(An Autonomous Institution)

SCHEME OF TEACHING AND EXAMINATION (Effective from 2020 – 2021 Batch)

B Tech (Fifth Semester, Electrical Engineering)

Sl. No.	Board of Studies (BOS)	Course Code	Courses	Period per Week			Scheme of Examination			Total Marks	Credit
				L	T	P	Theory/Lab				
							ESE	CT	TA		
1.	Electrical Engineering	**EE104501**	Control System Engineering	2	1	-	100	20	30	150	3
2.	Electrical Engineering	**EE104502**	Signal and Systems	2	1	-	100	20	30	150	3
3.	Electrical Engineering	**EE104503**	Power System-II	3	-	-	100	20	30	150	3
4.	Electrical Engineering	**EE104504**	Analog Electronics Circuits-II	3	-	-	100	20	30	150	3
5.	Electrical Engineering	**Refer Table-1**	**Professional Elective-I**	3	-	-	100	20	30	150	3
6.	Electrical Engineering	**EE104591**	Control System Engineering Lab	-		2	25	-	25	50	1
7.	Electrical Engineering	**EE104592**	Analog Electronics Circuits-II Lab	-		2	25	-	25	50	1
8.	Electrical Engineering	**EE104593**	Power System -II Lab	-		2	25	-	25	50	1
9.	Electrical Engineering	**EE104594**	Minor Project-1	-		2	25	-	25	50	1
10.	Electrical Engineering	**EE104595**	Practical Training/Internship (Report Writing and Seminar)	-	-	2	-	-	25	25	1
11	Electrical Engineering	**EE100596**	Constitution of India						25	25	-
	Total			**13**	**2**	**10**	**600**	**100**	**300**	**1000**	**20**

Table-I Professional Elective-I

S.N	Board of Studies (BOS)	Subject Code	Program Elective-I
1	Electrical Engineering	**EE104521**	Analog and Digital Communication
2	Electrical Engineering	**EE104522**	**Microprocessor and Microcontroller**
3	Electrical Engineering	**EE104523**	Electrical Machine Design
4	Electrical Engineering	**EE104524**	Computer Organization and Architecture
5	Electrical Engineering	**EE104525**	Distributed Generation

L-Lecture **T-Tutorial** **P-Practical**
CT-Class Test **TA-Teachers Assessment** **ESE-End Semester Exam**

		July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairman (AC)	Chairman (BoS)	Date of Release	Version	

Subject Code	EE104501	L=2	T=1	P=0	Credits=3
Subject	**Control System Engineering**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**100**	**20**	**30**	**150**	**3 Hours**

COURSE OBJECTIVES	COURSE OUTCOMES
1. Identify the basic elements and structures of feedback control systems 2. Apply final value theorem to determine the steady state response of stable control system. 3. Use root locus method for design of feedback control systems. 4. Construct Bode, Polar and Nyquist plots for rational transfer function. 5. Understand the fundamentals of modern control theory.	At the end of the course, the students can: **CO1:** Ability to acquire and apply fundamental principles of science and technology. **CO2:** Analyze continuous systems mathematically through the use of Laplace functions and state equations form. **CO3:** Represent any physical system in both transfer functions and state equations form. **CO4:** Apply classical design methods to improve the performance of continuous controlled system.

UNIT-I **CO1**

Mathematical Model of Physical Systems: Concepts of Control Systems, Industrial Control Examples, Open Loop and closed Control Systems and their Differences, Classification of Control Systems, Transfer Function, Block Diagram Algebra, Signal Flow Graphs. Feedback Characteristics of Control Systems, Mathematical Models –Differential Equations– Translational and Rotational Mechanical Systems, Control System Components: DC Servo Motor, AC Servomotor, Tachometer, Synchro As A Error Detector. **[8 Hrs]**

UNIT-II **CO2**

Time Response Analysis: Standard Text Signals, Time Response of First And Second Order System, Steady State Error and Error Constants, Effect of Adding Poles and Zeroes to a System,. Design Specifications of Second Order System, Stability Concept, Routh- Hurwitz Stability Criteria, Types 0f Stability, Root-Locus Technique. Construction of Root-Loci. **[8Hrs]**

Unit- III **CO3**

Frequency-Response Analysis:, Relationship Between Time and Frequency Response, Bode Plots. Polar Plots, Nyquist Stability Criterion, Nyquist Plots, Concept of Gain Margin and Phase Margin.

[6Hrs]

Unit – IV **CO4**

Basics on Controllers and Compensators: Introduction, Types of Basic Compensators and Controllers, Application of Proportional, Integral and Derivative Controllers, Basic Control Actions and Effects of Integral and Derivative Control Actions on System Performance, Applications, Advantages and Disadvantages of Controllers, Compensator Design: (Cascade Lag, Cascade Lead,) using Bode Plots. **[8 Hrs]**

Unit -V **CO5**

Sate Variable Analysis And Design: Concept of States, State Variables and State Model. State Model for Linear Continuous Time Systems (Electrical), Eigen Values, Determination of Transfer Function from State Matrices, Solution of State Equations, Concept of Controllability And Observability.

[6Hrs]

Text Books:

S. No.	Title	Authors	Publisher
1	Control System Engineering	L. Nagrath and Gopal	New Age International Publications
2	Control System Engineering	S K Bhattacharya	Pearson Publications
3	Modern Control Engineering,	Katsuhiko Ogata	Pearson Publications

Reference Books:

S. No.	Title	Authors	Publisher
1	Automatic Control System	B.C. Kuo	PHI Publications
2	Modern Control Engineering	Roy Choudhury	PHI Publications
3	Introduction to Control Engineering	Ajit K. Mandal	New Age International Publications

Subject Code	EE104502	L = 2	T = 1	P = 0	Credits = 3
Subject	Signals and Systems	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

COURSE OBJECTIVES	COURSE OUTCOMES
1. To understand the characteristics of signals and systems. 2. To get transforms of various signals. 3. To apply various mathematical expressions on the signals.	On completion of this course, the students: **CO1:** have the knowledge of various signals and systems. **CO2:** knows the properties of various transforms. **CO3:** can design various systems to get desire output.

UNIT I : Classification of Signals **CO1,3**

Continues and discrete time systems, Representation of Discrete time signals, Elementary signals: unit step, unit ramp, unit parabolic, unit impulse, Basic operation on signals, Types of signals: Deterministic and random signals, periodic and non periodic signals, energy and power signals, causal and non causal signals, even and odd signals **[8Hrs]**

UNIT II : Classification Systems **CO1,3**

Lumped and distributed parameter systems, static and dynamic systems, causal and non causal systems, linear and non linear systems, time invariant and time variant systems, stable and unstable system. **[8Hrs]**

UNIT III : Fourier Series and Fourier Transform CO2

Determination of Fourier series representation of continuous time periodic signals -Explanation of properties of continuous time Fourier series, Continuous time Fourier Transform analysis with examples - properties of the Continuous time Fourier Transform basic properties, convolution in time and frequency domains. **[6Hrs]**

UNIT IV : Z Transforms **CO2**

Definition, region of convergence, properties of ROC, Properties of z-transform, Poles and Zeros, inverse z-transform Residue Theorem, Power Series expansion and Partial fraction expansion, Computation of Impulse response and Transfer function using Z Transform. **[8Hrs]**

UNIT V: Convolution and Correlation of Signals **CO2,3**

Concepts of convolution, Properties of Convolution: Commutative Law, Associative Law, Distributive Law, Convolution Sum, Convolution theorem, Linear Convolution, Circular Convolution, Linear Convolution using Circular Convolution, Graphical method, Correlation: Autocorrelation, Cross Correlation. **[6Hrs]**

Text Books:

S. No.	Title	Author	Publisher
1.	Signals and Systems	A. Anand Kumar	PHI Learning Private Limited
2.	Signals and Systems	I. J. Nagrath	Tata Mc-Graw Hill

Reference Books:

S. No.	Title	Author	Publisher
1.	Linear Systems and Signals	B. P. Lathi	Oxford University Press
2.	Digital Signal Processing	Salivahanan	Tata Mc-Graw Hill

Subject Code	EE104503	L = 3	T = 0	P = 2	Credits = 3
Subject	Power System-II	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

COURSE OBJECTIVES	COURSE OUTCOMES
1. To give a broad coverage on all types of protective relays and provide a strong background for working in a practical power system protection. 2. To understand and implement the protection of alternators, transformer and feeders. 3. To explain the working principle, applications of circuit breakers.	**Students will be able to:-** **CO1:** Explain the purposes of protection, in relation to major types of apparatus, protection principle, dangers and criteria. **CO2:** Choose and justify a suitable protection system for a specified application. **CO3:** Analyze and compare specified protection systems **CO4:** Illustrate the function of various CBs and related switching issues. .

UNIT I: Symmetrical Faults: **CO1,2**

Single line diagram, per unit quantities, per unit impedance of three phase transformer, expression for three phase power in p.u. impedance diagram and reactance diagram of power system, computation of voltage and current at various locations of power system using reactance diagram, Three phase short circuit on power system, Calculation of different current ratings and interrupting capacity of circuit breaker. **[8Hrs]**

UNIT II: Symmetrical Components: **CO1,2**

Expression for positive, negative & zero sequence components, existence of sequence components of current & voltages for three phase circuit, expression for three phase power in terms of symmetrical components, sequence networks of unloaded three phase alternator, three phase transmission line and three phase transformers, development of sequence networks of power system. **[6Hrs]**

UNIT III: Unsymmetrical Faults: **CO1,3,4**

Single line to ground fault, line to line fault, double line to ground fault on unloaded generator, unsymmetrical faults through impedance on unloaded generator, unsymmetrical faults on power system, open conductor faults. **[8Hrs]**

UNIT IV: Economic Operation of Power Systems: : **CO1,3**

Input output curves , criteria for economical distribution of power between generating units in a plant, Expression for transmission line loss in terms of loss formula coefficients, criteria for economical distribution of power between generating plants. **[8Hrs]**

UNIT V: Power System Stability: **CO1,2**

The stability problem, steady-state stability, transient stability, swing equations of a synchronous machine connected to an infinite bus, power angle curve, steady-state stability criterion, equal area criterion of stability, application of equal area criterion, critical clearing angle. **[6Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Elements of power system analysis	W.D. Stevenson	Mc Graw Hill
2.	Power System Engg.	I.J. Nagrath & Kothari	Tata McGraw Hill

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	Electrical Power System	Ashfaq Hussain	CBS Pub. & Dist.
2.	Power System Engineering	A. Chakraborti, M.L. Soni, P.V. Gupta and Bhatnagar	DhanpatRai and Co. (P) Ltd.

Subject Code	EE104504	L = 3	T = 0	P = 0	Credits = 3
Subject	Analog ElectronicCircuits-II	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

COURSE OBJECTIVES	COURSE OUTCOMES
1. To introduce the basic building blocks of linear integrated circuits. 2. To teach the linear and non-linear applications of operational amplifiers. 3. To introduce the theory and applications of timer, analog multipliers, voltage regulators and PLL. 4. To understand the operation of ADC and DAC. 5. To introduce special integrated circuits.	On completion of this course, the students will be able to: **CO1:** understand the working of various integrated circuits. **CO2:** to design various circuits using operational amplifiers and other ICs for various applications.

UNIT I : Characteristics of Op Amp: **CO1,2**

OPAMP Symbol and terminal characteristics, Block Schematic of OPAMP, Basics of Differential Amplifier, Ideal and Practical OPAMP Characteristics, Open Loop and Closed Loop Configuration of OPAMP, Input & Output impedance of closed loop OPAMP, Input Bias and Offset Currents, Input Offset Voltage, Inverting Amplifier, Non-Inverting Amplifier differential amplifier; frequency response of OP-AMP. **[8Hrs]**

UNIT II : Linear Applications of Op Amp: **CO1,2**

Voltage Follower, Summer, Differentiator and Integrator ,Voltage Comparators , Zero Crossing Detector, Level Detector, Window Detector, Peak Detector, Precision Half Wave Rectifier, Precision Full Wave Rectifier, Instrumentation amplifier, Current to Voltage and Voltage to Current Converter, Differentiator, Integrator, Logarithmic Amplifier, Norton Amplifier. **[8Hrs]**

UNIT III : NON-Linear Applications of Op Amp: **CO1,2**

Applications of Op Amp-II: S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types, First and second order active filters, Phase Shifter, Oscillators-Waveform generator (Square, Triangular, Saw-tooth) ,Schmitt trigger, Multivibrator. **[8Hrs]**

UNIT IV : Special ICs: **CO1,2**

IC 555 Timer circuit: Functional block, characteristics & applications as Monostable and Astable Multivibrator; 566-voltage controlled oscillator circuit; 565-phase lock loop circuit functioning and applications. **[6Hrs]**

UNIT V:Application of ICs: **CO1,2**

Analog multiplier ICs.

Voltage regulator: Characteristics, Regulator Performance parameters, Types of Voltage regulator ,Three Terminal IC Regulator (LM 317, LM 337, 78XX, 79XX), [Description, Schematic Diagram and Pin Diagram], General Purpose IC Regulator (723): Important features and Internal Structure. **[6Hrs]**

Text Books:

S. No.	Title	Author	Publisher
1.	Integrated Electronics Analog and Digital Circuits Systems	J. Milliman, C. Halkias and C. D. Parikh	McGraw Hill Education (India)Private Limited.
2.	Integrated Circuits	K. R. Botkar	Khanna Publication

Reference Books:

S. No.	Title	Author	Publisher
1.	Operational Amplifiers	R. Gayekwad	Pearson Education
2.	Operational Amplifiers and Linear Integrated Circuits	J Lal Kishore	Prentice Hall of India

Subject Code	EE104522	L = 3	T = 0	P = 0	Credits = 3
Subject	Microprocessor & Microcontrollers	CT	TA	Total	ESE Duration
Evaluation Scheme	100	20	30	150	3 Hrs

COURSE OBJECTIVES	COURSE OUTCOMES
● To provide knowledge about the fundamentals of Microprocessors & Microcontroller and their evolution internal architecture and construction. ● To provide the knowledge of various supporting chips provided with the Microprocessor 8085 and Microcontroller 8051. ● To give the knowledge of various instructions, basic programming with Microprocessors 8085 and Microcontroller 8051.	On completion of this course, the students will ➢ Understand the basic architecture of Microprocessor and Microcontroller. ➢ Understand various instructions and their application in programming. ➢ Understand the working of microprocessor and microcontroller.

UNIT I Microprocessor 8085: Fundamentals of Microprocessor, Architecture of 8085, Pin Configuration and their Function, Address Bus, Data Bus, Interrupt Signals, DMA Signals, internal registers & flag register, Arithmetic and Logical Unit, Memory Stack organization, Generation of Control Signals, De-Multiplexing of Address / Data bus.	**CO1,2,3[8Hrs]**
UNIT II Instruction Set and Programming with 8085: Instruction for Data Transfer, Arithmetic Operation, Logical Operations, Branching Operations, Stacks, Subroutine and Related Instructions. Addressing Modes: Immediate Addressing, Register Addressing, Direct Addressing, Indirect Addressing, Inherent/Implicit/Implied Addressing. Instructions Format, Simple Programs using Instruction Set of 8085.	**CO1,2,3[6 Hrs]**
UNIT III Microprocessor 8086: Introduction to processors of Intel 8086 family , Registers and flags, Internal Architecture , Pipelining, Instruction Set, Addressing modes, Data Transfer Instruction, Arithmetic Instructions, Branching and Looping Instructions, NOP and Halt, Flag Manipulation Instructions, Logical, Shift and Rotate Instruction, Byte and String Manipulation: String Instructions REP Prefix, Assembler Directives.	**CO1,2,3[6 Hrs]**
UNIT IV The 8051 Architecture: Pin Diagram of 8051, Block Diagram of 8051,Registers of 8051, Inbuilt RAM, Register Banks, Stack, On-Chip and External Program Code Memory ROM, Power Reset and Clocking Circuits, I/O Port Structure, Classification of MCS-51 Family Based on Their Features (8051, 8052, 8031, 8751, AT89C51)	**CO1,2,3[8 Hrs]**
UNIT V Instruction Set and Programming of 8051: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Simple Assembly language programs.	**CO 1,2,3[8 Hrs]**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Microprocessor Architecture, Programming and Application	R. S. Gaonkar	Wiley Eastern
2.	Digital Systems – From Gates to Microprocessors	Sanjay K. Bose	New Age International Publishers.

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	8085 Microprocessor Programming & Interfacing	N.K. Srinath	PHI
2.	0000 to 8085: Introduction to Microprocessor for Engineers and Scientists	Ghosh & Sridhar	PHI

Subject Code	EE104591	L=0	T=0	P=2	Credits=1
Subject	**Control System Engineering Lab**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**25**	**-**	**25**	**50**	**3 Hours**

COURSE OBJECTIVES	COURSE OUTCOMES
6. Identify the basic elements and structures of feedback control systems 7. Apply final value theorem to determine the steady state response of stable control system. 8. Use root locus method for design of feedback control systems. 9. Construct Bode, Polar and Nyquist plots for rational transfer function. 10. Understand the fundamentals of modern control theory.	At the end of the course, the students can: **CO1:** Ability to acquire and apply fundamental principles of science and technology. **CO2:** Analyze continuous systems mathematically through the use of Laplace functions and state equations form. **CO3:** Represent any physical system in both transfer functions and state equations form. **CO4:** Apply classical design methods to improve the performance of continuous controlled system.

List of Experiments

1. To determine the Gain of an Open Loop and Closed Loop System.
2. To Study the Effect of Disturbance on an Open loop and Closed Loop System.
3. Simulation of Transfer Function using OP-AMP (Analog Computer Trainer)
4. To Determine the Transfer function of a DC Servomotor.
5. To determine Transfer Function of an AC Servomotor.
6. To plot characteristics of Synchro- Transmitter and Receiver Pair.
7. To Plot characteristics of a Potentiometer as an Error Detector.
8. Study of a basic electrically controlled hydraulic system.
9. Study of a basic electrically controlled pneumatic system
10. To Study the time response of a first and second order system.
11. To determine the effect of P, PI controller on second order system.
12. To determine the effect of PID controller on second order system.
13. To determine TF using bode plot (type-0, type-I).
14. To design he Lag Compensator.
15. To Design he Lead Compensator.

List of Equipment Required in the Lab.

S.No.	Equipment/Machines/Instruments Required
1.	An open and closed loop system with two input signals (one acting as reference and the other as the disturbance signal).
2.	A R-L or R-C Circuit, Bread board, CRO, Multi-meters, Function Generator.
3.	Synchro Transmitter-receiver Pair.
4.	An AC Servomotor.
5.	A Potentiometer.
6.	Bode Plot Analyzer.
7.	Linear Variable Differential Transformer.
8.	P, PI, PID Controller trainer.
9.	Stepper Motor.
10.	Lag Compensator, Lead Compensator.

Subject Code	EE104592	L=0	T=0	P=2	Credits=1
Subject	**Analog Electronics Circuits-II Lab**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**25**	**-**	**25**	**50**	**3 Hours**

COURSE OBJECTIVES	COURSE OUTCOMES
1. To introduce the basic building blocks of linear integrated circuits. 2. To teach the linear and non-linear applications of operational amplifiers. 3. To introduce the theory and applications of timer, analog multipliers, voltage regulators and PLL. 4. To understand the operation of ADC and DAC. 5. To introduce special integrated circuits.	On completion of this course, the students will be able to: **CO1:** understand the working of various integrated circuits. **CO2:** to design various circuits using operational amplifiers and other ICs for various applications.

List of Experiments

1. To design an inverting amplifier using OPAMP (741) and find output waveform.
2. To design a non-inverting amplifier using OPAMP (741) and find output waveform.
3. To design voltage follower circuit using OPAMP (741) and calculate voltage gain.
4. To design differentiator circuit using OPAMP (741) and find output waveform.
5. To design integrator circuit using OPAMP (741) and find output waveform.
6. To design half wave rectifier using OPAMP (741) and find output waveform.
7. To design full wave rectifier using OPAMP (741) and find output waveform.
8. To study R-2R ladder digital to analog converter.
9. To study successive approximation analog to digital converter.
10. To design a comparator circuit using OPAMP (741) and find output waveform.
11. To design an astable multivirator using 555 timer
12. To design a monostable multivibrator using 555 timer.
13. To study a 566 voltage controlled oscillator and find output waveform.
14. To study the voltage regulation of 78XX series of voltage regulators.
15. To study general purpose regulator 723 IC.

List of Equipment Required in the Lab.

S.No.	Equipment/Machines/Instruments Required
1.	Circuit components
2.	Power supply
3.	CRO
4.	Function generator
5.	Multimeter
6.	Breadboard

Text Books:

S. No.	Title	Author	Publisher
1.	Integrated Electronics Analog and Digital Circuits Systems	J. Milliman, C. Halkias and C. D. Parikh	Second Edition, McGraw Hill Education (India) Private Limited, 2018.
2.	Integrated Circuits	K. R. Botkar	Khanna Publication
3.	Operational Amplifiers	R. Gayekwad	Pearson Education
4.	Operational Amplifiers and Linear Integrated Circuits	J Lal Kishore	Prentice Hall of India

Subject Code	EE104593	L=0	T=0	P=2	Credits=1
Subject	**Power System- II Lab**	**CT**	**TA**	**Total**	**ESE Duration**
Evaluation Scheme	**25**	**-**	**25**	**50**	**3 Hours**

COURSE OBJECTIVES	COURSE OUTCOMES
4. To give a broad coverage on all types of protective relays and provide a strong background for working in a practical power system protection. 5. To understand and implement the protection of alternators, transformer and feeders. 6. To explain the working principle, applications of circuit breakers.	On successful completion of the Course, the student will be able to: **CO1:** Analyze different types of short-circuit faults which occur in power systems **CO2:** Perform load flow computations and analyze the load flow results **CO3:** Analyze a power system network under Symmetrical Conditions. **CO4:** Analyze the power system stability analysis.

List of Experiments

1. To determine phase sequence of supply by static method.
2. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator
3. To study the effect of load angle on stability of synchronous machine.
4. To determine zero sequence reactance of three phase alternator.
5. To determine positive & negative sequence reactance of three phase alternator.
6. To determine fault current in case of single line to ground fault on power system.
7. Single line to ground fault analysis in case of unloaded generator.
8. Line to line fault analysis in case of unloaded generator.
9. Computer simulation of balanced & unbalanced fault on alternator
10. To determine the bus impedance matrix for the given power system network.
11. Load Flow Analysis using Gauss Siedel Method & NR Method for Both PQ and PV Buses.
12. Formation of Jacobian for a System not Exceeding 4 Buses (No PV Buses) in Polar Coordinates.