Annasaheb Dange College of Engineering and Technology, Ashta

An Autonomous Institute

Department of Electrical Engineering
Curriculum Structure

B. Tech.

SEMESTER V - VI

Curriculum

Third Year B.Tech - Semester – V

Annasaheb Dange College of Engineering and Technology, Ashta

Department of Electrical Engineering

Teaching and Evaluation Scheme

T. Y. B. Tech, Semester V

Course Code	Course Name	Teaching Scheme				THEORY							PRACTICAL						GRAND TOTAL
						ISE		MSE+ ESE			Total	Min	ISE		ESE		Total	Min	
		L	T	P	Credits	Max	Min	MSE	ESE	Min			Max	Min	Max	Min			
2EEPC301	Feedback Control Systems	3	1	2	5	40	16	30	30	24	100	40	50	20	50	20	100	40	200
2EEPC302	AC Machines	3	0	2	4	40	16	30	30	24	100	40	50	20	50	20	100	40	200
2EEPC303	Power System Analysis	3	0	2	4	40	16	30	30	24	100	40	50	20	-	-	50	20	150
2ILOEXXX	Open Elective - I	3	0	0	3	100	40	-	-	-	100	40	-	-	-	-	-	-	100
2EE**3##	Minor Course - II^	3	0	0	3	40	16	30	30	24	100	40	-	-	-	-	-	-	100
2EEHS306	Entrepreneurship	0	0	2	1	-	-	-	-	-	-	-	25	-	-	-	25	10	25
2EEVS307	CAD for Electrical Machine Design	0	0	2	1	-	-	-	-	-	-	-	50		-	-	50	20	50
2EEEL308	Industrial Training / Internship*	0	0	0	1	-	-	-	-	-	-	-	50		-	-	50	20	50
2EECC309	Aptitude and Reasoning Part - III	0	0	2	1	-	-	-	-	-	-	-	50		-	-	50	20	50
Total		**15**	**1**	**12**	**23**														**925**
Total Contact Hours		**28**																	

^	Minor courses project work continuously assessed from Semester V. The final submission will be at VIII semester
*	Assessment of Industrial Training / Internship to be completed at the beginning of Semester V

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Department of Electrical Engineering

Class			T.Y. B. Tech. Semester - V
Course Code and Course Title			**2EEPC301, Feedback Control Systems**
Prerequisite/s			2EEBS201, 2EEPC209
Teaching Scheme: Lecture/Tutorial/Practical			03/01/02
Credits			05
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to,	
2EEPC301_1	**Determine** the transfer function using block diagram reduction and signal flow graph.
2EEPC301_2	**Analyze** the mathematical model of electrical and mechanical systems.
2EEPC301_3	**Compute** the transient and steady state response parameters of systems.
2EEPC301_4	**Analyze** the stability of system in time & frequency domain.
2EEPC301_5	**Analyze** the control system using state space representation.
2EEPC301_6	**Implement** controllers for simple control systems.

Unit	Course contents	Hours
1	**Introduction to Control System and Mathematical Modeling** Introduction, types of systems, feedback control system, Mathematical modeling of electrical, mechanical systems, force voltage and force current analogy, Determination of the transfer function using block diagram reduction and signal flow graph, components of control systems and its transfer function, pole zero concept.	7
2	**Time Domain Analysis and Stability** Time response of first order systems, second order systems, analysis of steady state error, static error constants and type of system, time response specifications, concept of stability, Routh-Hurwitz criteria for stability.	6
3	**Root Locus Technique** Definition of root locus, rules for plotting root loci, root contour, stability analysis using root locus, effect of addition of pole and zero on root locus.	6
4	**Frequency Response Analysis of Control system** Introduction to frequency response, frequency domain performance specifications, stability analysis of system using bode plots, polar plot, nyquist plot, co-relation between time domain and frequency domain.	7
5	**State Space Representation** Introduction to State space, phase variable form, canonical form, conversion of transfer function to state space and vice versa, state transition matrix and its significance, Eigen values, Eigen vectors, solution of state equations, controllability and observability.	7
6	**PID Controller** Introduction to P, PI, PID controller, Ziegler and Nicholas rules for controller tunning, PID controller applications: Temperature control system, motion control system, level control system.	6

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List of experiments

Expt. No.	Title of Experiment
1	Generation & plotting of standard test signals.
2	Determine the transfer function using block diagram reduction.
3	Determine transient and steady state response specifications of system.
4	Determine the stability of control system using Root locus and analyze the effect of addition of poles and zeros on the performance of system
5	Determine the stability of control system using frequency domain analysis.
6	Conversion of transfer function to state space and vice- versa.
7	Determine the controllability and observability of given system.
8	Speed control of DC motor using PID controller.
9	Analysis of DC position control system.
10	Analysis of temperature control system

All experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Control System Engineering	Norman Nise	Wiley Publication	Seventh	2014
02	Control System Engineering	I.J. Nagrath M. Gopal	New Age International Publication	Fifth	2020
03	Modern Control Engineering	Ogata	Prentice Hall	Fifth	2010
04	Feedback Control Systems	U. A. Bakshi & S. C. Goyal	Technical Publications	Second	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Automatic Control System	Kuo & Golnaraghi	Wiley	Ninth	2014
02	Control Systems: Theory and Applications	Smarajit Ghosh	Pearson Education	Second	2012
03	Control Systems	N. C. Jagan	B. S. Publications	Third	2015
04	Feedback Control Systems	C.L. Phillips, R.D. Harbor	Prentice Hall	Fifth	2011

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Department of Electrical Engineering

Class			T.Y. B. Tech. Semester - V
Course Code and Course Title			**2EEPC302, AC Machines**
Prerequisite/s			2EEES102, 2EEPC210
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEPC302_1	**Explain** the constructional details and working principle of AC machines
2EEPC302_2	**Describe** the effects of system parameters during steady state and dynamic conditions
2EEPC302_3	**Solve** numerical problems to determine the essential parameters of machines at steady state and dynamic conditions
2EEPC302_4	**Analyze** the performance of a AC machine by using appropriate testing methods
2EEPC302_5	**Select** the suitable types of speed control methods and starting methods for rotating machines

Unit	Course Contents	Hours
1	**Three Phase Induction Motor** Principle of operation, Construction details, Torque-Slip Characteristics, Necessity of starters, types of starters (DOL, star-delta, rotor resistance starter), Speed control methods from stator side (Stator voltage control, Stator frequency control) & rotor side (rotor resistance control), V/f method, Braking Methods, Applications	7
2	**Testing & Performance of Induction Motor** Losses and Efficiency, Direct load test, No load & blocked rotor test, equivalent circuit of 3 phase induction motor, power flow diagram, Phasor diagram of 3 phase induction motor, performance of 3 phase induction motor using circle diagram, crawling & cogging, Induction motor as induction generator	7
3	**Three Phase Alternator** Principle of operation, Construction details, Emf equation, parameters of armature winding (Resistance & leakage reactance), armature reaction (at unity, lagging zero and leading zero power factor), concept of synchronous reactance and synchronous impedance. Equivalent circuit of 3 phase alternator, alternator on load (resistive, inductive & capacitive)	6
4	**Testing & Performance of Alternator** Direct load test, OC test & SC test on 3 Phase alternator, voltage regulation methods (EMF, MMF and direct loading method), Losses and efficiency, Necessity for parallel operation of alternators, conditions for parallel operation, synchronizing procedures, hunting and oscillation in alternators	7

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5	**Synchronous Motor** Principle of operation, Construction details, Starting methods of synchronous motors, Phasor Diagrams of three phase synchronous motor at Unity, lagging and leading power factor, Effect of Varying Field Current and Load, V & inverted V Curves, Operation of Synchronous motor as Synchronous Condenser, Hunting	**6**
6	**Single phase induction motors** Principle of operation, Construction details, Equivalent Circuit, Split phase induction motor, Capacitor start induction motor, Capacitor start capacitor run induction motor (two value capacitor method), shaded pole induction motor, universal motor	**6**

List of experiments

Expt. No	Title of the Experiment
1.	Speed control of 3 Ph. Squirrel Cage Induction Motor (SCIM) by using stator voltage control
2.	Speed control of 3 Ph. Slip Ring Induction Motor (SRIM) by using rotor resistance control.
3.	Determination of efficiency & speed regulation of 3 Phase SCIM by conducting No Load & Blocked Rotor Test.
4.	Determination of efficiency & speed regulation of 3 phase SCIM by direct loading method
5.	Determination of efficiency & speed regulation of 3 phase SCIM by indirect loading method
6.	Determination of efficiency & speed regulation of 1 phase induction motor by direct loading method.
7.	Determination of Voltage regulation of an alternator by EMF method.
8.	Determination of Voltage regulation of an alternator by MMF method.
9.	Determination of voltage regulation of Alternator by direct loading method
10.	Determination of V and Inverted V curves of a synchronous motor.
11.	Synchronization of three phase alternator
12.	Mini /Micro Project

Minimum **ten** experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Electric Machinery	Bimbhra P.S	Khanna Publisher	Seventh	2021
2	Electric machines	Ashfaq Husain	Dhanpatrai And Co.Publication	Third	2024
3	Electric Machinery	A.E Fitzgerald Stephen Kingsly	Tata Mcgraw Hill	Seventh	2014
4	Principles of Electrical Machines	V. K. Mehta	S. Chand	Second	2009

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Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Electric Machines	Kothari D.P Nagrath I.J	THM Publications	Fifth	2017
2	Generalized Machine Theory	Bhimra P.S	Khanna Publisher	Seventh	2021
3	Electric machines	M.V.Deshpande	PHI Publication	First	2011
4	Electric machines	Samarjit Ghosh	Pearson	Second	2012

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Annasaheb Dange College of Engineering and Technology, Ashta

An Autonomous Institute

Department of Electrical Engineering

Class			T.Y. B. Tech. Semester - V
Course Code and Course Title			**2EEPC303, Power System Analysis**
Prerequisite/s			2EEPC102, 2EEPC212
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE/ MSE / ESE**	40/30/30
	P	**ISE**	50

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEPC303_1	**Explain** the fundamentals of power systems analysis under steady state and fault conditions.
2EEPC303_2	**Model** power system components under steady state condition using per unit systems.
2EEPC303_3	**Draw** network diagram required for power system analysis using symmetrical Component theory.
2EEPC303_4	**Calculate** power system parameters under steady state conditions using power system analysis techniques
2EEPC303_5	**Analyze** expressions of system parameters under fault condition on transmission lines using Sequence network study.

Unit	Course Contents	Hours
1	**Performance of Transmission Lines** Introduction and classification of transmission lines, short, medium, long transmission lines, generalized constants of transmission lines, Ferranti effect, surge impedance & surge impedance loading, tuned power lines, complex power flow through a transmission line, Travelling wave equations, reflection & refraction coefficient	7
2	**Per unit Representation of Power system & its Components** Introduction, single phase representation of balanced 3 phase networks, single line diagram, impedance & reactance diagram, introduction of per unit system, P.U. representation of transformer, representation of generator, P.U. impedance diagram of power system, representation of loads	6
3	**Load flow analysis** Load flow analysis introduction and its importance, bus classifications, nodal admittance matrix (Y_{BUS}) formation, development of load flow equations, load flow solution using iterative techniques (Gauss Seidel, Newton Raphson method)	7
4	**Symmetrical Fault Analysis** Introduction to fault, types of faults, transient on transmission line, short circuit current and reactance's of synchronous machine on no load and loaded condition, short circuit MVA, algorithm for short circuit studies, Z- bus formulation (step by step method without mutual coupling)	7

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5	**Symmetrical Components for Fault Analysis** Introduction to symmetrical components, symmetrical component transformation, phase shift in star-delta transformers, sequence impedances and sequence network of transmission line, synchronous machine and transformer, power invariance, construction of sequence network of a power system.	**6**
6	**Unsymmetrical Fault Analysis** Introduction to unsymmetrical faults, single Line to Ground (L-G) fault, Line to Line (L-L) fault, Double Line to Ground (L-L-G) fault, open conductor faults, bus impedance matrix for analysis of unsymmetrical shunt faults	**6**

List of experiments

Expt. No	Title of the Experiment
1	Determination of efficiency and voltage regulation of Short/medium/long transmission line.
2	Demonstration of Ferranti effect on transmission line by using transmission line trainer kit
3	Measurement of ABCD parameters of a medium/long transmission line.
4	Study of per unit representation of power system network by using MATLAB.
5	Formation of Y- Bus matrix of a power system using MATLAB.
6	Load flow analysis using Gauss-Seidel method.
7	Load flow analysis using Newton-Raphson method.
8	Study of Transients behaviour in series R-L circuit & synchronous generator under symmetrical fault
9	Symmetrical fault analysis of a 3-bus system using MATLAB.
10	Conversion of phasors to symmetrical components and vice versa using MATLAB
11	Determination of Positive, negative and zero sequence impedances of transformer (hardware)
12	Load flow analysis using ETAP/power world simulator.
13	Unsymmetrical fault analysis for LL, LG, LLG Faults using MATLAB /ETAP /Power world simulator

Minimum **ten** experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Power System Engineering	D.P. Kothari, I. J. Nagrath	Mc-Graw Hill Publications	Third	2019
2	Electrical Power Systems	Ashfaq Hussain	CBS publishers, New Delhi	Third	2007
3	Power System Analysis	Hadi Saadat	Tata Mc-Graw Hill	First	2002

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Reference Books:					
Sr. No.	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Power System Analysis	Grainger John J and W D Stevenson	McGraw Hill	First	1994
2	Power System Analysis	P S R Murthy	BS Publication	First	2007
3	Electrical Power Systems	D. Das	New Age international	First	2010
4	Electric Power Systems: A first course	Ned Mohan	Wiley Publication	First	2012

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Annasaheb Dange College of Engineering and Technology, Ashta

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Department of Electrical Engineering

Minor Course – II, Track I : Electric Vehicle	
Class	T.Y. B. Tech. Semester – V
Course Code and Course Title	**2EEEV304, Energy Storage Systems for Electric Vehicles**
Prerequisite/s	**2EEEV213**
Teaching Scheme: Lecture/Tutorial/Practical	03/00 /00
Credits	03
Evaluation Scheme: ISE/MSE/ESE	40/30/30

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEEV304_1	**Apply** knowledge of EV drivetrain architectures to describe components and their functions in various electric drivetrains
2EEEV304_2	**Apply** knowledge to describe characteristics of different battery types
2EEEV304_3	**Use** battery specifications to explain chemical-to-electrical energy conversion and assess battery efficiency, electrical parameters, and heat generation.
2EEEV304_4	**Apply** performance criteria to assess battery requirements for EV propulsion
2EEEV304_5	**Use** concepts of energy storage systems to design a battery pack
2EEEV304_6	**Implement** knowledge of chemical and structural material properties to improve battery safety and design

Unit	Course Contents	Hours
1	**Electric Vehicle Mechanism** Basics of vehicle mechanisms, Electric Vehicle Drivetrain, Energy Storage and Management, Charging Infrastructure, Power/Energy supply requirements.	6
2	**Cells and Batteries fundamentals** Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters, Heat generation	7
3	**Battery types and ultracapacitors** Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Super capacitors and Ultra capacitors.	6
4	**Battery Performance** Performance criteria for Electric vehicles batteries; Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.	6

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5	**Battery monitoring and management** Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Introduction to Battery Management System.	**7**
6	**Battery testing & recycling** Battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.	**7**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Electric vehicle battery systems	Sandeep Dhameja	Newnes	--	2010
2	Electric Vehicle Technology Explained	John Lowry, James Larminie	Wiley	2nd	2012
3	Electric & Hybrid Vehicles Design fundamentals	Iqbal Husain	Taylor & Francis Group	2nd	2010
4	Energy storage: A new approach	Ralph Zito	Wiley	---	2010

Reference Books:

Sr. No.	Title	Author	Publisher	Edition	Year of Edition
1	Used Battery Collection and Recycling	Pistoia, J.P. Wiaux, S.P. Wolsky	Elsevier	---	2001
2	Hybrid electric Vehicle-Principles & Applications with Practical Properties	Chris Mi, Abul Masrur& David Wenzhong Gao	WILEY	---	2011
3	Recycling of Lithium-Ion Batteries: The LithoRec Way	Arno Kwade, Jan Diekmann	Springer	---	2018
4	Thermal Management of Electric Vehicle Battery Systems	Ibrahim Dinçer, Halil S. Hamut and Nader Javani	John Wiley& Sons	---	2016

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Department of Electrical Engineering

Minor Course – II, Track – II : Control Engineering	
Class	T.Y. B. Tech, Semester -V
Course Code and Course Title	**2EECE305, Control Systems**
Prerequisite/s	**2EECE214**
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	03
Evaluation Scheme: ISE / MSE / ESE	40/30/30

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
2EECE305_1	**Summarize** the fundamentals of control systems and the associated terms along with its transfer function.
2EECE305_2	**Develop** mathematical models for given dynamic systems.
2EECE305_3	**Determine** the transfer function using block diagram reduction and signal flow graph.
2EECE305_4	**Compute** the performance parameters of control system.
2EECE305_5	**Assess** the stability of the system in time domain and frequency domain.
2EECE305_6	**Analyze** the control systems using state space model.

Unit	Course Contents	Hours
1	**Introduction to Control System** Introduction, classification of control system, feedback control system, Components of control systems and its transfer function, Pole zero concept.	6
2	**Control System Representation** Mathematical representation of electrical, mechanical systems, Force Voltage and Force current analogy, Block diagram representation and reduction, Signal flow graph.	7
3	**Time Domain Analysis and Stability** Time response of first order systems, second order systems, Analysis of steady state error, static error constants and type of system, Time response specifications, Concept of stability, Routh-Hurwitz criteria for stability.	7
4	**Root Locus** Definition of root locus, rules for plotting root loci, root contour, stability analysis using root locus, effect of addition of pole and zero on root locus.	6
5	**Frequency Response Analysis** Introduction to frequency response, frequency domain performance specifications, stability analysis of system using Bode plots, Polar plot, Nyquist plot, co-relation between time domain and frequency domain.	7
6	**State Space Representation** Introduction to State space, phase variable form, canonical form, conversion of transfer function to state space and vice versa, state transition matrix and its significance, controllability and observability.	6

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Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Control System Engineering	I.J. Nagrath M. Gopal	New Age International Publication	Fifth	2009
02	Control System Engineering	Norman Nise	Wiley Publication	Sixth	2013
03	Modern Control Engineering	Ogata	Prentice Hall	Fifth	2010
04	Feedback Control Systems	U. A. Bakshi & S. C. Goyal	Technical Publications	Second	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Automatic Control System	Kuo & Gol Naraghi	Wiley	Ninth	2013
02	Control Systems: Theory and Applications	Smarajit Ghosh	Pearson Education	Second	2012
03	Control Systems	N. C. Jagan	B. S. Publications	Second	2008
04	Feedback Control Systems	C.L. Phillips, R. D. Harbor,	Prentice Hall	Fourth	1999

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Class	T.Y B.Tech., Sem - V
Course Code and Course Title	**2EEHS306 - Entrepreneurship**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	01
Evaluation Scheme: ISE	50

Course Objectives:

1. This course aims to equip engineering students with the knowledge and skills to identify opportunities, develop innovative solutions, and launch successful engineering-based ventures.

Course Outcomes (COs):	
After successful completion of this course, the student will be able to:	
2EEHS306_1	**Identify** and evaluate potential business opportunities in the engineering domain.
2EEHS306_2	**Conduct** market research and analyze the competitive landscape.
2EEHS306_3	**Craft** a comprehensive business plan, including financial projections.
2EEHS306_4	**Understand** the fundamentals of marketing, sales, and operations for engineering ventures.
2EEHS306_5	**Pitch** their business ideas to potential investors.
2EEHS306_6	**Grasp** the legal and ethical considerations of starting a business.

Course Contents:

1. The Entrepreneurial Ecosystem
2. Idea Identification and Prototyping
3. Testing, Validation and Commercialisation
4. Market Analysis and Competitive Landscape
5. Legal Procedure to setup an Startup Business
6. Understanding Finance Basics
7. Business Planning and Development
8. Marketing and Sustainability
9. Pitching and Fundraising
10. Startup Case Studies

Assessment activities

Assessment 1 : Business Plan

Assessment 2 : Peer Review of Business Plan

Assessment 3 : Elevator Pitch Competition

Assessment 4 : "Shark Tank" Simulation

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Reference Materials:

1. https://www.startupindia.gov.in/content/sih/en/international/go-to-market-guide/indian-startup-ecosystem.html
2. https://www.startupindia.gov.in/content/sih/en/learning-and-development_v2.html
3. https://onlinecourses.nptel.ac.in/noc24_mg93/preview

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes						Marks		Weightage
		1	2	3	4	5	6	Max	Min	
1	ISE : BP	☑	☑	☑	☑	☐	☑	10	20	20 %
2	ISE : PR	☑	☑	☑	☑	☐	☑	10		20 %
3	ISE :EPC	☑	☑	☐	☑	☑	☐	10		20 %
4	ISE : STS	☑	☑	☑	☑	☑	☑	20		40 %

- ISE - In-Semester Examination,
- BP - Business Plan, PR - Peer Review of Business Plan
- EPC - Elevator Pitch Competition, STS - "Shark Tank" Simulation

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Class	T.Y. B. Tech. Semester - V
Course Code and Course Title	**2EEVS307, CAD for Electrical Machine Design**
Prerequisite/s	2EEES104, 2EEPC210
Teaching Scheme: Lecture/Tutorial/Practical	00/00 /02
Credits	01
Evaluation Scheme: ISE	50

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEVS307_1	**Explain** the basic concepts of electrical machine design.
2EEVS307_2	**Design** machine elements by suitable method using CAD.
2EEVS307_3	**Determine** the overall dimensions of the Electrical Machine.
2EEVS307_4	**Implement** and develop CAD of transformer and induction motor.
2EEVS307_5	**Prepare** a well-organized report employing elements of technical writing and critical thinking

List of experiments

Expt. No	Title of the Experiment
1.	Introduction to computer aided drafting for Electrical Design.
2.	Design a DC lap winding with a design report using Auto-Cad
3.	Design a DC wave winding with a design report using Auto-Cad
4.	Design an AC winding with a design report using Auto-Cad
5.	Design of a Core of Transformer by using AutoCAD
6.	Design a DC machine with a design report using Auto-Cad • Numerical Solving • Design using AutoCAD
7.	
8.	Design a AC machine with a design report using Auto-Cad • Numerical Solving • Design using AutoCAD
9.	
10.	Design of Transformer by using AutoCAD • Numerical Solving • Design using AutoCAD
11.	
12.	Industrial Visit

Minimum **ten** experiments should be performed from the above list.

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1.	A Course in Electrical Machine Design	A.K. Sawhney,	Dhanpat Rai & sons New Delhi	Sixth	2006
2.	Theory and Performance and Design of A.C. Machines	M.G. Say,	ELBS London	Third	1992
3.	Principles of Electrical Machine Design,	R. K. Agarwal	S. K. Katariya and sons.	Fifth	2014
4.	Substation Design and Equipment	Satnam P.S.	Dhanpat Rai & Sons,	Third	2012

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1.	Computer Aided Electrical Drawing	M. Yogesh, B. S. Nagaraja, N. Nandan	PHI Learning	First	2014
2.	Electrical Machine Design Data	A Shanmugasundaram, G. Gangadharan, R. Palani,	Wiely Eastern Ltd., New Delhi	Third	2003
3.	Computer Aided Design for Electrical Machines	K.M. Vishnu Murthy	B.S. Publications.	First	2008
4.	Design for Electrical Machines	V.N.Mittle	Standard Publisher, New Delhi	Third	1992

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Annasaheb Dange College of Engineering and Technology, Ashta

An Autonomous Institute

Department of Electrical Engineering

Class	T. Y. B. Tech. Semester-V
Course Code and Course Title	**2EEEL308, Industrial Training / Internship**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial/ Practical	00/00/00
Credits	01
Evaluation Scheme: ISE	50

Course Outcomes (COs):

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

2EEEL308_1	**Explain** the knowledge acquired in a given field during industrial training
2EEEL308_2	**Demonstrate** competency in relevant engineering fields through case study
2EEEL308_3	**Apply** the fundamental knowledge of engineering to given industrial problems/ task using appropriate techniques, resources and modern engineering tools
2EEEL308_4	**Communicate** effectively, both orally and in writing report related to given field showing engineering & management principles.

Course Contents:

Industrial Training Requirement:

- Duration: Minimum two weeks during the semester break after the fourth semester.
- Completion: Within 15 calendar days before the start of the fifth semester.
- Industry Preference: Students should seek internships in industries related to electrical engineering to ensure the experience is relevant and beneficial
- The report should demonstrate practical application of course-related knowledge and skills.
- After completion of training, each student has to submit following documents to training in charge:

1. Industry Evaluation Rubric filled by industry
2. Report of the training (Minimum 25 pages contents of the report with Case Study)
3. Completion original Certificate of Training by Industry.
4. Photocopy of Institute application letter to industry.
5. GPS Images and Photos: Each student must give a hard copy of the Internship Glimpse This template consists of two pages dedicated to showcasing the highlights of your internship through photographs, ensure that the template is separate from the internship report document
6. Attendance Sheet

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Report Submission Guidelines

As part of the internship program, students are required to submit a detailed report documenting their experiences and learnings during the internship.

The following guidelines outline the requirements for the report submission:

Content Requirements:

1. The report should include an introduction that provides an overview of the internship, including the company name, duration, and objectives.
2. Students should describe the tasks and projects they were involved in, detailing the specific roles and responsibilities they undertook.
3. The report should highlight key observations and insights gained from the internship, focusing on industry practices, technologies, and methodologies encountered.
4. Students are encouraged to analyze and discuss any challenges faced during the internship and how they were addressed or overcome.
5. The conclusion should summarize the overall experience, emphasizing the practical skills and knowledge acquired, and reflecting on how the internship has contributed to their professional development.

Formatting and Structure:

1. The report should be well organized, clearly written, and free of grammatical errors.
2. It should include a title page, table of contents, and properly formatted sections and subsections.
3. Any diagrams, charts, or photographs included should be relevant and appropriately labelled.

Evaluation Process:

Individual student must undergo presentation of training content before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report. Marks will be awarded after the end of the presentation and submission of report

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Class			TY B.Tech, Semester -V
Course Code and Course Title			**2EECC309, Aptitude and Reasoning Part -III**
Prerequisite/s			2EECC208, 2EECC219
Teaching Scheme: Lecture/Tutorial/Practical			00/00/02
Credits			01
Evaluation Scheme:	**T**	**ISE/MSE/ESE**	00/00/00
	P	**ISE/ ESE**	50/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
2EECC309_1	Solve problem based on basic and advance Permutation and Combination
2EECC309_2	Solve problem based on Probability, Application of Probability, Cubes, Dices, cube painting and Syllogism
2EECC309_3	Solve problem based on Mensuration 3D, Circle & Triangle
2EECC309_4	Demonstrate on Resume writing skill, closed, advanced grammar, Synonyms and Antonyms

Unit	**Course Contents**	**Hours**
1	• Basic Permutation and Combination • Advance Permutation and Combination	**04**
2	• Probability • Application of Probability	**04**
3	• Cubes, Dices & cube painting • Syllogism	**04**
4	• Mensuration 3D • Circle & Triangle	**04**
5	• Resume writing & resume making • Interview Techniques	**04**
6	• Closed Test & advanced Grammar • Synonyms & Antonyms	**04**

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	R.S. Agarwal	R.S. Agarwal	S Chand		2019
02	R.S. Agarwal (Verbal & Non-verbal Reasoning)	R.S. Agarwal	S Chand		2010
03	Wren & Martin(Verbal, Grammar)	P.C.Wren	S Chand		2017

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Curriculum

Third Year B.Tech - Semester – VI

Annasaheb Dange College of Engineering and Technology, Ashta

Department of Electrical Engineering

Teaching and Evaluation Scheme

T. Y. B. Tech, Semester VI

Course Code	Course Name	Teaching Scheme				THEORY							PRACTICAL						GRAND TOTAL
						ISE		MSE+ ESE			Total	Min	ISE		ESE		Total	Min	
		L	T	P	Credits	Max	Min	MSE	ESE	Min			Max	Min	Max	Min			
2EEPC310	Power Electronics	3	1	2	5	40	16	30	30	24	100	40	50	20	50	20	100	40	200
2EEPC311	High Voltage Engineering	3	0	2	4	40	16	30	30	24	100	40	50	20	-	-	50	20	150
2EEPE3**	Professional Elective - I	3	0	2	4	40	16	30	30	24	100	40	50	20	50	20	100	40	200
2ILOEXXX	Open Elective - II	3	0	0	3	100	40	-	-	-	100	40	-	-	-	-	-	-	100
2EE**3##	Minor Course - III	3	0	0	3	40	16	30	30	24	100	40	-	-	-	-	-	-	100
2EEEL318	Mini Project	0	0	4	2	-	-	-	-	-	-	-	50	-	-	-	50	20	50
2EECC319	Aptitude and Reasoning Part - IV	0	0	2	1	-	-	-	-	-	-	-	50	-	-	-	50	20	50
Total		15	1	12	22														850
Total Contact Hours		28																	

Professional Elective - I[&@]		
Track	**Course Code**	**Course Name**
Power Engineering	2EEPE312	Switchgear Protection & Industrial Electrical Systems
Control Engineering	2EEPE313	Control System Design
Embedded Systems	2EEPE314	Embedded Systems
E Mobility	2EEPE315	Electric Vehicles

&	Students are permitted to choose all the professional electives from particular track or from different track
@	E Mobility track in Professional Elective, and Honors in E Mobility are same. The students those who are choosing Honors in E mobility are not eligible to choose E Mobility track in Professional Elective and vice versa. Therefore students are advised to opt right choice during the selection of the Professional Elective and Honors in E Mobility.

On exit at the end of third year

Course Code	Course Name	L	T	P	C
2EEEX301	Electric Vehicle Maintenance	0	0	8	4
2EEEX302	Control Panel Design	0	0	8	4

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Class			T.Y. B. Tech. Semester - VI
Course Code and Course Title			**2EEPC310 - Power Electronics**
Prerequisite/s			2EEPC113
Teaching Scheme: Lecture/Tutorial/Practical			03/01/02
Credits			05
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEPC310_1	**Analyze** semiconductor devices with suitable triggering mechanism and commutation techniques
2EEPC310_2	**Demonstrate** the performance of single-phase half controlled and fully controlled AC to DC converter
2EEPC310_3	**Analyze** the performance of semi controlled and fully controlled three phase AC to DC converter
2EEPC310_4	**Differentiate** cyclo converters & AC voltage regulators
2EEPC310_5	**Compare** isolated and non-isolated DC to DC converters, along with their hard and soft switching device
2EEPC310_6	**Analyze** the performance of inverters using various pulse width modulation techniques.

Unit	Course Contents	Hours
1	**Power semiconductor devices, triggering and commutation circuits** Structure, working, static and dynamic characteristics of current controlled devices and voltage-controlled devices - SCR, GTO, MOSFET and IGBT. RC and UJT Triggering circuits, triggering TRIAC using DIAC, SCR commutation circuits, Design of gate drive and snubber circuits, Design of heat sinks, series and parallel operation of SCR	7
2	**Single phase AC to DC Converter** Performance analysis of single-phase half controlled and fully controlled converter with R and RL load under continuous and discontinuous conduction modes, inverter mode operation, harmonics, concept of freewheeling diodes. Effect of source inductance	7
3	**Three phase AC to DC Converter** Performance analysis of three phase half controlled and fully controlled converter with R and RL load under continuous and discontinuous conduction modes, inverter mode operation, harmonics, capacitor and LC filters.	6
4	**Dual converter and AC to AC converters** Construction, working of single phase dual converter: Non circulating and circulating model. Construction, working of single phase cyclo converter: step up and step down cyclo-converters, Single phase AC voltage regulator, matrix converters	6

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5	**DC to DC Converters** Construction, working and types of chopper, Classification of various quadrants choppers, control strategies of chopper, buck converter, boost converter, buck-boost converter, Isolated topologies -forward DC to DC converter, basic of resonant converter.	**6**
6	**Inverters** Construction, working and types of single phase and three phase voltage source inverter -120 degree and 180 degree modes of operations, operation of current source inverter, PWM techniques, fundamentals of electrical drives.	**7**

List of Experiments

Expt. No	Title of the Experiment
1	Plot the static characteristics of current controlled devices (SCR & TRIAC)
2	Plot the static characteristics of voltage controlled devices (MOSFET & IGBT)
3	Generate SCR gate pulses using R, RC and UJT triggering circuits
4	Performance of single phase fully controlled rectifier with R and RL loads
5	Performance of three phase fully controlled rectifier with R load
6	Performance of DC to DC step up and step down choppers with R load
7	Simulation of single phase controlled rectifier with R and RL load
8	Simulation of single phase dual converter with R load
9	Simulation of three phase semi controlled rectifier
10	Simulation of buck converter
11	Simulation of 180/120 degree conduction mode voltage source inverter
12	Simulation of cyclo converter with R load

Minimum **ten** experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Power Electronics: Devices, Circuits and Applications	Muhammad H.Rashid,	Pearson Education	4th	2017
2	Power Electronics	Hart, Daniel W	Tata McGraw Hill Publication	2nd	2011
3	Power Electronics	P.C.Sen	Tata McGraw Hill Publication	2nd	2016
4	Power electronics systems - Theory and design	Agrawal Jai. P.	Pearson education	1st	2011

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Reference Books:					
Sr. No.	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Power electronics: Essentials and applications,	L.Umanand	Wiley	1st	2009
2	Power Electronics with Matlab	Kumar L.Ashok	Cambridge University Press.	1st	2022
3	Power Electronic Design: A Practitioners Guide	Keith H.Sueker	Elsevier Publication	1st	2022
4	SCR Manual	A.P.Connolly, R.W. Fox, F.B. Golden, et al.	General Electric Electronics Park,	5th	1972

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Department of Electrical Engineering

`Class			B. Tech. Semester-VI
Course Code and Course Title			**2EEPC311, High Voltage Engineering**
Prerequisite/s			2EEPC210, 2EEPC212
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE/ MSE /ESE**	40/30/30
	P	**ISE**	50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
2EEPC311_1	**Make use of** fundamental concepts of breakdown processes in gases, liquids, and solid dielectric media in uniform and non-uniform fields under diverse physical conditions.
2EEPC311_2	**Analyze** the generators and circuits used for generation of high impulse currents and high DC, AC, and impulse voltages as prescribed by national or international standards to study the insulation behavior under all conditions
2EEPC311_3	**Focus** the techniques of measuring high impulse currents and high DC, AC, and impulse voltages functional for the testing of HV equipment ensuring safety to the personnel and equipment.
2EEPC311_4	**Examine** the withstand capability of HV power apparatus using overvoltage as per IS/IEC/IEEE standards and coordinate the insulation level of the power system.

Unit	Course Contents	Hours
1	**Breakdown Mechanisms in Gaseous Dielectrics** Gases as Insulating Media, Ionization Processes, Townsends Mechanism, Streamer Mechanism of Spark, Paschen's Law, Breakdown in Electronegative Gases, Gaseous Breakdown in Non-uniform Fields and Corona Discharges, Practical Considerations using Gases for Insulation Purposes, alternate green gases and mixture of gases, Breakdown in Vacuum Insulation.	7
2	**Breakdown Mechanisms in Liquid and Solid Dielectrics** **Liquids Dielectrics:** Conduction and Breakdown in Pure and Commercial Liquids, Suspended Solid Particle Mechanism, Cavity Breakdown, Stressed Oil Volume Mechanism, Dissolved Gas Analysis. **Solids Dielectrics:** Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Electrochemical Breakdown, Breakdown due to Treeing and Tracking, Breakdown due to Internal Discharges, Breakdown in Composite Insulation.	7
3	**Generation of High DC and AC Voltages** Generation of HV DC by Single Phase Rectifier Circuits, Cockcroft Walton Voltage Multiplier Circuit – Voltage Regulation and Ripple Factor Calculation – Vande Graff Generator - Generation of HV AC by Cascade Transformers - equivalent circuit of cascaded transformer – Resonant Transformers and Tesla Coils.	6

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4	**Generation of Impulse Voltages and Currents** Standard Lightning & Switching Impulse Wave shape, Single Stage and Multistage Impulse Voltage Generation, Switching Impulse Voltage Generation Circuits, Generation of High Impulse Currents – Standard Waveshapes and Analysis.	**5**
5	**Measurement of High Voltages and High Currents** Resistance Potential Dividers, Generating Voltmeter - Electrostatic Voltmeters, Chubb Fortescue Method, Sphere Gaps for Peak Voltage Measurement of High DC, AC and Impulse Voltage Measurements, Hall Generator, Rogowski Coils. Measurement of loss angle, High Voltage Schering bridge, and partial discharge measurement techniques.	**7**
6	**High Voltage Testing and Insulation Co-Ordination** Objectives of High Voltage Testing, Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arresters, Insulation Resistance Test, Testing of Breakdown Strength of Oil, Standard BILs, Insulation Coordination.	**7**

Expt. No	**Title of the Experiment**
1.	Measurement of DC breakdown characteristics of air using sphere gap assembly
2.	Measurement of AC breakdown characteristics of air using sphere gap assembly
3.	Testing of Breakdown Strength of Transformer Oil.
4.	Dielectric Strength Test on Solid Insulation using 5kV AC HV Tester.
5.	Analysis and Simulation of Voltage Doubler Circuit for HV DC generation using MATLAB / Circuit simulation package.
6.	Analysis and Simulation of Cockcroft-Walton Multiplier for HV DC generation using MATLAB /Circuit simulation package.
7.	Generation and Measurement of Standard Impulse Voltage using 5-Stage 150kV 225J Impulse Generator.
8.	Analysis and Simulation of Two stage Standard Marx impulse voltage generator using MATLAB / Circuit simulation package.
9.	Measurement of Insulation Resistance Using Megger.
10.	Substation Insulation Coordination for Lightning and Switching Surges – A Case Study

Note: Visit to HV Substation.

All experiments should be performed from the above list.

Text Books:

Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1.	High Voltage Engineering	M.S.Naidu and V.Kamaraju	Tata McGraw Hill Education (India) Pvt. Ltd.	Fifth	2013
2.	High Voltage Engineering	C.L.Wadhwa	New Age International Pvt. Ltd.	Third	2012

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3.	High Voltage Engineering Fundamentals	E. Kuffel, W. S. Zaengl, J. Kuffel	Elsevier	Second	2012
4.	Fundamentals of High-Voltage Engineering	Ravindra Arora and Bharat Singh Rajpurohit	Wiley	First	2019

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
5.	An Introduction To High Voltage Engineering	Subir Ray	Prentice Hall India Learning Private Limited	Second	2013
6.	High Voltage Technology	L.L. Alston	Oxford University Press,	First	2011
7.	High Voltage Engineering	E.Kuffel and M. Abdullah,	Pergamon Press	First	2013
8.	High-Voltage Engineering: Theory and Practice	Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, RoshdyRadwan	Marcel Dekeer, New York	Second	2000

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Department of Electrical Engineering

Professional Elective, Track I: Power Engineering			
Class			T.Y. B. Tech. Semester - VI
Course Code and Course Title			**2EEPE312 Switchgear Protection & Industrial Electrical Systems**
Prerequisite/s			2EEPC210, 2EEPC212, 2EEPC302
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE/MSE/ESE**	40/30/30
	P	**ISE/ESE**	50/50

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEPE312 _1	**Describe** the arc interruption process in circuit breakers
2EEPE312 _2	**Analyze** the various relays based on their characteristics and applications
2EEPE312 _3	**Examine** the various relays using digital protection and power world simulator
2EEPE312 _4	**Apply** the appropriate protection scheme for various power system components like transformer, generator, and induction motor
2EEPE312 _5	**Apply** the appropriate protection scheme for busbar and transmission line
2EEPE312 _6	**Analyze** the electrical systems for protection of lightning, earthing, design of elevators, UPS and battery banks

Unit	**Course Contents**	**Hours**
1	**Arcing Phenomena** Voltage - current characteristics of arc, principles of DC and AC arc interruption, high resistance and current zero interruption, arc voltage, Transient restriking voltage, recovery voltage, repetitive reverse recovery voltage, current chopping, resistance switching, capacitive current interruption.	**7**
2	**Circuit Breakers** Air - break and air blast circuit breaker, oil – minimum oil and bulk oil circuit breaker, SF6 and vacuum circuit breaker, HVDC circuit breakers, MCB, ratings and testing of circuit breaker.	**6**
3	**Relays** Electromagnetic and its types, time current characteristics, plug setting multiplier, time setting multiplier, directional relay, protection of parallel feeders, protection of ring mains, static over current relays, digital overcurrent relay and numerical over current relays	**7**
4	**Transformer, Generator & Motor Protection** Transformer protection: Differential protection, carrier aided protection scheme, harmonic restraint and harmonic blocking schemes, restricted earth fault protection, Buchholz Relay Generator protection: Differential protection of generator, stator and rotor protection schemes of generator, loss of excitation, prime mover failure protection.	**7**

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	Motor protection: Induction motor stator and rotor protection	
5	**Protection of lines** **Transmission line Protection:** Impedance, reactance and admittance characteristics, relay settings for 3 zone protection, out of step blocking scheme, blinder relay, numerical relays for transmission line protection, digital impedance, Reactance and Mho relays **Bus bar protection:** Frame leakage protection of bus bar, circulating current protection of bus bar, high impedance protection of bus bar	**6**
6	**Industrial Systems** Industrial loads, motors, starting of motors, lightning phenomenon, methods of earthing, electrical systems for the elevators, selection of UPS and battery banks.	**6**

List of Experiments

Expt. No	Title of the Experiment
1	Drawing sheet showing construction of circuit breakers.
2	Drawing sheet showing construction of generator and transformer protection schemes.
3	Perform the simulation of restriking and recovery voltage
4	Analyse the performance of electro-mechanical over current relay
5	Analyse the performance of electro-mechanical over voltage relay
6	Characteristics of over current relay
7	Characteristics of over voltage relay
8	Characteristics of under voltage relay
9	Characteristics of impedance relay
10	Study of gas actuated Buchholz relay for oil filled transformer in virtual lab
11	Virtual lab / Simulation of induction motor protection using relay
12	Power world simulator for relay setting
13	Perform the simulation of three phase differential relay for power transformer

Minimum **ten** experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Power System Protection and Switchgear	Badri Ram, Vishwakarma,	Tata McGraw Hill	Fifteenth	2001
2	A Text book of Power System Engineering.	R.K. Rajput	Laxmi Publications,	First	2007
3	Switchgear and Protection	Sunil S. Rao,	Khanna publishers, New Delhi	Second	1986
4	Electrical estimating and costing	S. Singh and R. D. Singh	Dhanpat Rai and Co.	First	1997

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Reference Books:					
Sr. No.	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Switchgear and Protection	J.B.Gupta	S.K.Kataria& Sons	Second	2004
2	Fundamentals of Power System Protection	Y. G. Paithankar, S. R. Bhide	PHI	Second	2013
3	Power System Protection & Switchgear	Oza, Nair, Mehta and Makwana	MGH pub	Second	2011
4	Electrical Power Systems (Generation, Transmission, Distribution, Protection and Utilization of Electrical Energy)	S.L. Uppal, Sunil S. Rao	Khanna publishers, New Delhi	Fifteenth	1987

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Department of Electrical Engineering

Professional Elective, Track II: Control Engineering			
Class			T.Y. B. Tech. Semester - VI
Course Code and Course Title			**2EEPE313, Control System Design**
Prerequisite/s			2EEPC301
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): Upon successful completion, the student will be able to:	
2EEPE313_1	**Design** of compensators in time and frequency domain.
2EEPE313_2	**Design** of control system in state space using pole placement and state observer.
2EEPE313_3	**Compute z-** transform and analyze the relation between z & s-domain for a digital control system.
2EEPE313_4	**Analyze** describing function and phase plane analysis methods for non-linear control systems.
2EEPE313_5	**Analyze** advanced control system methods such as MRAC, fuzzy logic and sliding mode control.

Unit	**Course Contents**	**Hours**
1	**Control system design in time domain** Review of root locus, concept of lead, lag, lag- lead compensator, design of lead, lag and lag- lead compensators based on root locus approach.	**7**
2	**Control system design in frequency domain** Review of bode plot, design of lead, lag and lag- lead compensators based on frequency domain approach	**7**
3	**Control system design in state space** **Pole placement technique:** Introduction, controller design, state feedback law, pole placement technique by transformation method, direct substitution method and Ackermann's formula. **State observers**: Introduction, full order state observer, transformation approach, direct substitution approach and ackermann's formula to obtain observer gain matrix.	**6**
4	**Digital control systems** Introduction, block diagram of digital control systems, difference equation, review of Z-transform, Z-transform analysis of sampled data control system, relation between Z and S domains.	**7**
5	**Nonlinear control systems** Introduction, difference between linear and nonlinear systems, common physical non-linearities: Dead-zone, saturation, friction. Approaches for analysis of non-linear systems: Describing function analysis-phase plane analysis, concept of phase plane, phase trajectory, singular points.	**6**

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6	**Advanced control systems** Introduction, model reference adaptive control systems, controller structure, self-tuning regulators, concept of fuzzy logic and sliding mode control.	6

List of Experiments

Expt. No.	Title of Experiment
1.	Design of lead compensator using root locus method.
2.	Design of lag compensator using root locus method
3.	Design of lead-lag compensator using root locus method
4.	Design of lead compensator using bode plot method
5.	Design of lag compensator using bode plot method
6.	Design of lead-lag compensator using bode plot method
7.	Determination of state feedback gain matrix using pole placement approach
8.	Determination of observer gain matrix using state observer approach.
9.	Analysis of digital control system using MALAB
10.	Analysis of non-linear control system using MATLAB.

All experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Control System Engineering	Norman Nise	Wiley Publication	6th	2013
02	Modern Control Engineering	K. Ogata	Prentice Hall India	5th	2010
03	Feedback Control Systems	C.L. Phillips, R.D. Harbor,	Prentice Hall India	4th	1999
04	Introduction to Control Engineering: Model, Analysis & Design	A. K. Mandal	New Age International Pulishers	1st	2006

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Automatic Control System	Kuo & Golnaraghi	Wiley-India	9th	2013
02	Control System Engineering	I.J. Nagrath M. Gopal	New Age International Publication	5th	2009
03	Control Systems	N. C. Jagan	B. S. Publications	2nd	2008
04	Discrete Time Control Systems	K. Ogata	Prentice Hall International Inc.	2nd	1995

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Professional Elective, Track III: Embedded Systems			
Class			B. Tech, Semester-VI
Course Code and Course Title			**2EEPE314, Embedded Systems**
Prerequisite/s			2EEPC204
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
2EEPE314_1	**Describe** the components, architecture, characteristics of given embedded systems
2EEPE314_2	**Develop** the algorithm, flowchart and c code for data transfer, decision control, looping operations, timer/counter, serial communication & interrupt controllers
2EEPE314_3	**Explain** the modes of communication, control signals used in RS232 and communication protocols
2EEPE314_4	**Apply** the programming knowledge to interface the input and output devices
2EEPE314_5	**Discuss** the concepts of real time operating system for embedded system design in terms of characteristics, functions and features.

Unit	**Course Contents**	**Hours**
1	**Introduction to Embedded Systems** Block diagram of embedded system with hardware components. Harvard and Von-Neumann architecture. RISC and CISC processors. Characteristics of embedded system: Processor, power, memory, operating system, reliability, performance, power consumption, NRE cost, unit cost, size, flexibility, time-to-prototype, time-to-market, maintainability, correctness and safety. Classification of Embedded System: Small scale, medium scale, sophisticated, stand-alone, reactive/real time (soft and hard real time). Features of PIC, AVR and ARM microcontrollers with their applications.	**9**
2	**Programming using Embedded C** Data transfer, arithmetic and logical operations, decision control & looping. Timer/Counter, Serial communication and Interrupt control programming with embedded C for microcontroller.	**6**
3	**Communication standards** Modes of data communication: Simplex, duplex, half duplex, serial, parallel, synchronous and asynchronous communication. Serial communication standards: RS232. MAX232 bidirectional level converter.	**5**
4	**Communication protocols** Serial communication protocol: P'C, CAN, USB, Serial Peripheral Interface (SPI), Synchronous Serial Protocol (SSP). Parallel Communication Protocol: PCI, PCI-X. Overview of advanced serial protocol: IrDA, Bluetooth, Zigbee.	**6**

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5	**Interfacing Input and Output Devices** Programming and Interfacing of switches, keys, push-button, and sensors. Programming and interfa5cing of 7 segment LED, relay programming, interfacing of matrix keyboard and LCD. Programming and Interfacing of stepper motor, DC motor and 8-bit ADC/DAC	7
6	**Real Time Operating Systems** Operating System: General and real time operating system. Characteristics of Real time operating system: Consistency, reliability, scalability, performance, predictability. Functions of RTOS: Task management, scheduling, resource allocation and interrupt handling. Features of RTOS: Watchdog timer, semaphore, deadlock	6

List of Experiments

Expt. No.	Title of Experiment
1	Execute the C program to perform arithmetic operations on 8-bit data: addition, subtraction, multiplication, and division for microcontroller
2	Execute the C program to perform transfer of data from source to destination internal data memory location
3	Execute the C program to turn on LED with respect to Switches connected to port pins of 8051
4	Execute the C program to display numbers 0 to 9 on 7-segment display with some delay.
5	Interface 16 x 2 LCD to 8051, Execute embedded C language program to display string on it
6	Interface a 4 x 4 matrix keyboard and 7-segment display to 8051. Execute C language program to read and display key code on 7- segment display.
7	Interface 8-bit ADC to 8051. Execute C language program to read data of ADC and store the converted digital data in memory.
8	Interface 8-bit DAC to 8051. Execute C language program to generate square, saw tooth and triangular waveforms.
9	Interface stepper motor to 8051. Execute C language program to rotate stepper motor with different speed in clockwise and counter clockwise direction
10	Generate the triangular waveform using DAC and observe the status of control signals using IDE tool (Micro ProC, Keil)

All experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year
1.	Embedded System - Architecture Programming and Design	P.Raj Kamal	McGraw Hill Education	Third	2017
2.	Introduction to Embedded Systems	Shibu. K.V		Second	2017
3.	Fundamentals of Embedded Software	Daniel W Lewis	PHI	First	2013

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Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1.	Embedded System Design: A Unified Hardware/Software Introduction	Frank Vahid and Tony Givargis	John Wiley & Sons	Third	2006
2.	Computers as Components: Principles of Embedded Computing System Design	Wyne Wolf	Wiley India Pvt. Ltd	Second	2008
3.	Embedded Systems Architecture	Tammy Noergaard	Newnes	Second	2012
4.	An Embedded Software Primer	David E. Simon	Pearson Education India	First	2004

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Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

An Autonomous Institute

Department of Electrical Engineering

Professional Elective, Track IV: E Mobility			
Class			T.Y. B. Tech. Semester - VI
Course Code and Course Title			**2EEPE315, Electric Vehicles**
Prerequisite/s			2EEPC210, 2EEPC302
Teaching Scheme: Lecture/Tutorial/Practical			03/00/02
Credits			04
Evaluation Scheme	**T**	**ISE / MSE / ESE**	40/30/30
	P	**ISE / ESE**	50/50

Course Outcomes (COs): After successful completion of this course, the student will be able to,	
2EEPE315_1	**Identify** the difference between conventional and electric vehicle operation
2EEPE315_2	**Select** proper propulsion motor for EV by understanding the power train requirement
2EEPE315_3	**Choose** the type and size of battery & ultra-capacitor for EV
2EEPE315_4	**Describe** the operation and design aspects of fuel cell and hybrid electric vehicle
2EEPE315_5	**Perform** tests on 2W, 3W & 4W electric drive trains and batteries
2EEPE315_6	**Develop** EV battery packs by series parallel arrangement of cells and spot welding

Unit	**Course Contents**	**Hours**
1	**Environmental impact and vehicle fundamentals** Petroleum resources, induced cost, air pollution, global warming, importance of different transportation development, history of electric and hybrid electric vehicles, general description of vehicle movement vehicle resistance, power train tractive effort and vehicle speed, vehicle performance, operating fuel economy, braking performance	**7**
2	**Propulsion systems** IC Engine: Spark ignited IC engines- operating principle, operating parameters, Electrical Drives: DC motor drives - principle of operation and performance, chopper control of DC motor drives, Induction motor drive- Basic operating principle, Volt/hertz control, BLDC motor drive- basic principle, control of BLDC drive, SRM drive- SRM drive controller, PMSM drive controller	**7**
3	**EV and HEV configurations** Configurations of EV, performance of EV, traction motor characteristics, tractive effort and transmission requirement, vehicle performance, tractive effort in normal driving, energy consumption, concept of hybrid electric drive trains, architecture of HEV drive trains, series hybrid, parallel hybrid- torque coupling drive trains, speed coupling drive trains, speed and torque coupling drive trains.	**6**
4	**Control of hybrid drive train** Drive train configuration - speed-coupling analysis, drive train configuration, drive train control methodology - control system, engine speed control approach, traction torque control approach, drive train control strategies, engine speed control strategy, traction torque control strategy, regenerative braking control, drive train parameters design	**7**

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5	**Electric Energy Storage Systems** Energy Storage Requirements for Electrified Vehicles, Electrochemical Cells and types, Ultracapacitor Cells, Characteristic Terminology and Performance Parameters, Packs and Management Systems	6
6	**Fundamentals of Chargers** Charger Classification and Standards, Charger Requirements, Topology Selection for Level 1& level 2 AC Chargers and Level 3 DC Chargers, Wireless Chargers, Range extended EVs, Solar Electric Vehicle, Electric Bicycle	6

List of Experiments

Expt. No	Title of the Experiment
1.	Drawing of wiring harness diagram of high voltage and low voltage circuits in 2 wheeler and identify their components and specifications.
2.	Power and speed measurement of 2 wheeler electric vehicle power train
3.	Speed and power measurement of BLDC and IM electric vehicle power train.
4.	Data analysis of 4W Induction motor drive at different vehicle speed conditions
5.	Data analysis of BMS for Li-I prismatic cells using CAN
6.	Li-I battery status and performance monitoring under different load conditions using CAN
7.	Analysis of charging, discharging and cell balancing in cylindrical Li-I cells
8.	Design of battery pack using LFP cells, spot-welding machine and verify with BMS
9.	Design of battery pack using NMC cells, spot-welding machine and verify with BMS
10.	Study of V2G concept and the solar PV integration
11.	Study of combined operation of engine and motor under hybrid mode in HEV
12.	Study of level 2 AC charging unit

Minimum **ten** experiments should be performed from the above list.

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Modern Electric, Hybrid Electric and fuel cell vehicles	Mehrdad Ehsani, Yimin Gao	CRC Press	First	2009
2	Advanced Electric Drive Vehicles	Ali Emadi	CRC Press	First	2015
3	Electric and Hybrid Vehicles	Iqbal Husain	CRC Press	Second	2011
4	Electric Vehicle Technology Explained	James Larminie, John Lowry	Wiley	First	2016

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Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Modern Electric Vehicle Technology,	C.C Chan, K.T Chau	Oxford University Press Inc., NY	First	2001
2	Electrochemical Power Sources: Primary & Secondary Batteries	M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye	IEE Energy Series 1, A. Wheaton &Co, Exeter	First	1980
3	Switched Reluctance motor drives	R.Krishnan	CRC press	First	2001
4	Brushless magnet and Reluctance motor drives	T.J.E. Miller	Claredon press, London	First	1989

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Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

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Department of Electrical Engineering

Minor Course – III, Track – I: Electric Vehicle		
Class		T.Y. B. Tech. Semester - VI
Course Code and Course Title		**2EEEV316, Electric Drives and Controllers for Electric Vehicles**
Prerequisite/s		2EEEV213
Teaching Scheme: Lecture/Tutorial/Practical		03/00/00
Credits		03
Evaluation Scheme:	**ISE / MSE/ ESE**	40/30/30

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EEEV316_1	**Apply** knowledge of electric drive systems and their components, including the selection process and fundamental torque equations, to analyse and determine suitable drive solutions.
2EEEV316_2	**Elucidate** the modes of operation and closed loop control of an electric drive systems.
2EEEV316_3	**Analyse** vehicle performance under different conditions, considering factors such as acceleration, road gradients, and velocity profiles.
2EEEV316_4	**Evaluate** the impact of drivetrain design choices on vehicle velocity, acceleration, and gradability.
2EEEV316_5	**Analyse** the performance and impact of control schemes for AC/DC motor drives.

Unit	**Course Contents**	**Hours**
1	**Electric Drives System**, parts of electric drives, choice of electric drives, Fundamental torque equation, multi-quadrant operation, Equivalent values of drive parameters, classification and components of load torques, load equalization.	6
2	**Control of Electrical Drives** Mode of operation, drive classifications, Closed loop control of drives-current-limit control, torque control, speed control, speed sensing, current sensing, PLL control, position control.	7
3	**Vehicle mechanics** Roadway fundamentals, laws of motion, vehicle kinetics, dynamics of vehicle motion, propulsion power, force-velocity characteristics, maximum gradability, velocity and acceleration, constant FTR, level road, velocity profile, distance traversed, tractive power, energy required, nonconstant FTR, general acceleration, propulsion system design	6
4	**Design of electric vehicle drivetrain** EV transmission configurations, transmission components, gears, automobile differential, clutch, brakes, ideal gearbox: steady state model, gear ratio (GR), torque-speed characteristics, EV motor sizing, initial acceleration, rated vehicle velocity, maximum velocity, maximum gradability **Design of an HEV**	6

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	Hybrid drivetrains, sizing of components, rated vehicle velocity, initial acceleration, maximum velocity, maximum gradability	
5	**EV Motors Drive Topologies -1:** DC Motor Control - Single phase uncontrolled rectifiers, half and fully controlled rectifiers, chopper control, open and closed loop control. Current Loop Control, Speed Control Loop. Four quadrant operation. Basic principles of BLDC Motor, motor construction, Types of BLDC motors, DC Motor dynamics, Characteristic Curves; BLDC Motor Control: Trapezoidal back EMF BLDC motor control, sensored control.	**7**
6	**EV Motors Drive Topologies -2:** AC Motors control: Induction motor control- constructional details and Characteristic Curves; Variable-Voltage Variable-Frequency Control (VVVF), Field-Oriented Control (FOC), Direct Torque Control (DTC); Field Weakening Control. PM Synchronous Motor Control: Field-Oriented Control of PMSM, Flux-Weakening Control of PMSM, Position Sensor less Control of PMSM	**7**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	3rd	2021
2	Electric and Hybrid Electric Vehicles	James D. Halderman, Curt Ward	Pearson	1st	2023
3	Electric Vehicle Technology Explained	James Larminie John Lowry	John Wiley & Sons,Ltd	2nd	2012
4	Electric and Hybrid Vehicles	A. K. Babu	CRC PRess	2nd	2022

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles	JG Hayes G. Abas Goodarzi	Wiley	1st	2018
2	Emerging Power Converters for Renewable Energy and Electric Vehicles	Md. Rabiul Islam, Md. Rakibuzzaman Shah, Md. Hasan Ali	CRC Press	1st	2021
3	Electric and Hybrid Vehicles	Tom Denton, Hayley Pells	Institute of the Motor Industry	3rd	2024

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Annasaheb Dange College of Engineering and Technology, Ashta

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Department of Electrical Engineering

Minor Course – III, Track – II : Control Engineering	
Class	T.Y. B. Tech. Semester - VI
Course Code and Course Title	**2EECE317, Process Control Engineering**
Prerequisite/s	---
Teaching Scheme: Lecture/Tutorial/Practical	03/00 /00
Credits	03
Evaluation Scheme: ISE/MSE/ESE	40/30/30

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
2EECE317_1	**Illustrate** the concept of fundamental control system and the process control
2EECE317_2	**Develop** the controller for the process control by inferring the knowledge of different control modes
2EECE317_3	**Apply** various tuning methods to determine the controller parameters
2EECE317_4	**Explain** the principles and characteristics of pneumatic, hydraulic & electrical actuators and control valves
2EECE317_5	**Apply** the knowledge of control system to construct the multi-loop control schemes for process control

Unit	**Course Contents**	**Hours**
1	**Introduction to control systems** Basic Terminologies: Control variable and manipulated variable, measured variable, plants, process, systems, disturbances, feedback control, close-loop control system and open-loop control system, transfer function, standard test signals: step signal, impulse signal, ramp signal, parabolic signal, sinusoidal signal, types of input and steady-state error, basic control action: on-off control.	6
2	**Concept of process control** Process Control Principle: Human aided control & automatic control, process-control block diagram, control system evaluation: stability, steady-state regulation, transient regulation, evaluation criteria, process characteristics: process equation, process load, process lag & self-regulation, control system parameters - error, variable range, control parameter range, control lag, dead time, cycling.	6
3	**Modes of control and controllers** Discontinuous controller modes: two position, multi-position, floating control modes; continuous controller modes: proportional, integral, derivative; composite controller modes: PI, PD, PID; electronic controllers: design of discontinuous, continuous and composite controller modes. Pneumatic controllers (displacement type).	7
4	**Controller tuning** One-quarter decay ratio criteria, time integral performance criteria, process loop tuning: open-loop transient response method, Ziegler-Nichol's method, cohen-coon method, direct synthesis method.	7

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5	**Final control elements** Pneumatic actuators: spring actuator, hydraulic actuators: piston actuator, electrical actuators: solenoid, electro-pneumatic actuators, control valves: types of control valves and its characteristics, sliding-stem control valves, rotating-shaft control valves, selection of control valves, control-valve sizing, and pneumatic valve positioner.	**7**
6	**Multi loop control schemes** Cascade control, ratio control, feed forward control, over-ride, split range, case study on distillation column: principle control scheme- constant top product, constant bottom product and reflex rate, constant reflex rate and steam rate.	**6**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Process Control Instrumentation Technology	Curtis D. Johnson	Pearson Education, New Delhi	7th	2002
2	Modern Control Engineering	Katsuhiko Ogata	Pearson Education, Inc.	5th	2015
3	Process Control: Modeling, Design, and Simulation	B. Wayne Bequette	Prentice Hall PTR	---	2002
4	Process Control	K. Krishnaswamy	New Age International	2nd	2009

Reference Books:

Sr. No.	Title	Author	Publisher	Edition	Year of Edition
1	Process Control	Peter Harriot	TMH (McGraw-Hill)	---	
2	Process Dynamics and Control	Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Francis J. Doyle III	WILEY	4th	2016
3	Principles of Process Control	Patranabis	TMH	---	1981

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Department of Electrical Engineering

Class	T.Y. B. Tech. Semester – VI
Course Code and Course Title	**2EEEL318, Mini Project**
Prerequisite/s	All courses
Teaching Scheme: Lecture/Tutorial/Practical	00/00 /04
Credits	02
Evaluation Scheme: ISE	50

Course Outcomes (COs):
After successful completion of this course, the student will be able to:

2EEEL318_1	**Implement** electrical engineering concepts and techniques in the building and testing of their project.
2EEEL318_2	**Utilize** engineering tools and laboratory equipment to design, development, and testing of their project.
2EEEL318_3	**Use** of modern tools and integrate industry 4.0 wherever necessary.
2EEEL318_4	**Create** comprehensive report of the project and present their findings effectively through oral presentations.

Course Contents

- A group of students 3 to 4 may take up to design and fabricate a mini project
- Selection of mini project must be based on recent technology, innovative ideas, useful for society, etc.
- The work will involve appropriate literature survey and design calculations. The skill sets like PCB design, hands on fabrication, testing using available instruments and completion level of Mini project will be considered for due weightage.
- Mini project should be a working model based the level of their knowledge, understanding and practices.
- Evaluation of mini project will be through presentation, demonstration and report writing.

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Department of Electrical Engineering

Class			T. Y. B. Tech. Semester-VI
Course Code and Course Title			**2EECC319, Aptitude and Reasoning Part -IV**
Prerequisite/s			2EECC208, 2EECC219, 2EECC309
Teaching Scheme: Lecture/Tutorial/Practical			00/00/02
Credits			02
Evaluation Scheme	**T**	**ISE/MSE/ESE**	00/00/00
	P	**ISE/ESE**	50/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
2EECC319_1	Solve problem based on basic and advance probability, Permutation and Combination
2EECC319_2	Solve problem based on Syllogism, graphs, data interpretations
2EECC319_3	Solve problem based on gaming round
2EECC319_4	Demonstrate on Resume writing skill, closed, advanced grammar, Synonyms and Antonyms

Unit	Course Contents	Hours
1	**Advance Probability, Advance Permutation, Combination**	04
2	Statement Assumption, Syllogism	04
3	Mixed Bar Graph, Pie Chart Data Interpretation(Avg & Ratio Proportion based)	04
4	Gaming Round OR Capgemini Part 1 Gaming Round OR Capgemini Part 2	04
5	Company Specific Revision for Arithmetic (S.T.D., Time Rate Work) Revision of Calendar Reminder theorem Power Cycle	04
6	Verbal Ability Revision Part 1, Verbal Ability Revision Part 2 Interview Etiquettes & Grooming	04

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	R.S. Agarwal	R.S. Agarwal	S Chand		2019
02	R.S. Agarwal (Verbal & Non-verbal Reasoning)	R.S. Agarwal	S Chand		2010
03	Wren & Martin (Verbal, Grammar)	P.C.Wren	S Chand		2017

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