2	Ability to solve system of linear equations and Algebraic equations.	Explain	Understand
EC- 495.3	Ability to find Numerical solution of ordinary differential equations.	Implement	Apply
EC- 495.4	Ability to apply numerical methods to solve problems in science, engineering, and mathematics.	Organize	Analyze
EC- 495.5	Ability to compare and contrast different numerical methods and choose appropriate methods based on the problem at hand.	Assess	Evaluate
EC- 495.6	Ability to use programming languages such as MATLAB, Mathematica to implement numerical methods and solve problems numerically.	Construct	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	3	3	3	3	1
2	2	2	2	2	2	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	-	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	-	1
CO3	1	2	2	1	1	-	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO):

	PSO1	PSO2	PSO3
CO1	3	3	
CO2	3	3	
CO3	3		
CO4	3		
CO5	3		
CO6	3		

***** End of Syllabus *****