Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE
TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

SYLLABUS

DR VISHWANATH KARAD

MIT WORLD PEACE UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B. TECH. (ELECTRICAL AND COMPUTER ENGINEERING)

PROGRAM STRUCTURE AND SECOND YEAR SYLLABI

BATCH 2021 – 2025

MIT WORLD PEACE UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY

B. Tech. Electrical and Computer Engineering (Second Year) (Batch 2021 – 2025)

Semester – III

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Differential Equations and Transform Techniques	BS	3	1	-	4	-	60	-	40	**100**
2		Electrical Circuit Analysis	PC	2	-	2	2	1	60	50	40	**150**
3		Computer Organization and Operating Systems	PC	2	-	-	2	-	60		40	**100**
4		Analog and Digital Integrated Circuits	PC	3	-	2	3	1	60	50	40	**150**
5		Control Systems	PC	3	-	2	3	1	60	50	40	**150**
6		Electrical Machines - I	PC	3	-	2	3	1	60	50	40	**150**
7		Linux based Python Lab			-	2	-	1	-	50	-	**50**
8		Indian Constitution	HSS	1	-	-	1	-	100	-	-	**100**
		Total		**17**	**1**	**10**	**18**	**5**	**460**	**250**	**240**	**950**

Total Credits Second Year BTech Semester - III: 23

****Assessment Marks are valid only if Attendance criteria are met**

* CCA: Class Continuous Assessment

* LCA: Laboratory Continuous Assessment

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FACULTY OF ENGINEERING AND TECHNOLOGY

B. Tech. Electrical and Computer Engineering (Second Year) (Batch 2021 – 2025)

Semester – IV

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Discrete Mathematics and Basic Statistics	BS	3	1	-	4	-	60	-	40	**100**
2		Data Structures and Algorithms	PC	3	-	2	3	1	60	50	40	**150**
3		Electrical Machines - II	PC	3	-	2	3	1	60	50	40	**150**
4		Power System and Protection	PC	4	-	2	4	1	60	50	40	**150**
5		Renewable Energy Systems	PC	3	-	2	3	1	60	50	40	**150**
6		Basic IoT Lab	ES	-	-	2	-	2	-	50	-	**50**
7		Philosophy of Science and Religion Spirituality	WP	2	-	-	2	-	60	-	40	**100**
		Total		**18**	**1**	**10**	**19**	**6**	**360**	**250**	**240**	**850**

****Assessment Marks are valid only if Attendance criteria are met**

***** CCA: Class Continuous Assessment

***** LCA: Laboratory Continuous Assessment

Total Credits Second Year BTech Semester - IV: 25

Total SY BTech Credits: 23 + 25 = 48

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FACULTY OF ENGINEERING AND TECHNOLOGY

B. Tech. Electrical and Computer Engineering (Third Year) (Batch 2021 – 2025)

Semester – V

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Microcontrollers and Applications	PC	3	-	2	3	1	60	50	40	**150**
2		Communication Networks	PC	3	-	2	3	1	60	50	40	**150**
3		Power Electronics	PC	3	-	2	3	1	60	50	40	**150**
4		Artificial Intelligence and Machine Learning	PC	2	-	2	2	1	60	50	40	**150**
5		Database Management Systems	PC	2	-	2	2	1	60	50	40	**150**
6		Object Oriented Programming Lab	PC	1	-	2	1	1	100	50	-	**150**
6		Minor Project - I	PR	-	-	2	-	1	-	50	-	**50**
7		Innovation & Entrepreneurship	HSS	2	-	-	2	-	60	-	40	**100**
8		Employment Skills Development	HSS	-	-	-	-	1	-	50	-	**50**
9		Indian Tradition, Culture and Heritage	WP	2	-	-	2	-	60	-	40	**100**
		Total		**18**	**-**	**14**	**18**	**8**	**520**	**400**	**280**	**1200**

****Assessment Marks are valid only if Attendance criteria are met**

***** CCA: Class Continuous Assessment

***** LCA: Laboratory Continuous Assessment

Total Credits Third Year BTech Semester - V: 26

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Semester – VI

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA	LCA	ETT	Total
1		Electric Vehicle Technology	PC	3	-	2	3	1	60	50	40	**150**
2		Data Science for Engineers	PC	2	-	2	2	1	60	50	40	**150**
3		Full Stack Development	PC	2	-	2	2	1	60	50	40	**150**
4		Professional Elective - I	PE	3	-	2	3	1	60	50	40	**150**
5		Professional Elective - II	PE	3	-	2	3	1	60	50	40	**150**
6		Environmental Science	BS	1	-	-	1	-	100	-	-	**100**
7		Finance and Costing	HSS	2	-	-	2	-	60	-	40	**100**
8		Minor Project - II		-	-	-	-	1		50	-	**50**
9		Humanities-Ethical, Moral and Social Sciences	WP	2	-	-	2	-	60	-	40	**100**
		Total		**18**	**-**	**10**	**18**	**6**	**520**	**300**	**280**	**1100**

****Assessment Marks are valid only if Attendance criteria are met**

* CCA: Class Continuous Assessment

* LCA: Laboratory Continuous Assessment

Total Credits Third Year BTech Semester - VI: 24

Total TY BTech Credits: 26 + 24 = 50

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FACULTY OF ENGINEERING AND TECHNOLOGY

B. Tech. Electrical and Computer Engineering (Final Year) (Batch 2021 – 2025)

Semester – VII

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA	LCA	ETT	Total
1		Cyber Security	PC	2	-	2	2	1	60	50	40	**150**
2		Smart Grid Systems	PC	3	-	2	3	1	60	50	40	**150**
3		Open Elective	OE	2	-	-	2	-	100	-	-	**100**
4		Capstone Project	PR	-	-	12	-	6	-	200	-	**200**
5		Scientific Studies of Mind, Matter, Spirit and Consciousness	WP	2	-	-	2	-	60	-	40	**100**
		Total		**9**	**-**	**16**	**9**	**8**	**280**	**300**	**120**	**700**

****Assessment Marks are valid only if Attendance criteria are met**

***** CCA: Class Continuous Assessment

***** LCA: Laboratory Continuous Assessment

Total Credits Final Year BTech Trimester - VII: 17

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FACULTY OF ENGINEERING AND TECHNOLOGY

B. Tech. Electrical and Computer Engineering (Final Year) (Batch 2021 – 2025)

Semester – VIII

Sr. No.	Course Code	Name of Course	Type	Weekly Work Load Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA	LCA	ETT	Total
1		Professional Elective in Online Mode or MOOC	OPE	2	-	-	2	-	100	-	-	**100**
2		Internship	PR	-	-	12	-	6	-	200	-	**200**
		Total		**2**	-	**12**	**2**	**6**	**100**	**200**	-	**300**

****Assessment Marks are valid only if Attendance criteria are met**

***** CCA: Class Continuous Assessment

***** LCA: Laboratory Continuous Assessment

Total Credits Final Year BTech Trimester - VIII: 8

Total Final Year BTech Credits: 17 + 8 = 25

Total B. Tech Credits: 45 + 48 + 50 + 25 =168 Credits

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List of Elective Courses:

Type of Elective	Elective Abbreviation	Course Code	Name of Course
Professional Elective	PE - I		PLC and Automation
			Java Programming
	PE - II		Robotics
			Software Engineering and Project Management
Professional Elective in Online Mode	OPE - I		Industrial IoT
			Business Analytics
			Industrial Drives and Systems
			Blockchain Technologies
			Power Quality
Open Elective	OE	To be taken from other schools of FoET than the students own school.	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Electrical Circuit Analysis**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**-**	**2**	**2 + 0 + 1**

Pre-requisites: Basics of electrical engineering, Laplace transform and Linear differential equations.

Course Objectives:

1. To learn network simplification techniques and develop strong foundation for electrical networks.
2. To develop analytical qualities in electrical circuits by the application of various theorems.
3. To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace transform approach.
4. To apply knowledge of network theory to simulate linear and nonlinear networks.

Course Outcomes: After completion of this course, students will be able to

1. Understand the basic concepts of network theory (CL-I).
2. Apply the problem-solving techniques to solve complex electrical networks (CL-I).
3. Demonstrate the transient response for understanding the behavior of electrical network (CL-II).
4. Analyze linear as well as nonlinear circuits using software tools (CL-IV).

Course Contents:

Basic Circuit Analysis and Simplification Techniques: Source transformation: voltage and current sources, mesh analysis, nodal analysis, super node and super mesh, coupled circuits and dot conventions. Concept of graph theory and various matrices.

Network Theorems: Superposition, Thevenin, Norton, maximum power transfer, reciprocity, Millman theorems for solving ac and dc circuits. Simulation of all theorems using software.

Analysis of Transient Response in Circuits: Initial and steady state condition of various networks, general and particular solution, time constant. Transient response of R-L, R-C and R-L-C network in time domain, analyzing transient response through simulation.

Analysis of Transient Response in Circuits: Laplace transform approach: standard test inputs as step, ramp, impulse and their Laplace transform, representation of R, L, C in s domain, transformed network, application of Laplace transform to solve series and parallel source free and source driven R-L, R-C and R-L-C circuits.

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Laboratory Exercises / Practical:

1. Basic Operations on Matrices.
2. Generation of various signals and sequences (periodic and aperiodic), such as unit impulse, step, square, saw tooth, triangular, sinusoidal, ramp, sinc.
3. Operations on signals and sequences such as addition, multiplication, scaling, shifting, folding, computation of energy, and average power.
4. Mesh and nodal analysis of electrical circuits.
5. Application of Network Theorems to Electrical Networks.
6. Waveform Synthesis using Laplace Transform.
7. Locating the zeros and poles and plotting the pole-zero maps in S plane and Z-Plane for the given transfer function.
8. Harmonic analysis of non-sinusoidal waveforms simulation of DC Circuits.
9. Design of Low Pass and High Pass filters.
10. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.

Learning Resources:

Text Books:

1. Singh R. R, *Network Analysis and Synthesis*. New Delhi: McGraw Hill Education India, 3rd edition, 2015.
2. Chakroborty A., *Circuit Theory*. New Delhi: Dhanpat Rai and Company, 7th edition, 2018.

Reference Books:

1. Hayt W. H. and Kemmerly J. J., *Engineering Circuit Analysis*. New Delhi: McGraw Hill Publication, 6th edition, 2005.

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiative
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Basic Circuit Analysis and Simplification Techniques:** Source transformation: voltage and current sources, mesh analysis, nodal analysis, super node and super mesh, coupled circuits and dot conventions. Concept of graph theory and various matrices.	**8**	**8**	
2	**Network Theorems:** Superposition, Thevenin, Norton, maximum power transfer, reciprocity, Millman theorems for solving ac and dc circuits. Simulation of all theorems using software.	**7**	**8**	
3	**Analysis of Transient Response in Circuits:** Initial and steady state condition of various networks, general and particular solution, time constant. Transient response of R-L, R-C and R-L-C network in time domain, analyzing transient response through simulation.	**8**	**6**	
4	**Analysis of Transient Response in Circuits:** Laplace transform approach: standard test inputs as step, ramp, impulse and their Laplace transform, representation of R, L, C in s domain, transformed network, application of Laplace transform to solve series and parallel source free and source driven R-L, R-C and R-L-C circuits.	**7**	**8**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Computer Organization and Operating Systems**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**-**	**-**	**2 + 0 + 0**

Pre-requisites: Fundamentals of Computers, Data Structures, Computer Organization

Course Objectives:

1. To discuss a basic structure of computers.
2. To understand the I/O ports and memory system of the computers.
3. To acknowledge the concepts of operating systems and process management.
4. To explain the concepts of Memory Management and I/O management

Course Outcomes: After completion of this course students will be able to

1. Understand the basics of computer organization.
2. Learn about I/O ports and memory system of the computer.
3. Comprehend key mechanisms of the Operating System functions.
4. Assess memory management issues.

Course Contents:

Basic Structure of Computers: Basic operational concepts, bus structures, performance – processor clock, basic performance equation, clock rate, performance measurement, memory location and addresses, memory operations, instructions and instruction sequencing, addressing modes, assembly language, basic input and output operations, stacks and queues, subroutines, additional instructions, encoding of machine instructions

I/O Ports and Memory System: Accessing i/o devices, interrupts – interrupt hardware, direct memory access, buses, interface circuits, standard i/o interfaces: PCI bus, SCSI bus, USB. basic concepts, semiconductor RAM memories, ROM, speed, size, and cost, cache memories – mapping functions, replacement algorithms, performance considerations.

Overview of Operating Systems: Classification of signals, elementary signals: exponential, sinusoidal, unit step, impulse, signum functions, ramp-time-shifting, scaling, sampling, folding. Signal operations, autocorrelation, cross correlation, concept of a process, processes and threads, concept of Multithreading, types of threads, thread programming using Pthreads, types of scheduling, Scheduling Algorithms: FCFS, SJF, Priority, Round Robin.

Memory Management: Memory management requirements, memory partitioning: fixed partitioning, dynamic partitioning, paging, segmentation, virtual memory file management: overview, file organization and access, file directories, file sharing, record blocking. i/o management: i/o devices, organization of the i/o functions, i/o buffering, disk scheduling.

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Learning Resources:

Reference Books:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software interface, Elsevier, Third Edition, 2005
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, Tata McGraw Hill, Fifth Edition, 2002
3. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13:978-0131828278.
4. W. Richard Stevens, Stephen A. Rago, Advanced Programming in the UNIX Environment, Addison- Wesley Professional, ISBN: 9780321637734,3rd Edition.
5. Sumitabha Das, Unix concepts and applications, McGraw Hill,ISBN-13- 978-0-07063546-3,4th Edition.

Web Resources:

Weblinks: http://williamstallings.com/OperatingSystems/

MOOCs: http://nptel.ac.in/courses/106108101/
https://in.udacity.com/course/introduction-to-operating- systems--ud923

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Test	Presentation	Attendance
20	20	15	5

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab/ Tutorial*	*Assess*
1	**Basic Structure of Computers:** Basic operational concepts, bus structures, performance – processor clock, basic performance equation, clock rate, performance measurement, memory location and addresses, memory operations, instructions and instruction sequencing, addressing modes, assembly language, basic input and output operations, stacks and queues, subroutines, additional instructions, encoding of machine instructions	**7**		
2	**I/O Ports and Memory System:** Accessing i/o devices, interrupts – interrupt hardware, direct memory access, buses, interface circuits, standard i/o interfaces: PCI bus, SCSI bus, USB. basic concepts, semiconductor RAM memories, ROM, speed, size, and cost, cache memories – mapping functions, replacement algorithms, performance considerations.	**7**		
3	**Overview of Operating Systems:** Classification of signals, elementary signals: exponential, sinusoidal, unit step, impulse, signum functions, ramp-time-shifting, scaling, sampling, folding. Signal operations, autocorrelation, cross correlation, concept of a process, processes and threads, concept of Multithreading, types of threads, thread programming using Pthreads, types of scheduling, Scheduling Algorithms: FCFS, SJF, Priority, Round Robin.	**8**		
4	**Memory Management**: Memory management requirements, memory partitioning: fixed partitioning, dynamic partitioning, paging, segmentation, virtual memory file management: overview, file organization and access, file directories, file sharing, record blocking. i/o management: i/o devices, organization of the i/o functions, i/o buffering, disk scheduling.	**8**		

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Analog and Digital Integrated Circuits**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**-**	**2**	**3 + 0 + 1**

Pre-requisites: Basics of Electrical and Electronics Engineering, Analog and Digital Electronics

Course Objectives:

1. To introduce basics of the op-amp and its parameters.
2. Learn to design and test various linear and non-linear op-amp based applications.
3. Learn different ADC and DAC types.
4. To learn design techniques for finite state machines.

Course Outcomes: After completion of this course students will be able to

1. Classify op-amps; identify parameters for a particular application (CL-II).
2. Design and test linear applications of op-amp (CL-VI).
3. Design and test non-linear applications of op-amp (CL-VI).
4. Develop state machines for various applications (CL-III).

Course Contents:

Basics of Operational Amplifiers: Fundamentals, introduction to differential amplifier, block diagram of op-amp, Basics of an op-amp, op-amp parameters, frequency response.

Linear Applications: Different op-amps configurations, integrator, differentiator, instrumentation amplifiers.

Non-Linear Applications: Comparators, Schmitt trigger, precision rectifiers, square wave and triangular wave generators.

Active Filters and Convertors: Need of active filter, classification based on order, alignment and function, Sallen & key topology types- LPF, HPF, BPF, BRF(Notch), All pass filters, D/A converter specifications, weighted resistor type, R-2 Ladder type, A/D converters specifications, flash type, successive approximation type, ICs like MC1408(DAC), ADC0808

Digital Integrated Circuit Technology & Convertors: Introduction to logic families, logic gates using CMOS. Design of synchronous sequential circuits**,** concept of Moore and Mealy machines, finite state machine design, sequence detectors.

Laboratory Exercises / Practical's:

1. Measurement of Op-amp parameters: Input offset voltage, input offset current and bias current, Slew rate (OP-07C, LF 356, LM741C)
2. Design and build Summing amplifier/Averaging/ Integrator for given specifications.
3. Design and build Instrumentation amplifier (3 Op-amp based) for given specifications and validate performance using IC AD620 or equivalent.
4. Design and build inverting Schmitt trigger (Symmetric and Asymmetric) for given specifications and study performance of comparators IC's like LM311/LM339.
5. Design and build square wave and triangular wave generator for given specifications with

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variable duty cycle and voltage limiters.

6. Design and build Precision rectifier for given specifications.
7. Design a 2-bit R-2R DAC/2 bit ADC. Verify performance using ICs like MC1408(DAC), or equivalent DAC/ADC0808.
8. Design and build Active LPF/ HPF for given specifications.
9. Implementation of logic gates using TTL/CMOS
10. Design and implement sequence detector using JK Flip flops.

Project based learning:

PBL1: Any Application circuit to validate using op-amp.

PBL2: Using basic logic gates implement any application in real world.

Learning Resources:

Text Books:

1. Ramakant A. Gaikwad, *Op-Amps and Linear Integrated Circuits.* New Delhi: PHI, 4th edition, 2015.
2. Thomas L. Floyd, *Digital Fundamentals*. New Jersey: Pearson Education ,11th edition, 2015.

Reference Books:

1. S. Salivahanan and V. S. Kanchana Baskaran, *Linear Integrated Circuits.* New Delhi: McGraw Hill Education Pvt. Ltd, 2nd edition, 2014.
2. Sergio Franco, *Design with Operational Amplifiers and Analog Integrated Circuits.* New York: Tata McGraw Hill, 3rd edition, 2008.

Pedagogy:

- Power point presentations, videos
- Project based learning

Class Continuous Assessment (CCA) (60 Marks)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
20	20	20

Laboratory Continuous Assessment (LCA) (50 Marks)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15	15	20

Term End Examination:

Term end exam of 40 marks will be based on entire syllabus.

Syllabus:

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Unit	Contents	Workload in Hrs		
		Theory	*Lab/ Tutorial*	*Assess*
1	**Basics of Operational Amplifiers**: Fundamentals, introduction to differential amplifier, block diagram of op-amp, Basics of an op-amp, op-amp parameters, frequency response.	**9**	**6**	
2	**Linear Applications:** Different op-amps configurations, integrator, differentiator, instrumentation amplifiers.	**9**	**8**	
3	**Non-Linear Applications**: Comparators, Schmitt trigger, precision rectifiers, square wave and triangular wave generators.	**9**	**8**	
4	**Active Filters and Convertors**: Need of active filter, classification based on order, alignment and function, Sallen & key topology types- LPF, HPF, BPF, BRF(Notch), All pass filters, D/A converter specifications, weighted resistor type, R-2 Ladder type, A/D converters specifications, flash type, successive approximation type, ICs like MC1408(DAC), ADC0808	**9**	**4**	
5	**Digital Integrated Circuit Technology & Convertors**: Introduction to logic families, logic gates using CMOS. Design of synchronous sequential circuits**,** concept of Moore and Mealy machines, finite state machine design, sequence detectors	**9**	**4**	

Course Code	**EEE**
Course Category	**Professional Core**

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Course Title	Control Systems			
Weekly Teaching Hrs. and Credits	L	T	Laboratory	Credits
	3	0	2	3 + 0 + 1

Pre-requisites: Knowledge of electrical and electronic circuits

Course Objectives:

1. To impart knowledge of the elements of control system and their modeling using various techniques.
2. To understand relationship among the parameters of control system and specifications of control system in time domain and frequency domain.
3. To identify various methods to determine the stability of control system.
4. To learn various controllers.

Course Outcomes: After completion of this course students will be able to

1. Identify the system using mathematical model (CL-II).
2. Explain the relationship among the parameters of control system and specifications of control system in time domain and frequency domain (CL-II).
3. Analyze control system using different methods to determine stability of system (CL-III).
4. Understand PLC ladder and Tune PID controller (CL-II).

Course Contents:

Control System Modelling: Basic elements of control system, open loop and closed loop systems, differential equations and transfer function, modelling of electric systems, translational mechanical systems, block diagram reduction techniques, signal flow graph.

Time Response Analysis: Standard input signals, time response analysis of first order systems, and time response analysis of second order systems, steady state errors and error constants, design specifications for second order systems.

Stability Analysis: Concept of stability, Routh-Hurwitz criterion, relative stability, root locus technique, gain margin, phase margin from root locus technique, stability of the system from root locus.

Frequency Response Analysis: Frequency domain versus time domain analysis and its correlation. Bode plot, Nyquist plot, frequency domain specifications from the plots, stability analysis from plots.

State Variable Representation and Controllers: State space advantages and representation, transfer function from state space, physical variable form, phase variable forms (controllable canonical form, observable canonical form), introduction to PLC: P, PI, PD and PID controllers, introduction to digital circuit and gates.

Laboratory Exercises / Practical (using software):

1. To obtain pole, zeros, and gain value of given transfer function.
2. To obtain transient response of second order system.
3. To plot the root locus for a given transfer function of the system.
4. Determination of bode plot for second order system.
5. To obtain frequency response of given lag/lead network (using hardware).
6. To obtain the state space model from the given transfer function.
7. Implement basic logic gates using Programmable Logic Controller.

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8. Study of controllability of the system.
9. Study of Observability of the system.
10. To control the closed loop system using PID controller.

Learning Resources:

Text Books:

1. Nagrath N. J. and Gopal M., *Control System Engineering*. New Delhi: New Age International Publishers, 5th edition, 2012.
2. Johnson C. D., *Process Control and Instrumentation*. Houston: Pearson Publication, 5th edition, 1997.

Reference Books:

1. Palani S., *Control Systems Engineering.* New Delhi: Tata McGraw Hill Education, 2nd edition, 2010.
2. Anand Kumar A., *Control Systems*. New Delhi: Prentice Hall of India, 2nd edition, 2014.

Web Resources:
weblinks: https://nptel.ac.in/courses/108101037/
MOOCs: https://www.mooc-list.com/tags/control-system

Pedagogy:

- Power Point Presentations
- Videos
- Group Activities
- Project based learning

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Control System Modelling**: Basic elements of control system, open loop and closed loop systems, differential equations and transfer function, modelling of electric systems, translational mechanical systems, block diagram reduction techniques, signal flow graph.	**9**	**4**	
2	**Time Response Analysis**: Standard input signals, time response analysis of first order systems, time response analysis of second order systems, steady state errors and error constants, design specifications for second order systems.	**9**	**6**	
3	**Stability Analysis:** Concept of stability, Routh-Hurwitz criterion, relative stability, root locus technique, gain margin, phase margin from root locus technique, stability of the system from root locus.	**9**	**6**	
4	**Frequency Response Analysis**: Frequency domain versus time domain analysis and its correlation. Bode plot, Nyquist plot, frequency domain specifications from the plots, stability analysis from plots.	**9**	**4**	
5	**State Variable Representation and Controllers:** State space advantages and representation, transfer function from state space, physical variable form, phase variable forms (controllable canonical form, observable canonical form), introduction to PLC: P, PI, PD and PID controllers, introduction to digital circuit and gates.	**9**	**10**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Electrical Machines - I**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Primary knowledge of Basic Electrical Engineering

Course Objectives:

1. To understand electro-mechanical conversion processes.
2. To study the construction, working principle and operation of various electrical machines.
3. To select ac and dc machines for specific applications.
4. To study and analyze the performance of the machines.

Course Outcomes: After completion of this course students will be able to

1. Explain fundamental principles of electrical machines (CL-I).
2. Understand construction and working of various electrical machines (CL-II).
3. Select various types of electrical machines for different applications (CL-III).
4. Analyze the performance parameters of various machines (CL-IV).

Course Contents:

Principles of Electromechanical Energy Conversion: Introduction, flow of Energy in electromechanical devices, energy in magnetic systems, singly excited system, determination of mechanical force, mechanical energy, torque equation, doubly excited system, energy stored in magnetic field, electromagnetic torque, generated emf in machines, general classifications of electrical machines.

Transformers: Introduction, ideal, practical transformer. Resistance, leakage reactance, and leakage impedance, equivalent circuit, direct and indirect loading tests to find efficiency and regulation, autotransformer, three phase transformers connections and their applications.

DC Machines: Construction, working principle and operation of dc machine. EMF equation and significance of back emf, types, characteristics, speed control and applications of dc motors, torque equation, losses, power flow diagram and efficiency, dc motor starters.

Three Phase Induction Motor: Construction, working principle, types, torque equation, torque-slip characteristics, condition for maximum torque, ratios, losses, efficiency and power-flow diagram, necessity of starter and speed control methods.

Single Phase Motors: Construction, working principle and applications of split phase induction motors, shaded pole induction motor. Universal motor: construction, working principle, speed torque characteristics, applications of various motors.

Laboratory Exercises / Practical:

1. Equivalent circuit of single-phase transformer using open circuit and short circuit test.
2. Polarity test on single phase transformers.
3. Speed control of dc shunt motor using armature voltage and field current control method.
4. Load test on dc shunt motor.
5. Load test on dc series motor.
6. Load test on 3-phase induction motor.

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7. No load and blocked-rotor test on 3-phase induction motor.
8. Variable voltage variable frequency drive for 3-phase induction motor.
9. Speed torque characteristics of single-phase induction motor.
10. Study of ac and dc motor starters.

Learning Resources:

Text Books:

1. Nagrath I. J. and Kothari D.P., *Electrical Machines*. New Delhi: Tata McGraw-Hill Publication, 4th edition, 2010.
2. Chakrabarti Abhijit and Debnath Sudipta, *Electrical Machines*. New Delhi: Tata McGraw-Hill Publication, 2nd edition, 2015.
3. Husain Ashfaq, *Electrical Machines.* New Delhi: Dhanpat Rai & Sons. 2nd edition, 2008.

Reference Books:

1. Theraja B. L. and Theraja A. K., *A Textbook of Electrical Technology, Vol. II*. New Delhi: S. Chand Publication, 1st revised edition, 2008.
2. Fitzgerald A. E., Charles Kingsley Jr., and Stephen D. Umans, *Electrical Machinery*. New Delhi: Tata McGraw-Hill Publication, 6th edition, 2003.

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:
Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Principles of Electromechanical Energy Conversion**: Introduction, flow of Energy in electromechanical devices, energy in magnetic systems, singly excited system, determination of mechanical force, mechanical energy, torque equation, doubly excited system, energy stored in magnetic field, electromagnetic torque, generated emf in machines, general classifications of electrical machines.	**9**	**2**	
2	**Transformers:** Introduction, ideal, practical transformer. Resistance, leakage reactance, and leakage impedance, equivalent circuit, direct and indirect loading tests to find efficiency and regulation, autotransformer, three phase transformers connections and their applications.	**9**	**4**	
3	**DC Machines**: Construction, working principle and operation of dc machine. EMF equation and significance of back emf, types, characteristics, speed control and applications of dc motors, torque equation, losses, power flow diagram and efficiency, dc motor starters.	**9**	**8**	
4	**Three Phase Induction Motor:** Construction, working principle, types, torque equation, torque-slip characteristics, condition for maximum torque, ratios, losses, efficiency and power-flow diagram, necessity of starter and speed control methods.	**9**	**8**	
5	**Single Phase Motor**: Construction, working principle and applications of split phase induction motors, shaded pole induction motor. Universal motor: construction, working principle, speed torque characteristics.	**9**	**8**	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Linux based Python Lab**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	0	**0**	**2**	**0 + 0 + 1**

Pre-requisites

- Basic knowledge of operating system
- Basic knowledge of programming concepts

Course Objectives:

1. To learn basic concepts of Linux operating system.
2. To study fundamentals of Python programming.
3. To use Python for data analytics of real-life applications.

Course Outcomes:

After completion of this course, students will be able to:

1. Identify features and use of Linux environment.
2. Apply Python programming to real life problems.
3. Perform data analytics using Python on real-life applications.

Course Content:

1. Linux operating system: Installation and Basics
2. Fundamentals of Python Programming
3. Introduction to Basic data structures of Python
4. Introduction to Advanced Data Structures of Python
5. File Handling Concepts
6. Exploratory Data Analysis

Laboratory Exercises / Practical:

Sr. No.	Contents	Workload in Hrs
1	Installation of Linux operating system	2
2	Execution of Basic Commands	2
3	Introduction to fundamentals of Python	2
4	Introduction to Basic data structures of Python (Attempt any three) a) Write a program to check if a number is a perfect number. b) Python Program to Count the Occurrences of Each Word in a Given String Sentence. c) Write a python program to print numbers between 1 to 50 which are divisible by 6 & 4. d) Write a Python program to get numbers divisible by 2 from a list. e) Write a python program to create set of n numbers. Print max of set elements. f) Write a python program to check even numbers from a set of numbers from 1 to 50.	6
	Introduction to Advanced Data Structures of Python (Any two) a) Write a python program to create a sorted merged list of two unsorted lists.	6

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	b) Write a python program to create dictionary of vehicles (mode_lno, manufacturer, year). Write a function to search a key into it c) Write a python program to create dictionary of customer (id, name, ph_no). Write a function to search a key into it d) Write a python program to create dictionary of mobiles (brand, color, memory). Write a function to search a key into it e) Write a python program to create dictionary of bank (name, account_no, balance). Write a function to search a key into it	
6	File Handling Concepts (Attempt any one) a) Write a python program to perform following file handling operations: Create, Open, Append, Read, Write b) Write a python program to count occurrences of characters, numbers, newlines, special characters, spaces from a file and write it in a new file c) Create a database of (Bank/library/students) using lists and write it in a file. Perform different operations like read, write, search, update, delete.	4
7	Exploratory data analysis using Pandas, Numpy and Matplotlib. Student can choose any two of the problem statements from the Problem Statements Repository for exploratory data analysis. They can download required datasets from Kaggle for analysis. (https://www.kaggle.com) Course Coordinators of respective schools can create their own problem statements if they want and give them to students for solving, in that case students need not select problem statements from Repository. **Problem Statements Repository:** 1. Download the 3D printer dataset from Kaggle and perform following operations on the data: • Read the csv file in python notebook • Display top records of the dataset • Display size of the dataset (no of records) • Check if null value is present • Plot correlation matrix of the data 2. Download Mechanical Tools Classification dataset and perform following operations on the data: a. Importing Image data into NumPy arrays b. Plotting NumPy arrays as Images c. Applying pseudo color schemes to image plots d. Examining a specific data range using histogram 3. Download Gear Box Fault Diagnosis dataset and perform following operations on the data: • Plot Time series of vibration data • Plot Time series of the 4 accelerometers • Histogram of the four vibration signals • Plots of probability density functions of vibration signals 4. Download cnc-milling-machine-tool-wear-detection dataset and perform following operations on the data: • Mean value of velocity, voltage, feed rate (x,y,z) • Distribution of feed rate, clamp_ pressure	8

- Correlation of each feature

5. Building a Motion-Activated Alarm System (Assignment Raspberry Pi kit)
   - Set up a new Raspberry Pi
   - Run Python on the Raspberry Pi using the Mu editor or remotely over SSH
   - Read input from physical sensors connected to the Raspberry Pi
   - Send output to external components using Python

6. Build button-controlled "music box" (Assignment with Raspberry Pi kit)
   - Play sounds in Python with pygame
   - Use the Python gpiozero library to connect button presses to function calls
   - Use the dictionary data structure in Python
7. Face Tracking using openCV and Ardiuno
   - Facial detection identifies and localizes human faces and ignores any background objects such as curtain, windows, trees, etc. OpenCV uses Harr cascade of classifiers where each frame of the video is passed through stages of classifiers and if the frame passes through all the classifiers, the face is present.
   - These coordinates are passed to the Arduino UNO using the pyserial library.
8. Smart Phone Controlled Mouse:
   - The project involves a smartphone application that sends the data, scroll status, left and right click status using Bluetooth to the Arduino Uno connected to the HC-05 Bluetooth module. These data upon reception to the Arduino is manipulated to make changes in the current cursor's position to obtain a new position. The resulting data along with scroll and button status is then printed as the output that is recognized to be read by the Python sketch. The Python sketch is made to execute mouse actions using the mouse module.
9. Download Stock market data and perform exploratory data analysis on Financial Data
   - Calculate the stocks daily returns and obtain correlations
   - Perform interactive data visualization using Plotly Express
   - Use matplotlib finance API for plotting financial Data
10. Download Chemical Engineering dataset and perform following operations on data:
    - Investigating chemical counts
    - Plot no of products containing chemicals
    - Find chemicals in Baby Products
11. Read the Chemicals in Cosmetics dataset and perform following operations on data.
    - Import data to pandas dataframe and clean the data, including standardizing the ProductName, CompanyName, and ChemicalName columns
    - What is the most frequently reported chemical? Create plot for visualization.

- Which are highest chemicals reported? Is Titanium Dioxide very harmful? Group the data by the product ID and primary category, and plot out a chart and find the answers.
- Plot the Histogram of ratio if product containing very harmful chemical to total products reported.

12. Read the data and explore different features provided in the data and give a brief chemical background of each feature. Also visualize the distributions of these features in the dataset.
    - Load training data and get list of molecule types
    - Visualize distribution of scalar coupling coefficient
13. Download dipole moment data and perform following operations on the data.
    - Visualize the distribution of dipole moments in X, Y and Z directions
    - Visualize the distribution of dipole moments in all directions for each molecule type

Learning Resources:

Text Books:

1. Unix concepts and applications, Fourth Edition, Sumitabha Das, TMH
2. Eric Matthas, Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming

Reference Books:

1. William Shotts, The Linux Command Line, 2nd Edition: A Complete Introduction
2. David Beazley Python Cookbook: Recipes for Mastering Python 3

Supplementary Reading:

Web Resources:

www.nptel.ac.in/course.php,
https://videoken.com,
https://www.tutorialspoint.com

MOOCs: https://www.udemy.com

Pedagogy:

1. PPT presentation
2. Smart board teaching
3. Few video lecturers (ex. NPTEL)
4. Hands-on experiments

Assessment Scheme:

Laboratory Continuous Assessment (LCA) (50 Marks)

Practical	Problem Based Learning	Student Initiative
30	10	10

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Course Code				
Course Category	**Professional Core**			
Course Title	**Data Structures and Algorithms**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Programming and Problem Solving

Course Objectives:

1. Understand the concept of data structures using C.
2. Create and manipulate linear data structures like arrays, linked list, stack, and queue.
3. Create and manipulate nonlinear data structures like graphs and tress.
4. Develop the ability to write program in C for problem solving using suitable data structure.

Course Outcomes: After completion of this course students will be able to

1. Develop skills of writing and analyzing algorithms to solve problem (CL-III).
2. Identify and apply the concept of Linear Data Structures for problem solving and its applications (CL-III).
3. Demonstrate the usage and applications of stacks and queues (CL-II).
4. Apply concept of nonlinear data structure (Trees) for problem solving and its applications (CL-III).
5. Apply concept of Nonlinear data structure (Graphs) for problem solving and its applications (CL-III).

Course Contents:

Introduction to Data Structures: Data, Data Objects, and Data Structure, Classification of data structure (Primitive and Non-primitive, Linear and Non-linear, Static and dynamic), C Basics, Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs- Linear, Quadratic, Cubic, Logarithmic.

Linked List: Introduction to Linked Lists, Dynamic memory allocation, Operations on Singly Linked List, Doubly Linked List, Circular Linked List, Case study: Polynomial addition using linked list, Garbage collection.

Stacks: Representation of Stack using Array and Linked List, Stack Applications: Reversing List, Arithmetic expressions conversion and evaluation.
Queues: Representation of Queue using Array and Linked List, Circular Queue, Application: Job scheduling in Operating System.

Non-Linear Data Structure (Trees): Binary Tree**:** Basic Terminologies, Properties of Binary Trees, Representation of Binary Trees, Binary Tree Traversal, Binary Search Trees (BST) and its operations, Reconstruction of Binary Tree, Applications of Tree.

Non-Linear Data Structure (Graph): Graph Terminologies, Sequential and Linked Representation of Graph, Creation and Traversal of Graph, Spanning Tree, Minimum Spanning Tree-Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Shortest Path Algorithm

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Laboratory Exercises / Practical:

1. Searching
2. Sorting
3. Operations on linked list.
4. Palindrome using stack
5. Expression conversion
6. Circular queue.
7. Binary Search Tree creation and Traversals.
8. Graph Creation and Traversal
9. Mini project.

Learning Resources:

Text books:

1. Horowitz, S. Sahani, S. Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2008.

Reference Books:

1. Balgurusamy E., *Programming in ANSI.* New Delhi: Tata McGraw-Hill, 3rd edition.
2. ISRD Group, *Data Structures Using C*. New Delhi: Tata McGraw Hill, 2nd Edition, 2012.
3. Yedidyah Langsam, Moshe J Augenstein, and Aaron M Tenenbaum, *Data structures using C and C++*.New Delhi: PHI Publications, 2nd edition.

Supplementary Reading:

1. Peter van der Linden, *Experts C Programming.* Pearson Education
2. Seymour Lipschutz, *Data Structure with C.* New Delhi: Tata McGraw-Hill. Schaum's Outlines.

Web Resources:

www. leetcode.com
www.hackerrank.com/domains/algorithms/warmup

Web links:

www.tutorialspoint.com/data_structures_algorithms/
www.programiz.com/dsa

MOOCs:

www.edx.org/course/foundations-data-structures-iitbombayx-cs213-1x-0

Pedagogy:

- White board
- Group Activities
- Power Point Presentations, Videos
- Co-teaching

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Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Test	Case study	Mid term
20	15	5	20

Laboratory Continuous Assessment (LCA) (50 Marks)

Practical	Oral based on practical	Any other (Problem solving though coding platform)
15	**25**	**10**

Term End Examination: 40 Marks

Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction to Data Structures:** Data, Data Objects, and Data Structure, Classification of data structure (Primitive and Non-primitive, Linear and Non-linear, Static and dynamic), C Basics, Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.	**15**		-
2	**Linked List:** Introduction to Linked Lists, Dynamic memory allocation, Operations on Singly Linked List, Doubly Linked List, Circular Linked List, Case study: Polynomial addition using linked list, Garbage collection.	**8**		--

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3	**Stacks:** Representation of Stack using Array and Linked List, Stack Applications: Reversing List, Arithmetic expressions conversion and evaluation. **Queues:** Representation of Queue using Array and Linked List, Circular Queue, Application: Job scheduling in Operating System.	**8**		-
4	**Non-Linear Data Structure (Trees):** Binary Tree**:** Basic Terminologies, Properties of Binary Trees, Representation of Binary Trees, Binary Tree Traversal, Binary Search Trees (BST) and its operations, Reconstruction of Binary Tree, Applications of Tree.	**7**		-
5	**Non-Linear Data Structure (Graph):** Graph Terminologies, Sequential and Linked Representation of Graph, Creation and Traversal of Graph, Spanning Tree, Minimum Spanning Tree-Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Shortest Path Algorithm	**7**		

Unit	**Contents**	**Workload in Hrs**		
		Theory	***Lab***	***Assess***
1	Write a program to search a number from the given list of numbers stored in an array using linear search and binary search.		**2**	
2	Write a C program to create a student database using an array of structures and apply: (a) Bubble sort, (b) Insertion sort and display the output after each pass.		**2**	
3	Write a C program to perform the following operations on a singly linked list: (a) Create (b) Delete (c) Insert (d) Display (e) Search.		**4**	
4	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the		**4**	

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	original-in a palindrome, the sequence will be identical. Write C program with functions a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not			
5	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions.		**4**	
6	Pizza parlor accepting maximum M orders. Orders are served on a first come first-served basis. Order once placed cannot be canceled. Write a C program to simulate the system with a simple queue using an array. Implement the same system using Circular Queue		**2**	
7	Write a C program to perform the following operations on Binary Search Tree: (a) Create (b) Search (c) Traverse (in-order, pre-order, post-order recursive)		**4**	
8	Write a C program to create graph using adjacency matrix and traverse using BFS and DFS method.		**4**	
9	Mini Project		**4**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Electrical Machines - II**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Basics of electrical machines.

Course Objectives:

1. To understand basics of synchronous machine.
2. To study the construction, working principle and operation of special purpose motors.
3. To analyze the performance of the machines.
4. To design transformer for specific rating.

Course Outcomes: After completion of this course students will be able to

1. Describe fundamental principles and classification of synchronous machine (CL-I).
2. Explain various special purpose motors and its applications (CL-II).
3. Understand the design concepts with specification (CL-II).
4. Determine the performance parameters of transformer (CL-IV).

Course Contents:

Synchronous generator: Details of synchronous machines, emf equation and winding factors, armature reaction and effect of power factor on load angle, determination of voltage regulation – EMF, MMF and ZPF method, parallel operation of alternators.

Synchronous motor: Principle of operation, power flow, equivalent circuit, synchronous motor with different excitation, effect of changing excitation on constant load and effect of increased load with constant excitation, V and inverted V curves, starting methods, hunting effect.

Special motors-I: Linear induction motor: Construction, working, principle and its applications. Servo motor: construction, working and applications. Steeper motor: construction, working of permanent magnet, variable reluctance and hybrid steeper motor.

Special motors-II: Brushless dc motor**:** construction, principle, working, torque speed characteristics and concept of electronic commutation. Switch reluctance motor: Construction, principle, operation, power flow, effects of saturation, performance and torque speed characteristics.

Introduction to machine design: Design factors, limitations in design, modern trends in design, manufacturing techniques. Transformer design: choice of specific loadings, expression for volts/turn, core design, windings design. Design of tank and cooling tubes.

Laboratory Exercises / Practical:

1. Regulation of alternator by direct loading.
2. Regulation of alternator by EMF and MMF method.
3. Determination of X_d and X_q of a salient pole synchronous machine from slip test.
4. Synchronization of alternators using lamp and synchroscope method.
5. Load test on three phase synchronous motor.
6. V curve and inverted V curve of a 3-phase synchronous motor.
7. Performance characteristics of brushless dc motor.
8. Study and testing of switch reluctance motor using MATLAB.

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9. Study and testing of stepper motor using MATLAB.
10. Transformer design using FEM method.

Learning Resources:

Text Books:

1. Kothari D.P., and Nagrath I.J., *Electrical Machines*. New Delhi: Tata McGraw Hill Education India Private Limited, 3rd edition, 2004.
2. Venkataratnam. K., *Special Electric Machines.* Boca Raton: CRC Press,4th edition, 2015

Reference Books:

1. T.J.E. Miller, *Brushless Permanent magnet and Reluctance Motor Drives*. Oxford: Clarendon press, Oxford 4th edition, 2016.
2. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., *Electric Machinery*, New York: McGraw Hill, 4th edition, 2016.

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Synchronous generator:** Details of synchronous machines, emf equation and winding factors, armature reaction and effect of power factor on load angle, determination of voltage regulation – EMF, MMF and ZPF method, parallel operation of alternators.	**10**	**14**	
2	**Synchronous motor:** Principle of operation, power flow, equivalent circuit, synchronous motor with different excitation, effect of changing excitation on constant load and effect of increased load with constant excitation, V and inverted V curves, starting methods, hunting effect.	**10**	**6**	
3	**Special motors-I:** Linear induction motor: Construction, working, principle and its applications. Servo motor: construction, working and applications. Steeper motor: construction, working of permanent magnet, variable reluctance and hybrid steeper motor.	**8**	**2**	
4	**Special motors-II:** Brushless dc motor**:** construction, principle, working, torque speed characteristics and concept of electronic commutation. Switch reluctance motor: Construction, principle, operation, power flow, effects of saturation, performance and torque speed characteristics.	**8**	**4**	
5	**Introduction to machine design:** Design factors, limitations in design, modern trends in design, manufacturing techniques. Transformer design: choice of specific loadings, expression for volts/turn, core design, windings design. Design of tank and cooling tubes.	**9**	**4**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Power Systems and Protection**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	4	**0**	**2**	**4 + 0 + 1**

Pre-requisites: Basics of electrical engineering and electrical machines

Course Objectives:

1. To identify the basic structures and components of electrical power systems and calculate various related electrical parameters
2. To acquire knowledge requirements of mechanical and electrical design of overhead transmission lines.
3. To grasp knowledge of construction and working principles of various relays and circuit breakers
4. To understand various types of faults and protection schemes in power systems components.

Course Outcomes: After completion of this course students will be able to

1. Design of electrical and mechanical aspects in overhead transmission (CL – III)
2. Evaluate different electrical parameters of transmission line configurations (CL - III).
3. Identify, formulate and solve problems in protection of power systems (CL – IV).
4. Select and allocate proper protection scheme for the power systems (CL – IV)

Course Contents:

Power system structure: Structure of power system, evolution of power systems, power plants, national grid, factors and terms associated with the generating station, types of conductors, overhead line supports, spacing, span, sag, concept of real, reactive and complex power and their effect on power system operation.

Transmission line parameters and models: Per unit system, reactance diagram calculation of resistance, inductance and capacitance of single phase, three phase, double circuit lines, concept of GMR and GMD, skin effect, proximity effect and corona effect, transmission line models - short, medium and long lines.

Power Flow and Power System Stability: voltage and current waves, surge impedance loading, complex power flow, power transmission capability, Ferranti effect, tuned power lines, methods of voltage control, stability, dynamics of synchronous machine, swing equation, power angle equation and curve, equal area criterion.

Protection and relays: Need for protective systems, faults, causes, effects, classification of relays, zones of protection, primary and backup protection, basic trip circuit, operating principles of different relays, numerical relay's introduction, block diagram.

Circuit Breakers: Arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, circuit breaker ratings, classification of C.B.s - air break, air blast, vacuum, oil, SF6.

Protection Schemes in Power Systems: Differential and earth fault protection in transformers, Buchholz relay, protection against stator fault, ground fault, unbalanced loading in alternators, distance protection in transmission lines.

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Laboratory Exercises / Practical:

1. Experiment to determine efficiency and regulation of medium transmission line and to study Ferranti effect.
2. Experiment to study capacitive VAR compensation.
3. Synchronization of alternators.
4. Simulation of the effect of line parameters on performance of transmission line.
5. Formation of bus admittance matrix using MATLAB.
6. Testing of fuse, MCB and ACB.
7. Obtaining operating characteristics of IDMT relay.
8. Using distance relays for transmission line protection.
9. Using Buchholz relay for transformer protection.
10. Using differential protection relay for transformer protection.

Learning Resources:

Reference Books:

1. Grainger John J. and W. D. Stevenson Jr, *Power System Analysis* McGraw Hill Education, 2017.
2. I. J. Nagrath, D. P. Kothari, *Modern Power System Analysis*. New Delhi: Tata McGraw Hill Publishing Co. Ltd., 4th edition, 2011
3. O. I. Elgerd, *Electrical energy systems theory: An introduction. New Delhi:* Tata McGraw Hill, 2nd Edition, 2017
4. C. Russel Mason. Art and Science of Protective Relaying, Wiley 1966
5. S. S. Rao, Ravish R. Singh. Switchgear, Protection and Power System, Khanna Publishers, 13th edition, 2008

Supplementary Reading:

1. Hadi Sadat, *Power System Analysis.* PSA Publishing LLC, 3rd Edition, 2011
2. J. D. Glover and M. Sarma, *Power System Analysis and Design*. 5th Edition, Brooks/ Cole Publishing, 2011
3. A.R. Van, C. Warrington. Protective Relays – Theory and Practice, Chapman and Hall n, 3rd Edition,

Web Resources:

http://nptel.ac.in/courses/108102047/
http://nptel.ac.in/courses/108105067/

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

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Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Power system structure: S**tructure of power system, evolution of power systems, power plants, national grid, factors and terms associated with the generating station, types of conductors, overhead line supports, spacing, span, sag, concept of real, reactive and complex power and their effect on power system operation	**9**	**4**	
2	**Transmission line parameters and models:** Per unit system, reactance diagram calculation of resistance, inductance and capacitance of single phase, three phase, double circuit lines, concept of GMR and GMD, skin effect, proximity effect and corona effect, transmission line models - short, medium and long lines.	**12**	**6**	
3	**Power Flow and Power System Stability:** voltage and current waves, surge impedance loading, complex power flow, power transmission capability, Ferranti effect, tuned power lines, methods of voltage control, stability, dynamics of synchronous machine, swing equation, power angle equation and curve, equal area criterion.	**12**	**4**	
4	**Protection and relays:** Need for protective systems, faults, causes, effects, classification of relays, zones of protection, primary and backup protection, basic trip circuit, operating principles of different relays, numerical relay's introduction, block diagram.	**9**	**4**	
5	**Circuit Breakers:** Arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, circuit breaker ratings, classification of C.B.s - air break, air blast, vacuum, oil, SF6.	**9**	**6**	
6	**Protection Schemes in Power Systems:** Differential and earth fault protection in transformers, Buchholz relay, protection against stator fault, ground fault, unbalanced loading in alternators, distance protection in transmission lines.	**9**	**6**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Renewable Energy Systems**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Electrical generator, energy conversion basics.

Course Objectives:

1. Recognize the role of renewable energy sources with reference to energy scenario in nation as well as world.
2. To develop fundamental knowledge of solar, wind and other renewable energy systems
3. To learn about renewable technologies, availability and characteristics of renewable sources.
4. To familiarize with basic projects in renewable energies.

Course Outcomes: After completion of this course students will be able to

1. Understand the need of renewable energy on the basis of energy scenario.
2. Select the renewable energy source suitable for particular geographical area.
3. Model different standalone, off grid energy systems as per requirement.
4. Adopt the basic steps of solar, wind and biomass projects.

Course Contents:

Introduction: Classification of energy, domestic and global energy scenario, environmental impacts of fossil fuels, global primary energy reserves, energy consumption, energy sources and utilization, forms and characteristics of renewable. Work power energy types, their equations and conversions from one form to another.

Solar energy: Solar radiation, global, direct and diffuse radiation, solar irradiance, optimal tilt angle and power output, daily and annual radiation pattern. Solar photovoltaic: on grid, off grid and hybrid systems, components of solar PV systems, MPPT, applications. Solar thermal: non concentrating and concentrating type collectors, non-tracking, single and double axis tracking type collectors, various solar cookers, distillation plant, solar dryer parabolic dish Sterling engine, solar wind energy and different applications.

Biomass energy: Biomass sources, photosynthesis, bio-mass cycle and carbon neutral. Biomass energy conversion: direct combustion, thermo chemical and biochemical. Gasification and incineration, syngas and producer gas. Methods of pyrolysis, fermentation and anaerobic digestion. Biogas plants: structure, design and types and its applications**.**

Wind energy: History, wind energy scenario, origin and causes of wind, carioles effect, wind Special Scales. Fundamentals of wind energy: Wind flow, swept area, air density, capacity factor, Betz limit and power coefficient. Wind characteristics, resource assessment, types of wind turbines. Components, functions, controls and various electrical machines used in wind turbine. Applications such as water pumping hybrid power system. Hydraulic wind turbine.

Other alternate sources: Ocean thermal energy conversion: closed cycle, open cycle, types of plants, advantages and disadvantages. Geothermal: history & installed capacity, power plant types. Tidal and wave energy: tidal force, types of tidal power plants, advantages and disadvantages. Micro/Mini hydropower system. Fuel cells. Hydrogen Energy: benefits, storage, applications, advantages, disadvantages and problems associated with hydrogen energy. Environmental issues of energy

services**.**

Laboratory Exercises / Practical:

1**.** VI characteristics of solar module and effect of Tilt angle on solar module.
2. Series parallel solar PV.
3. VI characteristics of Wind turbine.
4. Effect of barrier on Wind turbine.
5. Theoretical Designing of Solar Power Plant according to estimated load.
6. Bio gas Plant design.
7. Wind Power Plant design.
8. Case study to evaluate performance of any renewable plant.

Learning Resources:

1. Gilbert M. Masters, *Renewable and Efficient Electrical Power Systems*, Wiley – IEEE Press, August 2004.
2. Godfrey Boyle, *Renewable Energy*, Third edition, Oxford University Press, 2012.
3. Chetan Singh Solanki, *Solar Photovoltaics-Fundamentals, Technologies and Applications*, PHI Third Edition, 2015.

Supplementary Reading:

1. D. P. Kothari, K.C. Singal, Rakesh Rajan, *Renewable Energy Sources and Emerging Technologies*, PHI Second Edition, 2011.

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit.	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Introduction:** Classification of energy, domestic and global energy scenario, environmental impacts of fossil fuels, global primary energy reserves, energy consumption, energy sources and utilization, forms and characteristics of renewable. Work power energy types, their equations and conversions from one form to another.	**9**	**4**	
2	**Solar energy:** Solar radiation, global, direct and diffuse radiation, solar irradiance, optimal tilt angle and power output, daily and annual radiation pattern. Solar photovoltaic: on grid, off grid and hybrid systems, components of solar PV systems, MPPT, applications. Solar thermal: non concentrating and concentrating type collectors, non-tracking, single and double axis tracking type collectors, various solar cookers, distillation plant, solar dryer parabolic dish Sterling engine, solar wind energy and different applications.	**9**	**8**	
3	**Biomass energy:** Biomass sources, photosynthesis, bio-mass cycle and carbon neutral. Biomass energy conversion: direct combustion, thermo chemical and biochemical. Gasification and incineration, syngas and producer gas. Methods of pyrolysis, fermentation and anaerobic digestion. Biogas plants: structure, design and types and its applications**.**	**9**	**4**	
4	**Wind energy:** History, wind energy scenario, origin and causes of wind, carioles effect, wind Special Scales. Fundamentals of wind energy: Wind flow, swept area, air density, capacity factor, Betz limit and power coefficient. Wind characteristics, resource assessment, types of wind turbines. Components, functions, controls and various electrical machines used in wind turbine. Applications such as water pumping hybrid power system. Hydraulic wind turbine.	**9**	**8**	
5	**Other alternate sources:** Ocean thermal energy conversion: closed cycle, open cycle, types of plants, advantages and disadvantages. Geothermal: history & installed capacity, power plant types. Tidal and wave energy: tidal force, types of tidal power plants, advantages and disadvantages. Micro/Mini hydropower system. Fuel cells. Hydrogen Energy: benefits, storage, applications, advantages, disadvantages and problems associated with hydrogen energy. Environmental issues of energy services**.**	**9**	**6**	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Basic IoT Lab**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	0	**0**	**4**	**0 + 0+ 2**

Pre-requisites: Exposure of programming and problem solving

Course Objectives:

1. **Knowledge:**
   - (i) To understand IoT prototyping platforms
   - (ii) To know basic architecture and protocols of Internet of Things
2. **Skills:**
   - (i) To comprehend sensor and actuators interfacing with development boards
   - (ii) To relate web and cloud technologies to empower IoT applications
3. **Attitude:**
   - (i) To illustrate integration and deployment issues through IoT based project specific to domain application.

Course Outcomes: By the end of the course, students will be able to

1. Choose IoT development platforms as per requirement (CL-II).
2. Demonstrate use of sensors and actuators with hardware platforms (CL-III).
3. Experiment with hardware platform and cloud for data analysis and visualization (CL-III).
4. Develop an IoT system for real life application (CL-V) .

Laboratory Exercises / Practical:

1. To introduce various hardware platforms for IoT based design. (Example platforms are Arduino Uno /Node MCU/ Raspberry Pi/ ESP8266 / Beagle board/ Tiva / MSP430 /Jetson Nano/ Intel Galileo).
2. Install, Understand Arduino IDE and write a program to blink LED
3. Interface RGB LED with Arduino to obtain different colors and brightness control using PWM.
4. Interfacing of Analog/Digital Sensors with hardware platforms (minimum 2).
5. Interfacing of Relay/DC Motor/ Servo Motor/Stepper motor (any 2) with Arduino hardware platforms.
6. Understanding Node MCU as development platform and connecting to Wi-Fi network through Arduino IDE.
7. Interfacing of Sensors and Actuators (minimum 2) with NodeMCU hardware platform
8. Exploring cloud infrastructure for connecting IoT devices and sending and visualizing sensor data to open-source cloud via Arduino IDE.
9. Data Analysis for IoT. Upload and retrieve sensor data using Thing Speak or similar Platform.
10. Project based on real life IoT applications (use minimum 2 domain specific sensors and actuators) and report submission.

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Learning Resources:

Text Books:

1. Hakima Chaouchi, *The Internet of Things: Connecting Objects to the Web*, ISTE Ltd and John Wiley & Sons, Inc., 2010.
2. Michael Margolis, *Arduino Cookbook*, 2nd Edition, O'Reilly Media, Inc, 2011.

Reference Book:

1. Charles Bell, *Beginning Sensor Networks with Arduino and Raspberry Pi*, 1st Edition, Apress, 2014.

Web Resources:

https://www.iot-experiments.com/

Weblinks:

https://www.tutorialspoint.com/internet_of_things/
https://www.arduino.cc/en/Tutorial/HomePage?from=Main.Tutorials
https://lastminuteengineers.com/esp8266-nodemcu-arduino-tutorial/

MOOCs:

https://www.coursera.org/learn/arduino-platform
https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English
https://www.udemy.com/course/nodemcu-esp8266-dev-board-tutorial/

Pedagogy:

- Power-point Presentation
- Videos
- Group Activity
- Project Based Learning

Assessment Scheme:

Laboratory Continuous Assessment (LCA) (50 Marks)

Lab Assignment	Practical Exam	Mini Project
20	20	10

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Course Code				
Course Category	**Program Core**			
Course Title	**Communication Networks**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**-**	**2**	**3 + 0 + 1**

Pre-requisites: Basics knowledge of communication systems

Course Objectives:

1. To introduce basics of communication networks, requirements and their architectures.
2. To understand TCP/IP stack and associated protocols for Internet applications.
3. To familiarize with wireless and Internet of Things technologies for sensing and control applications.
4. To understand different protocols that are used in power and energy sector.

Course Outcomes: After completion of this course, students will be able to

1. Configure the nodes and networks in different settings of the network and applications (CL-II).
2. Visualize the actual working of networks and analyze the traffic and performance (CL-III).
3. Choose appropriate wired or wireless technology or protocols for a given application (CL-V).
4. Design a small Internet of Things based application (CL-V).

Course Contents:

Introduction to Communication Networks: Basic blocks, topologies, network parameters and terminologies, multiplexing techniques, transmission media, switching techniques, network types, internet, network components, standardization bodies, OSI reference model, TCP/IP Stack, Physical layer.

Data Link and Network Layers: Data link layer - framing, flow control, error control, multiple access: random access, controlled access, channelization, addressing, IEEE802.3 Ethernet, network layer - IPv4/IPv6 addressing, subnetting, NAT, support protocols such as ARP, RARP, ICMP, ICMPv6, NAT, DHCP, DORA, DNS, routing.

Transport/Applications Layers and Applications: Transport layer functionalities: UDP, TCP, three-way handshake, TCP reliable transfer and sliding window, TCP flow and congestion control; application layer protocols, http, client-server paradigm, mailing services, ftp.

Wireless Technologies and Internet of Things: Cellular concepts, architecture, various generation's introduction of Wi-Fi/IEEE 802.11, features of 4G and 5G, Internet of Things (IoT) - requirements and characteristics, architectures, topologies, different technologies: Bluetooth, ZigBee, IEEE 802.15.4. LPWANs: LoRa.

Communication Networks for Power and Energy Sector: Requirement and challenges, power line carrier communication, MODBUS, serial interfaces, DNP 3.0, CAN; Network security, network attacks, cryptography, and encryption standards.

Laboratory Exercises/Practicals:

1. Study of networking components

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2. Basic TCP/IP network configurations, settings and network commands such as ping, ipconfig, tracert, open visual trace route and related tools
3. GNS3 simulator and basic network configurations
4. Advanced network configuration using routers and switches on GNS3 simulator.
5. Configuration web server
6. Network protocol analyzer tools/software such as Wireshark
7. Configuration of Wi-Fi access point
8. Study of LPWAN-IoT based LoRA
9. Implementation of RSA Algorithm
10. Mini Project on any of the technologies studied in the course (Group activity)

Learning Resources:

Text Books:

1. Forouzan Behrouz, *Data Communications and Networking.* New Delhi: Tata McGraw-Hill, 5th edition, 2017.
2. Forster Anna, *Introduction to Wireless Sensor Networks.* NJ: John Wiley & Sons, Inc, 2016.

Supplementary Reading:

1. Stallings Williams., *Data and Computer Communications.* New Delhi: Prentice Hall of India Pvt. Ltd., 10th edition, 2021.
2. Chaudhari Bharat and Zennaro Marco, *LPWAN Technologies for IoT and M2M Applications.* London: Academic Press-Elsevier, 2020.

Web Resources:

1. https://nptel.ac.in/courses/106105183
2. https://nptel.ac.in/courses/106105081
3. https://www.ethercat.org

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Introduction to Communication Networks:** Basic blocks, topologies, network parameters and terminologies, multiplexing techniques, transmission media, switching techniques, network types, internet, network components, standardization bodies, OSI reference model, TCP/IP Stack, Physical layer.	**9**	**6**	
2	**Data Link and Network Layers:** Data link layer - framing, flow control, error control, multiple access: random access, controlled access, channelization, addressing, IEEE802.3 Ethernet, network layer - IPv4/IPv6 addressing, subnetting, NAT, support protocols such as ARP, RARP, ICMP, ICMPv6, NAT, DHCP, DORA, DNS, routing.	**9**	**8**	
3	**Transport/Applications Layers and Applications:** Transport layer functionalities: UDP, TCP, three way handshake, TCP reliable transfer and sliding window, TCP flow and congestion control; application layer protocols, http, client-server paradigm, mailing services, ftp.	**9**	**6**	
4	**Wireless Technologies and Internet of Things:** Cellular concepts, architecture, various generations introduction of Wi-Fi/IEEE 802.11, features of 4G and 5G, Internet of Things (IoT) - requirements and characteristics, architectures, topologies, different technologies: Bluetooth, ZigBee, IEEE 802.15.4. LPWANs: LoRa.	**9**	**6**	
5	**Communication Networks for Power and Energy Sector**: Requirement and challenges, power line carrier communication, MODBUS, serial interfaces, DNP 3.0, CAN; Network security, network attacks, cryptography, and encryption standards.	**9**	**4**	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Power Electronics**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**-**	**2**	**3 + 0 + 1**

Pre-requisites: Basics of Electrical and Electronics Engineering

Course Objectives:

1. To perceive the structure and characteristics of power semiconductor devices.
2. To design gate triggering circuits for power semiconductor devices.
3. To understand the operation of various power converters viz. AC to DC, DC to AC, DC to DC and AC to AC.

Course Outcomes: After completion of this course, students will be able to

1. Select the appropriate power semiconductor device for a given application (CL-I).
2. Understand the operation of various single and three phase AC to DC converters (CL-II).
3. Explain the operation of various single and three phase DC to AC inverters (CL-II).
4. Analyze the operation of various isolated and non-isolated DC to DC and AC to AC converters (CL-IV).

Course Contents:

Power Electronics Devices and Protection: Structure, characteristics and ratings of power diode, SCR, MOSFET and IGBT, firing and gate drive circuits, commutation circuits, losses and cooling, snubbers and protection circuits.

AC – DC Converters: Uncontrolled, half-controlled and fully-controlled single and three phase bridge rectifiers, single phase dual converters, effect of source inductance, power factor improvement. Applications-light dimmer, excitation system, Solar PV systems.

DC – AC Converters: Voltage and current source inverters, single and three phase square wave and PWM inverters, modulation techniques for voltage control and harmonics reduction. PWM techniques: Single phase, multiple phase and sinusoidal pulse modulation. Applications-Induction heating, UPS.

DC – DC Converters: Non-isolated buck, boost and buck-boost converters under continuous and discontinuous conduction modes, isolated fly-back and half-bridge converters for SMPS. Introduction to resonant converters. Applications- Battery operated vehicles.

AC Voltage Regulator: Single-phase on-off and phase angle-controlled AC regulators, power factor improvement with PWM control. Multistage sequence control -single phase and three phase cyclo converters. Applications –welding.

Laboratory Exercises/Practicals:

1. Verification of ideal and non-ideal characteristics of SCR/MOSFET/IGBT.
2. Study of line synchronized SCR triggering circuit.

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3. Analysis of single phase FCB with RLE load.
4. Analysis of three phase HCB with RL load.
5. Study single phase PWM bridge inverter with R load.
6. Design and implement three phase 6 step (180°) bridge inverter with RL load.
7. Study of Buck converter with RL load.
8. Variable frequency drive (VFD) for three phase induction motor.
9. Study of Boost converter with RL load.
10. Working and analysis of Single Phase AC Voltage Controller.

Learning Resources:

Text Books:

1. Rashid M.H., *Power Electronics Circuits, Devices and Applications*. New Delhi: Pearson Education, 4th edition, 2014.
2. Jamil Asghar M. S., Power *Electronics*. New Delhi: PHI Publication, 2nd edition, 2011.
3. Ericsson R.W. and Marksimovik D., *Fundamentals of Power Electronics,* New Delhi: Pearson Education, 3rd edition, 2020.

Supplementary Reading:

1. Mohan N., Undeland T.M., and Robbins W.P., *Power Electronics: Converters, Applications & Design*. New York: John Wiley & Sons, 3rd edition, 2002.
2. Singh M.D. and Khanchandani K.B., *Power Electronics*. New Delhi: TMH Publication, 2nd edition, 2017

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Power Electronics Devices and Protection:** Structure, characteristics and ratings of power diode, SCR, MOSFET and IGBT, firing and gate drive circuits, commutation circuits, losses and cooling, snubbers and protection circuits.	**10**	**8**	
2	**AC – DC Converters:** Uncontrolled, half-controlled and fully-controlled single and three phase bridge rectifiers, single phase dual converters, effect of source inductance, power factor improvement. Applications-light dimmer, excitation system, Solar PV systems.	**9**	**6**	
3	**DC – AC Converters:** Voltage and current source inverters, single and three phase square wave and PWM inverters, modulation techniques for voltage control and harmonics reduction. PWM techniques: Single phase, multiple phase and sinusoidal pulse modulation. Applications-Induction heating, UPS.	**9**	**6**	
4	**DC – DC Converters:** Non-isolated buck, boost and buck-boost converters under continuous and discontinuous conduction modes, isolated fly-back and half-bridge converters for SMPS. Introduction to resonant converters. Applications- Battery operated vehicles.	**9**	**6**	
5	**AC Voltage Regulator: S**ingle-phase on-off and phase angle-controlled AC regulators, power factor improvement with PWM control. Multistage sequence control -single phase and three phase cyclo converters. Applications –welding.	**8**	**4**	

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Course Code	**EEE**			
Course Category	**Professional Core**			
Course Title	**Database Management Systems**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**-**	**2**	**2 + 0 + 1**

Pre-requisites: Discrete Structure, Data Structures

Course Objectives:

1. Understand and successfully apply logical database design principles, including E-R diagrams and database normalization.
2. Learn database programming languages and apply in DBMS application.
3. Understand transaction processing and concurrency control in DBMS.
4. Learn database architectures, DBMS advancements and its usage in advance application.

Course Outcomes: After completion of this course, students will be able to

1. Design ER-models to represent simple database application scenarios and improve the database design by normalization (CL-VI).
2. Design database relational model and apply SQL, PLSQL concepts for database programming (CL-VI).
3. Describe transaction processing and concurrency control techniques for databases (CL-II).
4. Identify appropriate database architecture for the real-world database application (CL-II).

Course Contents:

Introduction to Database Management Systems and Data Modeling: DBMS vs file systems, database system architecture, data abstraction, data independence, data definition and data manipulation languages, database system internals-components of a database system, data models, E-R diagram: Components of E-R model, conventions, keys, EER diagram components, E-R diagram into tables, relational model, relational integrity, referential integrities, enterprise constraints, schema diagram, relational algebra- basic operations, normalization, Armstrong axiom's, functional dependency, normal Forms (1 NF—5 NF).

SQL and PL/SQL: Introduction to SQL, characteristics of SQL, SQL data types, DDL and DCL commands, SQL queries, DML queries with select query clauses, creating, modifying, deleting, set operations, predicates and joins, set membership, grouping and aggregation, aggregate functions, nested queries, PL/SQL concepts, functions, procedures, cursors, database triggers, query processing and optimization.

Transaction Management and Concurrency Control: Transaction management, ACID properties, transactions, schedules and concurrent execution of transactions, serializability: view, conflict, cascade-less schedule, recoverable schedule, concurrency control: lock-based protocol, deadlocks: prevention and detection techniques, database recovery, failure classification recovery and atomicity: log-based recovery, shadow paging.

Advanced techniques, Databases and applications: Database architecture: Centralized, client-server, parallel, distributed and database connectivity. Decision support Systems: Data warehousing, data mining, knowledge discovery, business intelligence. Big data analytics and NoSQL:

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introduction, application, challenges, Hadoop, XML, JSON, structured vs unstructured databases, CAP theorem and BASE P\properties, NoSQL databases.

Laboratory Exercises/Practicals:

6. Case Study on ER
7. SQL- DDL commands (Create, Alter, Drop, Truncate Rename, Describe), DCL (Grant, Revoke)
8. SQL- DML (Insert, Update, Delete), SQL Select- Logical IN, Negation, NULL, Comparison Operators. Where Clause, Between AND, Exists, ALL, LIKE
9. SQL Queries on: Functions-Single Row, Aggregate Functions, Data Sorting, Subquery, Joins (Inner, Outer, Natural, Self), Group by-Having, Set Operations, View.TCL Commands (Rollback, Commit, Savepoint)
10. PLSQL Procedures and Functions
11. PLSQL Triggers and Cursors
12. Mini Project L SQL-Java Connectivity

Learning Resources:

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 6th edition.
2. Connally T, Begg C., "Database Systems", Pearson Education.
3. Elmasri R., Navathe S.B. *Fundamantals of Database*. New York: Addison - Welsey, 6th edition, 2014.

Supplementary Reading:

1. Kevin Roebuck, “Storing and Managing Big Data - NoSQL, HADOOP and More”, Emereopty Limited

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	10	05

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction to Database Management Systems and Data Modeling:** DBMS vs file systems, database system architecture, data abstraction, data independence, data definition and data manipulation languages, database system internals-components of a database system, data models, E-R diagram: Components of E-R model, conventions, keys, EER diagram components, E-R diagram into tables, relational model, relational integrity, referential integrities, enterprise constraints, schema diagram, relational algebra- basic operations, normalization, Armstrong axiom's, functional dependency, normal Forms (1 NF—5 NF).	**8**	**10**	
2	**SQL and PL/SQL:** Introduction to SQL, characteristics of SQL, SQL data types, DDL and DCL commands, SQL queries, DML queries with select query clauses, creating, modifying, deleting, set operations, predicates and joins, set membership, grouping and aggregation, aggregate functions, nested queries, PL/SQL concepts, functions, procedures, cursors, database triggers, query processing and optimization.	**8**	**8**	
3	**Transaction Management and Concurrency Control:** Transaction management, ACID properties, transactions, schedules and concurrent execution of transactions, serializability: view, conflict, cascade-less schedule, recoverable schedule, concurrency control: lock-based protocol, deadlocks: prevention and detection techniques, database recovery, failure classification recovery and atomicity: log-based recovery, shadow paging.	**7**	**6**	
4	**Advanced techniques, Databases and applications:** Database architecture: Centralized, client-server, parallel, distributed and database connectivity. Decision support Systems: Data warehousing, data mining, knowledge discovery, business intelligence. Big data analytics and NoSQL: introduction, application, challenges, Hadoop, XML, JSON, structured vs unstructured databases, CAP theorem and BASE P\properties, NoSQL databases.	**7**	**6**	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Object Oriented Programming Lab**			
Weekly Teaching Hrs. and Credits	**Lectures**	**Tutorial**	**Laboratory**	**Credits**
	1	**-----**	**2**	**1 + 0 +1**

Pre-requisites: Programming and Problem Solving

Course Objectives:

1. Learn object-oriented paradigm and its fundamentals.
2. Understand Inheritance, Polymorphism and dynamic binding.
3. Study the concepts of file handling.
4. Learn to design generic classes and use Exception Handling.

Course Outcomes:

After completion of this course, students will be able to:

1. Demonstrate the basic concepts of object-oriented Programming to design an application (CL-II).
2. Develop real world applications using inheritance and polymorphism (CL-III).
3. Apply the concepts of file handling to store and retrieve the data (CL-III).
4. Analyze an application using templates and exceptions (CL-IV).

Course Contents:

- Introduction to Object Oriented Programming
- Inheritance and Polymorphism
- File and IO Streams
- Exception Handling and Templates

Laboratory Exercises:

1. Classes
2. Types of constructors and dynamic allocation
3. Inheritance
4. Operator Overloading
5. Polymorphism
6. File handling and Exception handling
7. Templates
8. Standard Template Library

Learning Resources:

Text books:

1. Robert Lafore, 'Object-Oriented Programming in C++', Fourth Edition, Sams Publishing, ISBN: 0672323087, ISBN-13: 978-8131722824
2. Deitel, "C++ How to Program", 10th Edition, Pearson Education, ISBN 13: 9780134448237

Reference Books:

1. Herbert Schildt, 'C++ The Complete Reference', Eighth Edition, McGraw Hill Professional, 2011, ISBN-13: 978-0072226805
2. Bjarne Stroustrup, 'The C++ Programming language', Seventh Edition, Pearson Education. ISBN: 9788131705216

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3. K. R. Venugopal, Rajkumar Buyya, T. Ravishankar, 'Mastering C++', Tata McGraw-Hill, ISBN 13: 9780074634547
4. E.Balaguruswamy, "Object-Oriented Programming with C++", 7th edition, Graw-Hill Publication, ISBN 10:9352607996 ISBN 13:9789352607990

Supplementary Reading:

1. Power Point Slides
2. Lab Manual
3. Question Bank
4. Practice Assignments

Web Resources:

1. https://www.springer.com/gp/book/9781852334505
2. https://www.ebookphp.com/object-oriented-programming-in-c-epub-pdf/
3. https://www.springer.com/gp/book/9781447133780

MOOCs:

1. https://www.coursera.org/learn/c-plus-plus-a
2. https://nptel.ac.in/courses/106/105/106105151/
3. https://www.classcentral.com/course/swayam-programming-in-c-6704

Pedagogy:

1. PPTs
2. Practical Demos
3. Videos
4. Expert lectures
5. Workshop
6. Co Teacher Scheme

Assessment Scheme:

Class Continuous Assessment (CCA) (100 Marks)

Theory Assignments	Mid Term Exam	Active Learning	MCQ
30	30	20	20

Laboratory Continuous Assessment (LCA)(50 Marks)

Lab Assignment	Practical Exam	Mini Project	Any other
20	20	10	Nil

Term End Examination: NA

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Syllabus: Theory

Unit	Contents	Workload in Hrs Theory
1	**Introduction to Object Oriented Programming (OOP)** **Fundamentals of OOP:** Introduction to OOP, Fundamentals of object-oriented programming: Classes, Objects, methods, Data Abstraction, Data Encapsulation, Information hiding, Inheritance, Polymorphism. Benefits of OOP **Introduction to C++**: Basics of C++, Class, Object, Array of objects, Data Members, Member Function, Access Specifiers, Function prototype, Passing and Returning object in Function, Constructor and destructor, Types of constructors, Objects and Memory requirements, Inline function, Friend function, Friend Class, Static members: variable and function,	4
2	**Inheritance and Polymorphism** **Inheritance:** Introduction, Base and Derived Classes, Protected: Data member and Member Function. Member Access Control, Inheriting Constructors and Destructors, Types of Inheritance, Overriding Member Functions, Ambiguity in Multiple Inheritance, Virtual Base Class. **Polymorphism:** Introduction to Polymorphism, Types of Polymorphism, Function overloading, Operator Overloading: Concept of Operator Overloading, Overloading Unary and Binary Operators, Prefix and Postfix Operator Implementation. **Run time Polymorphism**: Pointers to Objects, Pointers to Derived Class, Importance of Virtual Function, Pure Virtual Function and virtual table, Virtual Destructors, Early and Late Binding. Abstract base Class	4
3	**File and IO Streams** **File Handling:** Stream and Files, Stream Classes, File Pointers, File I/O with Member Functions, Formatted I/O and I/O Manipulators, Error handling during file operations, Overloading Insertion and Extraction Operators.	3
4	**Exception Handling and Templates** **Exception Handling**: Introduction, Exception Handling Mechanism - try, catch and throw, Multiple Exceptions, Re-throwing an exception, Exception and Inheritance. **Templates**: Introduction to Template, types of templates, Function Template, overloading Function templates, Class Template.	4

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	Introduction to STL, STL components, Containers - Sequence Containers and Associative Containers, Container Adapters, Application of Container : vector, list Algorithms: searching and sorting. Introduction to iterator.	

Laboratory:

Unit	Contents	Workload in Hrs Lab
1	A airline information system want to maintain the information of passengers travelling by their airways. Following is the information that is to be maintained for the passengers. • Name of passenger • Age of passenger • flight no. • departure time • source • destination Design a C++ class to accept and display information for the airlines.	**4**
2	Develop an object-oriented program in C++ to create a database of employee information system containing the following information: Employee Name, Employee number, qualification, address, contact number, salary details (basic, DA, TA, Net salary), etc Construct the database with suitable inline member functions for initializing and destroying the data viz constructor, default constructor, Copy constructor, destructor. Use dynamic memory allocation concept while creating and destroying the object of a class. Use static data member concept wherever required. Also, Display the Employee information.	**4**
3	Design and develop inheritance for a given case study, identify objects and relationships and implement inheritance wherever applicable. Employee class has Emp_name, Emp_id, Address, Mail_id, and Mobile_no as members. Inherit the classes: Programmer, Team Lead, Assistant Project Manager and Project Manager from employee class. Add Basic Pay as the member of all the inherited classes with 97% of Basic Pay as DA, 10 % of Basic Pay as HRA, 12% of Basic Pay as PF, 0.1% of Basic Pay for staff club fund. Generate pay slips for the employees with their gross and net salary.	**4**
4	Define a class Box consisting of the following: Data members: length, breadth, height Member Functions: 1. One default constructor 2. Two overloaded operator member functions “<<” and “>>” to display and read Box dimensions.	**4**

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<table>
<tr><td></td><td>3. One-member function “+” to add the two box objects and one friend function to compute the volume of this box using operator overloading.</td><td></td></tr>
<tr><td>5</td><td>Write a C++ program with base class Employee and derive classes Class1_Employee, Class2_Employee and Class3_Employee.
Salary of an employee is calculated as per his/her designation. Declare calculate salary () as a pure virtual function in base class and define it in respective derive classes to calculate salary of an employee.</td><td>4</td></tr>
<tr><td>6</td><td>A school maintains the mark sheets of all standard students in the following form –

<table><tr><td>PRN</td><td>Student Name</td><td>Maths</td><td>Physics</td><td>Chemistry</td><td>Total %</td><td>Grade</td></tr></table>
A teacher put marks for the student by his/her PRN and the system checks whether marks for different subjects are negative or not. If it is negative, the system displays appropriate message, otherwise updates the file by storing the marks across the selected subject. The system calculates the total percentage after putting marks for all three subjects and accordingly finds the grade. Whenever an administrator wants to search a student’s record, he/she inputs the student's PRN and the system searches in a file and displays whether it is available or not, otherwise an appropriate message is displayed. An administrator can also delete/modify a record of a student.
Design such system using C++ Program with file and exceptions handling.</td><td>4</td></tr>
<tr><td>7</td><td>Perform bubble sort operation using the template for integer and float data type.</td><td>3</td></tr>
<tr><td>8</td><td>Write a program to manage a shopping list. Each shopping list item is represented by a string stored in a container. Your design requires a print function that prints out the contents of the shopping list.

• Create an empty list.
• Append the items, "eggs," "milk," "sugar," "chocolate," and "flour" to the list. Print the list.
• Remove the first element from the list. Print the list.
• Insert the item, "coffee" at the beginning of the list. Print the list.
• Find the item, "sugar" and replace it with "honey." Print the list.
• Insert the item, "baking powder" before "milk" in the list. Print the list.
• Sort and Search the item in the list.</td><td>3</td></tr>
</table>

Course Code				
Course Category	**PR**			
Course Title	**Minor Project - I**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	0	**0**	**2**	**0 + 0 + 1**

Pre-requisites: Knowledge of Electrical and allied areas of engineering

Course Objectives:

1. To design and undertake minor project
2. To plan various activities related to the project such as designing, budgeting and execution
3. To optimize the designing and execution skills using various hardware and software tools
4. To prepare a technical report and presentation of the mini project carried out
5. To Work as a team member

Course Outcomes:

After completion of this course students will be able to:

1. Identify, plan and implement minor project using hardware /software tools
2. Plan the budget for hardware requirement
3. Design a proof of concept or real-life project by considering realistic constraints and standards
4. Develop the project and present a quality technical report

Course Contents:

Minor Project- I is undertaken by students based on the knowledge gained in the field of electrical, electronics, computer, and allied areas of engineering. A small group of students' needs define a problem statement after literature review, design actual project by using suitable hardware and software tools in any area related to Engineering. The project or proof of concept is to be designed by considering the realistic constraints and standards. Students should report a stage wise progress of the project. The project team must demonstrate the project and justify/validate the results. At the end of the semester, a detailed technical project report is to be submitted in a professional manner to the University.

Assessment Scheme:

Laboratory Continuous Assessment (LCA) (50 Marks)

Regularity and punctuality	Understanding the Objective	Understanding of procedure	Experiment Skills	Ethics
10	10	10	10	10

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Course Code				
Course Category	**Program Core**			
Course Title	**Electric Vehicle Technology**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Electrical Machines, Power Electronics Equations.

Course Objectives:

1. To understand the difference between conventional vehicle and EVs.
2. To gain knowledge about electric drives used in EVs.
3. To discuss energy management system related to EVs.
4. To understand the challenges for the infrastructure of EVs in India.

Course Outcomes: After completion of this course, students will be able to

1. Explain the difference between conventional and electric vehicle. (CL-IV)
2. Choose a drive for the specified EVs. (CL-III)
3. Explain energy management system for EVs. (CL-IV)
4. Criticize eMobility and connectors used in India. (CL-V)

Course Contents:

Introduction to Hybrid Electric Vehicle: Review of conventional vehicle: Introduction to hybrid electric vehicles: Types of EVs, hybrid electric drive-train, Tractive effort in normal driving.

Electric Drives: Energy consumption concept of hybrid electric drive trains, architecture of hybrid electric drive trains, series hybrid electric drive trains, parallel hybrid electric drive trains, Electric propulsion unit, Configuration and control of DC Motor drives, Induction motor drives, Permanent magnet motor drives, switched reluctance motor

Energy Storage: Introduction to energy storage requirements in hybrid and electric vehicles: - battery based energy storage and its analysis, fuel cell based energy storage and its analysis, hybridization of different energy storage devices.

Energy Management System: Energy management strategies, automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: emobility business, electrification challenges, business- emobility business, electrification challenges.

Mobility and Connectors: Connected Mobility and autonomous mobility- case study emobility Indian roadmap perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- types of EV charging connector, indian EV Plug Standards.

Laboratory Exercises/Practicals:

1. Speed control of Induction Motor.
2. Speed control set of D.C. shunt motor by thyristorised control method.
3. Study of energy recovered using regenerative Braking.
4. Characteristics of 3-Ph slip ring induction moto.r
5. Calculate energy saving by series parallel control of d. C. Motor (for two and four motors).
6. Study set for regenerative braking for D.C. shunt motor.

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7. Characteristics of BLDC Motor.
8. Characteristics of D.C series motor.

Learning Resources:

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., *Vehicular Electric Power Systems*, Boca Raton, CRC Press, 2003
2. Husain, I. *Electric and Hybrid Vehicles,* Boca Raton, CRC Press, 2010.
3. Larminie J., and Lowry J., *Electric Vehicle Technology Explained*, John Wiley and Sons, 2012
4. Tariq Muneer and Irene Illescas García, *The automobile, In Electric Vehicles: Prospects and Challenges*, Elsevier, 2017

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Student Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
05	10	10	25

Term End Examination:

Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction to Hybrid Electric Vehicle:** Review of conventional vehicle: Introduction to hybrid electric vehicles: Types of EVs, hybrid electric drive-train, Tractive effort in normal driving.	**9**	**4**	
2	**Electric Drives:** Energy consumption concept of hybrid electric drive trains, architecture of hybrid electric drive trains, series hybrid electric drive trains, parallel hybrid electric drive trains, Electric propulsion unit, Configuration and control of DC Motor drives, Induction motor drives, Permanent magnet motor drives, switched reluctance motor.	**9**	**6**	
3	**Energy Storage:** Introduction to energy storage requirements in hybrid and electric vehicles: - battery based energy storage and its analysis, fuel cell-based energy storage and its analysis, hybridization of different energy storage devices.	**9**	**6**	
4	**Energy Management System:** Energy management strategies, automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: emobility business, electrification challenges, business-emobility business, electrification challenges.	**9**	**6**	
5	**Mobility and Connectors:** Connected Mobility and autonomous mobility- case study emobility Indian roadmap perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- types of EV charging connector, Indian EV Plug Standards.	**9**	**8**	

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Course Code				
Course Category	Program Core			
Course Title	Full Stack Development			
Weekly Teaching Hrs and Credits	L	T	Laboratory	Credits
	2	-	2	2 + 0 + 1

- **Pre-requisites**: Principles of Programming Languages
- Computer Networks
- Co-requisite
- Database Management Systems

Course Objectives:

1. To understand and apply the best practices for project development.
2. To acquire skills for developing web applications using front end technologies.
3. To learn application development using back-end technologies.
4. To study testing and deployment processes for real world web-based applications.

Course Outcomes: After completion of this course, students will be able to

1. Apply best practices for software development and tracking code changes. (CL-III).
2. Select and apply appropriate front end technologies for responsive User Interface (UI) development (CL-II).
3. Design and develop application using appropriate backend technologies (CL-VI).
4. Test and deploy real world web-based application on different platforms **(**CL-IV).

Course Contents:

Introduction to World Wide Web: Introduction to web technology: Internet and www, website planning and design issues. Web development solution stacks. Hypertext markup language (HTML): Structure of HTML document, HTML elements: headings, colors & fonts, links, lists, tables, images and forms. Difference between HTML and HTML5. Cascading style sheets, introduction to style sheet, need of CSS, basic syntax and structure, inline, internal and external CSS, CSS box model, inserting CSS in an HTML page, CSS selectors. BOOTSTRAP technology.XML and JSON.

Client-Side Scripting: JavaScript: Introduction to JavaScript (JS), Core features, JS in an HTML (Embedded, External). Document object model (DOM): DOM levels, DOM Objects and their properties and methods, Manipulating DOM. JQuery, working of Ajax. Responsive web design**.** React JS, Angular JS.

Server-Side Technology and Content Management Systems: Server-Side scripting and its need. PHP Hyper-text pre-processor (PHP**):** Introduction to PHP form handling in PHP, database connectivity using MySQL and PHP, Cookies and session tracking. Content management systems. WordPress/Drupal/Joomla.

Advanced Technologies: MEAN/MERN stack: Introduction to web solution stacks, Express Framework, Mongo DB database, Node JS, sample case study using MERN. Design patterns, MVC, spring MVC and hibernate, FLUX design pattern.

Web Services: REST APIs (Representational State Transfer), SOAP (Simple Object Access Protocol, Web Services Description Language (WSDL).

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Laboratory Exercises/Practicals:

1. Git repository and version control.
2. Responsive Web Design using HTML5 and BOOTSRAP.
3. Javascript for PHP Session, Cookies and DOM real-time update.
4. Interactive front-end design using React.
5. Responsive Design using React JS.
6. Single page application development using MEAN/MERN Stack.
7. Implementation of MVC or FLUX design pattern with React JS.
8. Developing REST APIs capable of reading a JSON.
9. Mini Project based on technologies learned.

Learning Resources:

Text Books:

1. Diego Jose Arguelles Rojas, Erikson Haziz and Murrugarra Sifuentes: *Hands-On Full Stack Web Development with Aurelia : Develop modern and real-time web applications with Aurelia and Node.js*, 2018, Packt
2. Eric Bush:*Full-Stack JavaScript Development* ISBM details

Supplementary Reading:

- Eric Bush, Maura van der Linden: *Full-Stack JavaScript Development Develop, Test and Deploy with MongoDB, Express, Angular and Node on AWS*, 2016
- Zammetti and Frank: *Modern Full-Stack Development Using TypeScipt, React, Node,js, Webpack, Docker*

Web Resources:

- The Full Stack Developer Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer by Chris Northwood, Apress, 2018
- PHP And MongoDB Web Development Beginners Guide Book by Rubayeet Islam, PACKT, 2019
- Full Stack Javascript by Azat Mardan Apress Publication, 2015

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	10	05

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Introduction to World Wide Web:** Introduction to web technology: Internet and WWW, Website planning and design issues. Web Development Solution Stacks. Hyper Text Markup Language (HTML): Structure of HTML document, HTML elements: headings, colors & fonts, links, lists, tables, images and forms. Difference between HTML and HTML5. Cascading Style Sheets Introduction to Style Sheet, Need of CSS, basic syntax and structure, Inline, Internal and External CSS, CSS Box Model, Inserting CSS in an HTML page, CSS selectors. BOOTSTRAP Technology.XML and JSON	9	8	
2	**Client-Side Scripting: JavaScript:** Introduction to JavaScript (JS), Core features, JS in an HTML (Embedded, External). Document Object Model (DOM): DOM levels, DOM Objects and their properties and methods, Manipulating DOM. J JQuery, working of Ajax. Responsive web design**.** React JS, Angular JS	9	8	
3	**Server-Side Technology and Content Management Systems:** Server-Side Scripting and its need. PHP Hyper-Text Pre-processor (PHP**):** Introduction to PHP Form handling in PHP, Database Connectivity using MySQL and PHP, Cookies and Session Tracking. Content Management Systems. WordPress/Drupal/Joomla.	9	6	
4	**Advanced Technologies:** MEAN/MERN stack: Introduction to web solution stacks, Express Framework, Mongo DB database, Node JS, Sample case study using MERN. Design Patterns, MVC, Spring MVC and Hibernate, FLUX design pattern	9	4	
5	**Web Services:** REST APIs (Representational State Transfer), SOAP (Simple Object Access Protocol, Web Services Description Language (WSDL)	9	4	

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Course Code				
Course Category	**Professional Elective - I**			
Course Title	**PLC and Automation**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**-**	**2**	**3 + 0 + 1**

Pre-requisites: - Basics of Electrical Engineering, Analog and Digital Electronics.

Course Objectives:

1. To understand the architecture and hardware of PLC.
2. To be familiar with the use of PLC software for automation of various industrial processes.
3. To study the role of elements of automation system in industrial control.
4. To study the real time control of modern industrial systems.

Course Outcomes: After completion of this course, students will be able to

1. Explain the PLC block diagram with its component (CL-II).
2. Execute program for automation using PLC (CL-III).
3. Interpret and develop wiring diagram for industrial applications (CL-III).
4. Implement the real time control in modern industrial systems (CL-III).

Course Contents:

Fundamentals of PLC: Concept of PLC, comparison to relay logic, types, selection criteria, architecture, basic operation, scan cycle, i/o devices, interfacing, memory structures, wiring.

PLC Programming Aspects: Programming techniques, ladder diagram, component symbols, instruction set, addressing, timer, counter, latching, and on/off applications, advanced programs.

PLC Applications: Input/output on/off control, PID control for continuous process and close loop system, industrial applications, motor controls.

SCADA Systems: Concept**,** Monitoring and supervising functions, components, typical architectures, communication, applications in power system and industry**.**

Industrial Automation: Types, measurement systems, and their characteristics, actuators, hydraulic systems, pneumatic systems, NC, CNC, DNC machines, smart factory, industry 4.0, case study on advanced factory automation.

Laboratory Exercises/Practicals:

1. Design a simple on-off application.
2. Design and develop timing applications.
3. Design and develop counting applications.
4. Implement motor control by using PLC.
5. Design factory applications using PLC/SCADA.
6. Design an HMI using PLC for an industrial application.
7. Characterize the LVDT.
8. Simulate any industrial automation using hydraulics/pneumatic system.
9. Demonstration of ODIN Station for Battery Pack Assembly System.
10. Industrial visit to automation industry.

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Learning Resources:

Text Books:

1. John W. Webb, Ronald A. Reis. *Programmable Logic Controllers: Principles and Application*, PHI Learning, New Delhi, 5th Edition, 2003.
2. Gary Dunning. *Introduction to Programmable Logic Controllers,* Delmar Thomson Learning, 2nd Edition, 2002.
3. John R. Hackworth, Frederick D., Hackworth Jr. *Programmable Logic Controllers Programming Methods and Applications,* PHI Publishers, 2013.
4. Devdas Shetty and Richard A. Kolk, *Mechatronics System Design*, Thomson India edition, 2007.

Reference Books:

1. W. Bolton, *Programmable Logic Controllers*, Burlington, MA: Elsevier Newnes Publication, 4th Edition, 2006.
2. Peng Zhang, *Advanced Industrial Control Technology*, William Andrew Publishing, 1st Edition, 2010.

Web Resources:

MOOCs:

https://www.udemy.com/course/learn-siemens-s7-1200-plc-from-scratch-using-tia/
https://www.udemy.com/course/learn-SCADA-in-a-day-starting-from-scratch/

Pedagogy:

- Power point presentations, videos.
- Co-teaching.
- Group activities.

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus :

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Fundamentals of PLC:** Concept of PLC, comparison to relay logic, types, selection criteria, architecture, basic operation, scan cycle, i/o devices, interfacing, memory structures, wiring.	**8**	**2**	
2	**PLC Programming Aspects:** Programming techniques, ladder diagram, component symbols, instruction set, addressing, timer, counter, latching, and on/off applications, advanced programs.	**10**	**10**	
3	**PLC Applications:** Input/output on/off control, PID control for continuous process and close loop system, industrial applications, motor controls.	**10**	**10**	
4	**SCADA Systems:** Concept**,** Monitoring and supervising functions, components, typical architectures, communication, applications in power system and industry**.**	**8**	**8**	
5	**Elements of Automation:** Measurement systems, and their characteristics, actuators, hydraulic systems, pneumatic systems, NC, CNC, DNC machines, smart factory, industry 4.0, case study on advanced factory automation.	**9**	**2**	

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Course Code				
Course Category	**Professional Elective - I**			
Course Title	**Java Programming**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**-**	**2**	**3 + 0 + 1**

Pre-requisites: Basics of Electrical and Electronics Engineering

Course Objectives:

1. To understand the basic concepts of Java.
2. To develop computational ability in Java programming language.
3. To learn and understand I/O packages and threading in Java.
4. To translate vast data into abstract concepts and to understand JAVA concepts

Course Outcomes: After completion of this course, students will be able to

1. Understand the basic concepts of Java (CL-II).
2. Write codes in Java (CL-II).
3. Solve real world problems using Java (CL-III).
4. Design Graphical User Interface using JavaFX (CL-IV).

Course Contents:

Java Fundamentals: Introduction Java Basics: Java Design goal - Features of Java Language - JVM - Bytecode - Java source file structure basic programming constructs Arrays one dimensional and multi-dimensional enhanced for loop String package.

Object Oriented Programming: Class fundamentals - object reference array of objects constructors' methods over- loading this reference static block - nested class inner class garbage collection, wrapper classes inheritance types - use of super - polymorphism abstract class interfaces packages and sub packages.

Robustness and Concurrency: Exception handling - exceptions errors - types of exception - control flow in exceptions - use of try, catch, finally, throw, throws in exception handling, user defined exceptions, multithreading thread creation sharing the workload among threads synchronization inter thread communication deadlock.

Files, Streams, Object Serialization and GUI: Java I/O streams, working with files serialization and deserialization of objects Lambda expressions, collection framework list, map, set generics annotations, GUI programming using JavaFX, exploring events, controls and JavaFX menus accessing databases using JDBC.

Generic Programming: Motivation for generic programming, generic classes, generic methods, generic code and virtual machine, inheritance and generics, reflection and generics, multi-threaded programming, interrupting threads, thread states, thread properties, thread synchronization, executors, synchronizers.

Laboratory Exercises/Practicals:

1. Write a program to demonstrate the use of multidimensional arrays and looping constructs.
2. Write a program to demonstrate the application of String handling functions.
3. Write a program to demonstrate the use of Inheritance.

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4. Write a program to demonstrate the application of user-defined packages and sub-packages.
5. Write a program to demonstrate the use of Java Exception handling methods.
6. Write a program to demonstrate the use of threads in Java.
7. Demonstrate with a program the use of File handling methods in Java.
8. Demonstrate the use of Java collection frameworks in reducing application development time.
9. Build a GUI application using JavaFX
10. Write a program to register students data using JDBC with MySQL Database.
11. Write a program that uses Servlets to perform basic banking tasks.
12. Write a web application using JSP and demonstrate the use of http request and response methods.
13. Write a JSP program for an order management system.
14. Write a JSP program that using JDBC and MySQL database to store the user data.
15. JSP with Java BEAN.

Learning Resources:

Text Books:

1. Schildt H., *Java The Complete Reference*, McGraw-Hill Education Pvt Ltd, 9th Edition, 2014.
2. Dean J., *Introduction to Programming with Java: A Problem-Solving Approach,* McGraw-Hill, Higher Education, 2008.
3. Deitel P.J., Deitel H., *Java SE8 for Programmers (Deitel Developer Series),* Pearson P T R, 3rd Edition, 2014
4. Y. Daniel Liang, *Introduction to Java programming-comprehensive version*, Pearson ltd, 10th Edition, 2015.

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Java Fundamentals:** Introduction Java Basics: Java Design goal - Features of Java Language - JVM - Bytecode - Java source file structure basic programming constructs Arrays one dimensional and multi-dimensional enhanced for loop String package.	**9**	**8**	
2	**Object Oriented Programming:** Class fundamentals - object reference array of objects constructor's methods over- loading this reference static block - nested class inner class garbage collection, wrapper classes inheritance types - use of super - polymorphism abstract class interfaces packages and sub packages.	**9**	**8**	
3	**Robustness and Concurrency:** Exception handling - exceptions errors - types of exception - control flow in exceptions - use of try, catch, finally, throw, throws in exception handling, user defined exceptions, multithreading thread creation sharing the workload among threads synchronization inter thread communication deadlock.	**9**	**6**	
4	**Files, Streams, Object Serialization and GUI:** Java I/O streams, working with files serialization and deserialization of objects Lambda expressions, collection framework list, map, set generics annotations, GUI programming using JavaFX, exploring events, controls and JavaFX menus accessing databases using JDBC.	**9**	**4**	
5	**Generic Programming**: Motivation for generic programming, generic classes, generic methods, generic code and virtual machine, inheritance and generics, reflection and generics, multi-threaded programming, interrupting threads, thread states, thread properties, thread synchronization, executors, synchronizers.	**9**	**4**	

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Course Code				
Course Category	**Professional Elective - II**			
Course Title	**Robotics**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Knowledge of mathematics, power electronics, controllers.

Course Objectives:

1. To give knowledge of fundamental concepts of robotics and hence robotic automation in industry.
2. To develop skills in performing transformations associated with rigid body motions.
3. To impart knowledge on kinematic analysis of robotic systems.
4. To impart knowledge about various drive systems, sensors and its selection for particular applications.

Course Outcomes: After completion of this course, students will be able to

1. Understand the basic structure of robots, its classification, use of sensors, and actuators used in robotic systems (CL-II).
2. Apply transformation to obtain forward kinematic equations (CL-III).
3. Analyze simple manipulators to obtain forward and inverse kinematics (CL-IV).
4. Carry out the robot control for servo motors (CL-III).

Course Contents:

Introduction to Robotics: Definition, classification of robots, geometric and control classification. Robot elements: drive systems, control systems, sensors, end effectors, gripper, actuators and gripper design, applications and programming languages.

Robot Coordinate Systems and Manipulator Kinematics: Robot coordinate system representation, transformation, homogeneous transforms and its inverse relating the robot to its world. Manipulator kinematics, DH parameters for links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control.

Dynamics of Robot and Trajectory planning: Introduction to dynamics, joint velocities, kinetic energy, Lagrangian equation of motion, dynamic equation and its equation for a general manipulator. Trajectory planning: Path control modes, consideration in joint trajectory planning, joint interpolated trajectory, trajectory generation planning and trajectory planning with different control order system.

Servo Systems for Robot Control: Types and functions of drive systems, sensor technology, general aspects of robot control, basic control techniques, selection of robot drive systems, mathematical modeling of robot servos, error responses and steady state errors, feedback and feedforward compensations, computer-controlled servo system for robot applications, define a suitable servo motor speed, servo motor gearbox and base servo motor example in a robot.

Methods of Robot Programming and Applications: For various applications, languages used, structure, elements & simple programs, artificial intelligence in robotics, model of robotic arm, applications of robots in power system and industrial automation, application of robots in transmission line maintenance, production systems- machine tools, material handling (e.g., pick & place, loading-unloading, material sorting, inspection.

Laboratory Exercises / Practical:

1. Study of robots and its components.
2. Validation and control of robotic arms using any software.

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3. Validation of cartesian/cylindrical/spherical robot using any software.
4. Demonstration of articulated/SCARA robot.
5. Virtual modeling for kinematic and dynamic verification of any one robotic structure using suitable software (MATLAB).
6. Position control and orientation of the robot arm using MATLAB based GUI.
7. Validation of forward and inverse kinematics using DH parameters in MATLAB.
8. Design, modeling and analysis of two different types of grippers.
9. Study of sensor integration.
10. Case studies of application in industry.

Learning Resources:

1. Craig J.J. *Introduction to Robotics: Mechanics and Control*, John Wiley & Sons Inc., 2004.
2. Spong M.W., Seth Hutchinson, Vidyasagar M. *Robot Modeling and Control*, John Wiley & Sons Inc., 2006.
3. Saha S. K. *Introduction to Robotics*, McGraw Hill Education (India) Private Limited, New Delhi, 2008.

Supplementary Reading:

1. Mittal R. K. and Nagrath I. J. *Robotics and Control*, Tata McGraw Hill, New Delhi, 2003
2. Niku Saeed B. *Introduction to Robotics: Analysis, Systems*, Applications, PHI, New Delhi. 2001.

Web Resources:
Weblinks:

https://nptel.ac.in/courses/112/101/112101099/
https://nptel.ac.in/courses/112105249/
MOOCs: https://swayam.gov.in/nd1_noc19_me74/preview

Pedagogy:

- Power Point Presentations, Videos
- Co-teaching
- Group Activities
- Industrial Visit to Fully Automated Industry to observe automation of industrial processes.

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination: Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Introduction to Robotics:** Definition, classification of robots, geometric and control classification. Robot elements: drive systems, control systems, sensors, end effectors, gripper, actuators and gripper design, applications and programming languages.	**9**	**6**	
2	**Robot Coordinate Systems and Manipulator Kinematics:** Robot coordinate system representation, transformation, homogeneous transforms and its inverse relating the robot to its world. Manipulator kinematics, DH parameters for links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control.	**9**	**8**	
3	**Dynamics of Robot and Trajectory planning:** Introduction to dynamics, joint velocities, kinetic energy, Lagrangian equation of motion, dynamic equation and its equation for a general manipulator. Trajectory planning: Path control modes, consideration in joint trajectory planning, joint interpolated trajectory, trajectory generation planning and trajectory planning with different control order system.	**9**	**8**	
4	**Servo systems for Robot Control:** Types and functions of drive systems, sensor technology, general aspects of robot control, basic control techniques, selection of robot drive systems, mathematical modeling of robot servos, error responses and steady state errors, feedback and feedforward compensations, computer-controlled servo system for robot applications, define a suitable servo motor speed, servo motor gearbox and base servo motor example in a robot.	**9**	**4**	
5	**Methods of Robot Programming and Applications:** For various applications, languages used, structure, elements & simple programs, artificial intelligence in robotics, model of robotic arm, applications of robots in power system and industrial automation, application of robots in transmission line maintenance, production systems- machine tools, material handling (e.g., pick & place, loading-unloading, material sorting, inspection.	**9**	**4**	

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Course Code				
Course Category	**Professional Elective - II**			
Course Title	**Software Engineering and Management**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Nil

Course Objectives:

1. To understand the software life cycle models.
2. To know the importance of the software development process.
3. To learn about software project planning and management.
4. To study about the software project planning and risk management

Course Outcomes: After completion of this course, students will be able to

1. Understand the basic principles of software development life cycle (CL-II).
2. Acknowledge the importance of modeling and modeling languages (CL-II).
3. Implement software processes and metrics (CL-III).
4. Assure good software quality (CL-IV).

Course Contents:

Introduction: Software Engineering, software process, generic process model, prescriptive process model specialized, unified process, agile development, agile Process, extreme programming, other agile Process model, software engineering knowledge, core Principles, principles that guide each framework activity, requirements engineering, establishing the groundwork, analysis, modelling strategies.

Modelling: Modelling concepts and diagrams, use case diagrams, class diagrams, interaction diagrams, state chart diagrams, activity diagrams, package diagrams, component diagrams, deployment diagrams, diagram organization, diagram extensions, design process, design concepts: abstraction, architecture, patterns, separation of concerns, modularity, information hiding, functional independence, refinement, aspects, refactoring, design classes, design model.

Software Implementation: Structured coding techniques, coding styles, standards and guidelines-documentation guidelines, modern programming language features, type checking, user defined data types, data abstraction, testing and maintenance.

Software Management: Product process and project, definition, product life cycle: prototype development phase, alpha phase, beta phase, production and maintenance phase, project life cycle models, Software Configuration Management: Process and activities, configuration audit, metrics in SCM, tools and automation, software quality assurance, quality control and quality assurance, tools, measure of SQA success, risk Management.

Activities: In-stream activities, Project initiation: activities, outputs, quality records, completion criteria, project planning and tracking: components, activities specific to project tracking, project closure: effective closure process issues, metrics for project closure.

Laboratory Exercises/Practicals:

1. An introduction to software engineering.

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2. Development of DFD, data dictionary, E-R diagram, structured chart for the project.
3. To study and draw various UML diagrams.
4. To illustrate the use of class diagrams.
5. To draw an activity diagram and use case diagram for ATM and Library Management System.
6. Draw Object Diagram for ATM System.
7. Development of State Transition Diagram.
8. Draw ER Diagram for Hospital Management System. Write a program to demonstrate the use of multidimensional arrays and looping constructs.

Learning Resources:

Text Books:

1. Hans Van Vliet, "Software Engineering: Principles and Practices" Wiley; 3rd edition, 2008.
2. Richard Fairley, "Software Engineering Concepts" McGraw Hill Education, Indian Edition, 2008.

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction:** Software Engineering, software process, generic process model, prescriptive process model specialized, unified process, agile development, agile Process, extreme programming, other agile Process model, software engineering knowledge, core Principles, principles that guide each framework activity, requirements engineering, establishing the groundwork, analysis, modelling strategies.	**9**	**8**	
2	**Modelling:** Modelling concepts and diagrams, use case diagrams, class diagrams, interaction diagrams, state chart diagrams, activity diagrams, package diagrams, component diagrams, deployment diagrams, diagram organization, diagram extensions, design process, design concepts: abstraction, architecture, patterns, separation of concerns, modularity, information hiding, functional independence, refinement, aspects, refactoring, design classes, design model.	**9**	**8**	
3	**Software Implementation:** Structured coding techniques, coding styles, standards and guidelines-documentation guidelines, modern programming language features, type checking, user defined data types, data abstraction, testing and maintenance.	**9**	**6**	
4	**Software Management:** Product process and project, definition, product life cycle: prototype development phase, alpha phase, beta phase, production and maintenance phase, project life cycle models, Software Configuration Management: Process and activities, configuration audit, metrics in SCM, tools and automation, software quality assurance, quality control and quality assurance, tools, measure of SQA success, risk Management.	**9**	**4**	
5	**Activities**: In-stream activities, Project initiation: activities, outputs, quality records, completion criteria, project planning and tracking: components, activities specific to project tracking, project closure: effective closure process issues, metrics for project closure.	**9**	**4**	

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Course Code				
Course Category	**PR**			
Course Title	**Minor Project - II**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	0	**0**	**2**	**0 + 0 + 1**

Pre-requisites: Knowledge of Electrical and allied areas of engineering

Course Objectives:

6. To design and undertake minor project
7. To plan various activities related to the project such as designing, budgeting and execution
8. To optimize the designing and execution skills using various hardware and software tools
9. To prepare a technical report and presentation of the mini project carried out
10. To Work as a team member

Course Outcomes:

After completion of this course students will be able to:

5. Identify, plan and implement minor project using hardware /software tools
6. Plan the budget for hardware requirement
7. Design a proof of concept or real-life project by considering realistic constraints and standards
8. Develop the project and present a quality technical report

Course Contents:

Minor Project- II is undertaken by students based on the knowledge gained in the field of electrical, electronics, computer, and allied areas of engineering. Minor Project- II is to be different from the Minor Project – I, which already undertaken during previous semester. A small group of students' needs define a problem statement after literature review, design actual project by using suitable hardware and software tools in any area related to Engineering. The project or proof of concept is to be designed by considering the realistic constraints and standards. Students should report a stage wise progress of the project. The project team must demonstrate the project and justify/validate the results. At the end of the semester, a detailed technical project report is to be submitted in a professional manner to the University.

Assessment Scheme:

Laboratory Continuous Assessment (LCA) (50 Marks)

Regularity and punctuality	Understanding the Objective	Understanding of procedure	Experiment Skills	Ethics
10	10	10	10	10

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Course Code				
Course Category	**Program Core**			
Course Title	**Cyber Security**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**0**	**2**	**2 + 0 + 1**

Pre-requisites: Programming skills, familiarity with Linux and windows operating system.

Course Objectives:

1. To study information and data security aspects.
2. To understand about the threats and risk on cyber infrastructure.
3. To study encryption and decryption algorithms for network security.
4. To learn different mechanisms to tackle risks in cyber security.

Course Outcomes: After completion of this course, students will be able to

1. Understand about the technical aspects of cyber security.
2. Maintain security management and protection (CL-II).
3. Realize the threats posed by criminals, terrorist and nation states to national infrastructure (CL-II).
4. Design and develop secure software development and operating systems (CL-IV).

Course Contents:

Information/Network Security Overview: Introduction, current scenario, types of attacks, threats, harm, vulnerabilities, goals of security, e-commerce security, computer forensics, steganography

Encryption/Decryption: Introductions to cryptography/encryption, AAA, privacy, encryption algorithms, digital signatures, public key infrastructure, applications of cryptography, tools and techniques.

System Security: Desktop security, email security: PGP and SMIME, web security: web authentication, SSL and SET, database security, firewalls, intrusion detection and prevention systems.

Operating Systems Security: Vulnerabilities, rootkit, updates and patches, OS integrity checks, anti-virus softwares, configuring the OS for security.

Wireless Security: Vulnerabilities in existing wireless networks, Bluetooth security, cellular network security, Wi-Fi security.

Laboratory Exercises/Practicals:

1. Implementation of Caesar Cipherb.
2. Implementation of Rail Fence Row and Column Transformation.
3. To implement the HTML and Javascript based Diffie-Heliman key exchange mechanism.
4. To implement the Dictionary attack and Brute force attack.
5. Installation of wire shark, tcpdump and other packet capturing tools.
6. Installation of rootkits and study about the various options related to it.
7. To implement ARP poisoning-based Sniff traffic.
8. Implementation of intrusion detection system using snort tool.
9. To provide secure data storage and transmission for digital signature.
10. To study about the cloud computing security.

Practicals shall be engaged in four batches (batch size of 15 students) per division.

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Learning Resources:

Reference Books:

6. Pfleeger, C.P., *Security in Computing*, Prentice Hall, 5th edition, 2010.
7. Schneier, Bruce. *Applied Cryptography*, John Wiley & Sons, 2nd edition, 1996.

Web Resources:

Weblinks:

MOOCs:

https://nptel.ac.in/courses/106105031

https://www.coursera.org/specializations/cyber-security

Pedagogy:

- Power Point Presentations, Videos.
- Co-teaching.
- Group activities.

Assessment Scheme:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	05

Laboratory Continuous Assessment (LCA) (50 Marks**)**

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 Marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab/ Tutorial***	***Assess***
1	**Information/Network Security Overview:** Introduction, current scenario, types of attacks, threats, harm, vulnerabilities, goals of security, e-commerce security, computer forensics, steganography	**6**	**6**	
2	**Encryption/Decryption**: Introductions to cryptography/encryption, AAA, privacy, encryption algorithms, digital signatures, public key infrastructure, applications of cryptography, tools and techniques.	**6**	**6**	
3	**System Security:** Desktop security, email security: PGP and SMIME, web security: web authentication, SSL and SET, database security, firewalls, intrusion detection and prevention systems.	**6**	**6**	
4	**Operating Systems** Security: Vulnerabilities, rootkit, updates and patches, OS integrity checks, anti-virus softwares, configuring the OS for security.	**6**	**6**	
5	**Wireless Security:** Vulnerabilities in existing wireless networks, Bluetooth security, cellular network security, Wi-Fi security.	**6**	**6**	

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Course Code				
Course Category	**Program Core**			
Course Title	**Smart Grid Systems**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	3	**0**	**2**	**3 + 0 + 1**

Pre-requisites: Basics of power systems.

Course Objectives:

1. To introduce students to concept of smart grid with respect to conventional grid.
2. To understand the smart change in the areas of generation, transmission and utilization of power.
3. To impart knowledge of smart tools and technologies available in Smart Grid.

Course Outcomes: After completion of this course, students will be able to

1. Understand the architecture and need of smart grid (CL-II).
2. Identify the role of integration of smart systems into electric power grid (CL-II).
3. Use latest tools and technologies in operation of Smart Grid systems (CL-III).
4. Analyze the power quality issues and need of power quality management in smart grid (CL-IV).

Course Contents:

Introduction to Smart Grid: Concept, definition, need, opportunities and boundaries of smart grid, difference between conventional grid and smart grid, current development and future of smart grid. Resilient and self-healing grid, projects related to it. Smart grid technology drivers.

Smart Grid Systems: Energy Management System (EMS), distribution automation: smart substations, smart feeder automation, Remote Terminal Unit (RTU), Wide area monitoring Protection and control (WAMPAC), Distribution Management systems (DMS), Volt /VAR control, fault detection, isolation and service restoration, outage management.

Tools and Technologies for Smart Grid: Introduction to smart meters, Advanced Metering Infrastructure (AMI), intelligent electronic devices, demand side management, demand response programs, demand pricing, real time pricing, peak time pricing. Outage Management System (OMS).

Micro Grids: - concept need and applications of Micro Grid, micro grid architecture, DC micro grid formation Issues of interconnections, protection and control, Integration of renewable sources, micro grid and smart grid comparison. Cyber controlled micro grid. Suitable case study.

Power Quality Management in Smart Grid: Power quality and EMC in smart grid, power quality in connected renewable energy sources, power quality conditioners or smart grid. Web based power quality monitoring. Power quality audit.

Laboratory Exercises/Practicals:

1. Study of Solar PV system in standalone mode.
2. Study of Solar PV system in grid-connected mode.
3. Study of Wind Energy system in standalone mode.
4. Study of Solar and Wind Hybrid with battery system.
5. Study effect of different types of load with off-grid and -on grid operation of PV system.
6. Study of automatic switching of load and sources.

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7. Study of characteristics of linear and non-linear loads with grid connected system.
8. Study of smart home functionality and energy monitoring.
9. Remote access of smart home and energy monitoring system
10. Study effect of different types of loads integrated with smart home systems with off-grid Wind Energy system.

Learning Resources:

Text Books:

4. Keyhani A., Marwali M. N., and Dai M., *Integration of green and renewable energy in electric power systems.* John Wiley, Nov 2009.
5. Clark W. Gellings, *Smart Grid: Enabling Energy Efficiency and Demand Response*, CRC Press.
6. Borlase S., *Smart Grids-Infrastructures, Technology and Solutions*. CRC Press, Taylor and Francis group, 1st edition, 2013.
7. Ekanayake J., Liyanage K., J. Wu, and Akihiko Yokoyama, *Smart Grid Technology and Applications.* John Wiley, 2012.

Web Resources:
https://onlinecourses.nptel.ac.in/noc18_ee42/preview

Pedagogy:

- Power point presentations, videos.
- Group activities.
- Active learning methods.

Assessment Schemes:

Class Continuous Assessment (CCA) (60 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
20	20	15	5

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral
5	10	10	25

Term End Examination:

Term end exam of 40 marks will be based on entire syllabus.

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction to Smart Grid:** Concept, definition, need, opportunities and boundaries of smart grid, difference between conventional grid and smart grid, current development and future of smart grid. Resilient and self-healing grid, projects related to it. Smart grid technology drivers.	**9**	**6**	
2	**Smart Grid Systems:** Energy Management System (EMS), distribution automation: smart substations, smart feeder automation, Remote Terminal Unit (RTU), Wide area monitoring Protection and control (WAMPAC), Distribution Management systems (DMS), Volt /VAR control, fault detection, isolation and service restoration, outage management.	**9**	**6**	
3	**Tools and Technologies for Smart Grid:** Introduction to smart meters, Advanced Metering Infrastructure (AMI), intelligent electronic devices, demand side management, demand response programs, demand pricing, real time pricing, peak time pricing. Outage Management System (OMS).	**9**	**2**	
4	**Micro Grids:** - concept need and applications of Micro Grid, micro grid architecture, DC micro grid formation Issues of interconnections, protection and control, Integration of renewable sources, micro grid and smart grid comparison. Cyber controlled micro grid. Suitable case study.	**9**	**8**	
5	**Power Quality Management in Smart Grid:** Power quality and EMC in smart grid, power quality in connected renewable energy sources, power quality conditioners or smart grid. Web based power quality monitoring. Power quality audit.	**9**	**8**	

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Course Code				
Course Category	**PR**			
Course Title	**Capstone Project**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	0	**-**	**12**	**0 + 0 + 6**

Course Objectives:

1. Identify a real-life project/problem statement and define objectives, scope and outcomes by making use of the technical knowledge gained from courses studied, and through literature survey and industry trends in a selected domain.
2. To design and implement a project by developing algorithm/method/design schematics/circuitry/software for the chosen problem.
3. To apply project management skills such as planning of work, procuring parts, and documenting expenditures and working in team within the timeline.
4. Demonstrate and validate the actual working and operation of the designed project
5. Prepare and publish a technical paper based on the project undertaken
6. Write and submit a detailed report of the project in a professional manner

Course Outcomes: After completion of this course, students will be able to

1. Formulate a real-life project/problem statement and define objectives, scope and outcomes.
2. Design a proof of concept or real-life project by considering realistic constraints and standards in given timeframe.
3. Compose and present a quality technical paper/report
4. Develop organizational and team working skills such as decision making, planning, communication, leadership.

Course Contents:

Capstone Project: A small group of students' needs to design actual project by using suitable hardware and software tools in any area related to their studies. The work to be completed includes defining a problem statement, literature review, project overview, implementation scheme, system design, and partial implementation. The work should be intended towards the development of proof of concept (PoC) by considering the realistic constraints and standards. The actual and full-fledged implementation work is to be undertaken after the completion and approval of initial work. Capstone project may be completely based on hardware and/or software development work. The project team has to demonstrate the project and justify/validate the results. The team has to write and publish a paper based on their project work. At the end of the semester, a detailed technical project report is to be submitted in professional manner in a prescribed format to the University.

Readings:

1. Handbooks
2. Industry Literature
3. Journals and Magazines
4. Internet Resources

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Assessment Scheme: **Laboratory Continuous Assessment (LCA)** (200 Marks)				
Project, Objectives, and Depth	**Methodology**	**Progress of the Project and Understanding**	**Report and Ethics**	**Presentation**
40	40	40	40	40

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Course Code				
Course Category	**Professional Elective in Online Mode (OPE)**			
Course Title	**Industrial Drives and Systems**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**0**	**0**	**2 + 0 + 0**

Pre-requisites: Power Electronics, Electrical Machines

Course Objectives:

1. To study and analyse the operation of the electric drive system.
2. To study and understand the operation of control strategies.
3. To select the required drive as per various selection criteria.

Course Outcomes: After completion of this course, students will be able to

1. Understand the operation of the electric drive system (CL-II).
2. Model different control strategies for electrical drives (CL-III).
3. Compare various selection criteria with respect to its applications (CL-IV).

Course Contents:

Electrical Drives: Definition, Advantages of electrical drives, components of electric drive system, selection Factors, speed torque conventions and multi quadrant operation, load torque components, constant torque and constant power operation of a drive, steady state stability, load equalization by using flywheel.

Industrial Motor Drives: Motor braking methods using static devices, closed loop control of drives: current limit control, torque control and speed control, thyristorized stator voltage control, voltage source inverter, current source inverter, comparison, principle of vector control, AC servo drives.

Special Machine Drives: Permanent magnet synchronous motor drive: vector control of pm synchronous motor, control strategies: constant torque angle control, unity power factor control, speed controller design, permanent magnet brushless DC motor drive: half wave drives, sensor less control, design of current and speed controller.

Drive Selection: Selection criteria of motors, motor duties, inverter duty motors. Load diagram, heating and cooling, thermal resistance, determination of HP rating of motor based on duty cycle and various industrial applications.

Learning Resources:

Text Books:

1. Dubey G. K., *Fundamentals of Electric Drives*, Narosa Publishing House, 2nd Edition, Jan 2010.
2. De N. K. and Sen P. K., *Electric Drives*, Prentice Hall of India Eastern Economy Edition ISBN: 9788120314924, 9788120314924
3. Pillai S. K., *Analysis of Thyristor Power Conditioned Motors*, University Press, 2005, ISBN 8173710147, 9788173710148

Reference Books:

1. Malcolm Barnes, "*Practical Variable Speed Drives and Power Electronics*", Elsevier Newnes Publications, 1st Edition, 2003. ISBN: 9780750658089.
2. V. Subrahmanyam, "*Electric Drives: Concepts & Application*", Tata McGraw-Hill. Education, 2nd Edition, 2011
3. Singh M.D. and Khanchandani "*Power Electronics*", Delhi, Tata Mc-Graw Hill, 4th Edition, 2007.

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Pedagogy:

- Power point presentations, videos
- Co-teaching
- Group activities

Assessment Scheme:

Class Continuous Assessment (CCA) (100Marks)

Assignments	Midterm Exam	Quiz
40	30	30

Syllabus:

Unit	Content	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Electrical Drives:** Definition, Advantages of electrical drives, components of electric drive system, selection Factors, speed torque conventions and multi quadrant operation, load torque components, constant torque and constant power operation of a drive, steady state stability, load equalization by using flywheel.	**8**		
2	**Industrial Motor Drives:** Motor braking methods using static devices, closed loop control of drives: current limit control, torque control and speed control, thyristorised stator voltage control, voltage source inverter, current source inverter, comparison, principle of vector control, AC servo drives.	**7**		
3	**Special Machine Drives:** Permanent Magnet Synchronous Motor Drive: vector control of PM synchronous motor (PMSM), control strategies: constant torque angle control, unity power factor control, speed controller design, permanent Magnet Brushless DC Motor Drive: Half wave drives, sensor less control, design of current and speed controller.	**8**		
4	**Drive Selection:** Selection criteria of motors, motor duties, inverter duty motors. Load diagram, heating and cooling, thermal resistance, determination of HP rating of motor based on duty cycle and various industrial applications.	**7**		

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Course Code				
Course Category	**Professional Elective in Online Mode (OPE)**			
Course Title	**Business Analytics**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**0**	**0**	**2 + 0 + 0**

Pre-requisites: Knowledge of Microsoft excel, python, R language,

Course Objectives:

1. Select, understand and apply appropriate analytical tools in the analysis of quantitative and qualitative data from a variety of business scenarios.
2. Use software package for data analysis; understand data gathering and input considerations; and be able to analyze and interpret output (graphs, tables, mathematical models, etc.)
3. Know considerations in collecting data and selection of appropriate analysis tools; and know how to report results in a fair, objective and unbiased manner.

Course Outcomes: After completion of this course, students will be able to

1. Analyze the business scenario using different tools for the company
2. Understand as well as represent various data in graphical forms for better analysis.
3. Prepare a detailed reports after completing the data analysis.

Course Contents:

Introduction to Business Analytics: Concept, big data, data collection, ethics, tools of business analytics, linear regression, time series analysis.

Data Mining: Cluster analysis, market basket analysis, spreadsheet models, decision analysis, supervised learning.

Prediction in business analytics: Lending analytics, recommendation analytics, healthcare analytics, sports analytics, retail analytics, salesforce analytics, retail analytics

Applications and Case studies: Applications in marketing, management and entrepreneurship, economics, real life cases of business analysis from different types of industries.

Learning Resources:

Reference Books:

1. Business Analytics by James R. Evans, 2nd edition; Publisher: Pearson; ISBN-13: 9780321997821
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston, CENGAGE Learning, 5th edition, 2013.

Web Resources:
Weblinks:

http://www.solver.com/simulation-tutorial
http://www.solver.com/risk-analysis-tutorial
http://www.solver.com/monte-carlo-simulation-tutorial
http://www.solver.com/video-demos
https://www.youtube.com/user/FrontlineSolvers

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Pedagogy:

- Power Point Presentations, Videos.
- Co-teaching.
- Group activities.

Assessment Scheme:

Class Continuous Assessment (CCA) (100 Marks)

Assignments	Midterm Exam	Quiz
40	30	30

Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab/ Tutorial*	*Assess*
1	**Introduction to Business Analytics:** Concept, big data, data collection, ethics, tools of business analytics, linear regression, time series analysis.	**8**		
2	**Data Mining:** Cluster analysis, market basket analysis, spreadsheet models, decision analysis, supervised learning.	**8**		
3	**Prediction in business analytics:** Lending analytics, recommendation analytics, healthcare analytics, sports analytics, retail analytics, salesforce analytics, retail analytics	**7**		
4	**Applications and Case studies:** Applications in marketing, management and entrepreneurship, economics, real life cases of business analysis from different types of industries.	**7**		

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Course Code				
Course Category	**Professional Elective in Online Mode (OPE)**			
Course Title	**Industrial IoT**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**0**	**0**	**2 + 0 + 0**

Pre-requisites: Knowledge of communication networks and protocols.

Course Objectives:

1. To study requirements and architecture of Internet of Things (IoT) and Industrial IoT systems.
2. To understand and analyze various technology candidates available for Industrial IoT and applications.
3. To get familiarize with data analytics and cloud platforms for IoT applications.
4. To develop end to end applications for Industrial IoT settings.

Course Outcomes: After completion of this course, students will be able to

1. Select appropriate technologies for Industrial IoT applications (CL-II).
2. Design Industrial IoT applications for monitoring/measurement of given parameters (CL-IV).
3. Integrate IoT based systems in the electrical networks (CL-V).
4. Assess the data and network through cloud securely (CL-IV).

Course Contents:

Introduction to Internet of Things: Requirement of wireless sensor networks, design constraints, topologies, sensor nodes, constraints, types of sensors/actuators, operating systems, media access control protocols, characteristics of IoT and Industrial IoT, generalized layer models and architectures, applications, introduction to Industry 4.0 and M2M communication.

Technologies for Industrial IoT: Architectures, layer models and features of IEEE 802.15.4 LR-WPAN, Zigbee, WirelessHART, ISA 100.11a, RFID, NFC, Wibree, BLE, Zwave, ANT, Insteon, Wavenis, 6LowPAN, RPL, REST, LPWANs, LoRaWAN, Sigfox, NB-IoT, LTE-M, AMPQ, CoAP, MQTT, TinyML and associated topics.

Data Analytics for IoT: Introduction, Bigdata, types of data, characteristics of big data, data handling technologies, introduction to Hadoop, data analytics, types of data analytics, statistical models, introduction to fog, edge and cloud computing, different platforms available for IoT applications.

Applications of Internet of Things: Smart city, environment, industries, M2M, vehicular networks, intelligent transport systems, EMI/EMI radiation monitoring, transformer health monitoring, smart grids, SCADA, utilities, smart metering, smart lighting, building automation, and other fields.

Learning Resources:

Text Books:

1. Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob, and Henry Jerome, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things.* New Delhi: Pearson, 2017.

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2. Chaudhari Bharat and Zennaro Marco, *LPWAN Technologies for IoT and M2M Applications.* London: Academic Press-Elsevier, 2020.

Web Resources:

1. https://nptel.ac.in/courses/106105195
2. http://wireless.ictp.it/school_2015

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (100 Marks)

Assignments	Midterm Exam	Quiz
40	30	30

Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction to Internet of Things:** Requirement of wireless sensor networks, design constraints, topologies, sensor nodes, constraints, types of sensors/actuators, operating systems, media access control protocols, characteristics of IoT and Industrial IoT, generalized layer models and architectures, applications, introduction to Industry 4.0 and M2M communication.	**7**		
2	**Technologies for Industrial IoT:** Architectures, layer models and features of IEEE 802.15.4 LR-WPAN, Zigbee, Wireless HART, ISA 100.11a, RFID, NFC, Wibree, BLE, Zwave, ANT, Insteon, Wavenis, 6LowPAN, RPL, REST, LPWANs, LoRaWAN, Sigfox, NB-IoT, LTE-M, AMPQ, CoAP, MQTT, TinyML and associated topics.	**9**		
3	**Data Analytics for IoT:** Introduction, Bigdata, types of data, characteristics of big data, data handling technologies, introduction to Hadoop, data analytics, types of data analytics, statistical models, introduction to fog, edge and cloud computing, different platforms available for IoT applications.	**7**		
4	**Applications of Internet of Things:** Smart city, environment, industries, M2M, vehicular networks, intelligent transport systems, EMI/EMI radiation monitoring, transformer health monitoring, smart grids, SCADA, utilities, smart metering, smart lighting, building automation, and other fields.	**7**		

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Course Code	**EEE**			
Course Category	**Professional Elective (Online Mode)**			
Course Title	**Power Quality**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**0**	**0**	**2 + 0 + 0**

Pre-requisites: Basics of Power Systems

Course Objectives:

1. To identify and analyse various power quality issues.
2. To impart the basic knowledge of power quality monitoring techniques and instruments.
3. To understand the relevant IEEE standards.
4. To prepare students for learning and analyzing various power quality mitigation techniques.

Course Outcomes: After completion of this course, students will be able to

1. Explain various power quality issues, their causes and effects (CL-II).
2. Identify various causes of voltage sag, swell and interruptions (CL-III).
3. Analyze the harmonics created due to nonlinear load (CL-IV).
4. Select proper power quality compensating, measuring and monitoring equipment (CL-V).

Course Contents:

Electric Power Quality: Overview and importance of power quality. Power quality issues such as transients, short duration voltage variation, long duration voltage variation, voltage imbalance, waveform distortion, voltage fluctuations, power frequency variations, power quality standards.

Voltage Imperfections in Power System: Causes of voltage sags, voltage swell and interruptions, Sources of voltage sag, performance evaluation, area of vulnerability, motor sag at starting, and monitoring and mitigation methods for voltage sag.

Harmonics and their mitigation techniques: Harmonic distortion, voltage versus current distortion, power system quantities under non sinusoidal conditions, effects of harmonic distortion, power assessment under waveform distortion, modern devices for controlling harmonic distortion, standards on harmonics.

Power Quality Measuring and Monitoring: Monitoring considerations for various power quality problems, power quality measurement equipment, and application of intelligent systems for power quality monitoring, principle and working of DSTATCOM.

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Learning Resources:

Text Books:

1. Arrillaga J., Watson N., and Chen S., *Power Quality Assessment*. Chinchister: John Wiley and Sons, 1st edition, 2000.
2. Bollan M. H.J., *Understanding Power Quality Problems, Voltage Sag and Interruptions*. New York: IEEE Press, 1st edition, 2000.
3. Dugan R., McGranhhan Mak F., Santoso S., and Wane Beaty H., *Electrical Power System Quality* New York: McGraw-Hill, 3rd edition, 2018.

Supplementary Reading:

1. Arrillaga J. and Watson N., Power *System Harmonics*. Chinchister: John Wiley and Sons, 2nd edition, 2003.
2. Heydt G. T., *Electric Power Quality*. New York: Stars in Circle Publications, 1st edition, 1994.

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (100 Marks)

Assignments	Midterm Exam	Quiz
40	30	30

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Electric Power Quality:** Overview and importance of power quality. Power quality issues such as transients, short duration voltage variation, long duration voltage variation, voltage imbalance, waveform distortion, voltage fluctuations, power frequency variations, power quality standards.	**8**		
2	**Voltage Imperfections in Power System**: Causes of voltage sags, voltage swell and interruptions, Sources of voltage sag, performance evaluation, area of vulnerability, motor sag at starting, and monitoring and mitigation methods for voltage sag.	**8**		
3	**Harmonics and their mitigation techniques:** Harmonic distortion, voltage versus current distortion, power system quantities under non sinusoidal conditions, effects of harmonic distortion, power assessment under waveform distortion, modern devices for controlling harmonic distortion, standards on harmonics.	**7**		
4	**Power Quality Measuring and Monitoring:** Monitoring considerations for various power quality problems, power quality measurement equipment, and application of intelligent systems for power quality monitoring, principle and working of DSTATCOM.	**7**		

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Course Code				
Course Category	**Professional Elective (Online Mode)**			
Course Title	**Blockchain Technologies**			
Weekly Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	2	**-**	**-**	**2 + 0 + 0**

Pre-requisites: Nil

Course Objectives:

1. To understand the technology behind blockchain.
2. To comprehend the issues related to blockchain.
3. To study the real-world applications of blockchain.

Course Outcomes: After completion of this course, students will be able to

1. Understand the requirements of the basic design of blockchain. (CL-I)
2. Identify the need of blockchains to find the solution to the real-world problems. (CL-I)
3. Recognize the underlying technology of transactions, blocks, proof-of-work, and consensus building. (CL-I)
4. Design and implement new ways of using blockchain for applications other than cryptocurrency. (CL-IV).

Course Contents:

Introduction: Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges.

Working of Blockchain: Public ledgers, blocks in a blockchain, blockchain as public ledgers, transactions, distributed consensus, building a block: elements of cryptography-cryptographic hash functions, merkle tree, elements of game theory.

Blockchain Architecture: Design methodology for blockchain applications, blockchain application templates, blockchain application development, ethereum, solidity, sample use cases from industries, business problems.

Smart Contracts: Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mistwallet, smart contract examples, smart contract patterns.

Advanced Topics: Byzantine fault tolerance, proof-of-work vs proof-of-stake, security and privacy of blockchain, smart contract vulnerabilities, scalability of blockchain.

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Learning Resources:

Text Books:

8. B. Singhal, G. Dhameja, P. Panda, *Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions*, ,Apress, 2018.
9. J. Bambara and P. Allen, *Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions*, McGraw Hill, 2018.
10. Vikram Dhillon, David Metcalf and Max Hooper, *Blockchain enabled Applications*, Apress, 2017,
11. W. Mougayar, *The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology*, Wiley, 2016.

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods

Assessment Schemes:

Class Continuous Assessment (CCA) (100 Marks)

Assignments	Midterm Exam	Quiz
40	30	30

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Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	***Lab***	***Assess***
1	**Introduction:** Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges.	**9**		
2	**Working of Blockchain:** Public ledgers, blocks in a blockchain, blockchain as public ledgers, transactions, distributed consensus, building a block: elements of cryptography-cryptographic hash functions, merkle tree, elements of game theory.	**9**		
3	**Blockchain Architecture:** Design methodology for blockchain applications, blockchain application templates, blockchain application development, ethereum, solidity, sample use cases from industries, business problems.	**9**		
4	**Smart Contracts:** Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mistwallet, smart contract examples, smart contract patterns.	**9**		
5	**Advanced Topics**: Byzantine fault tolerance, proof-of-work vs proof-of-stake, security and privacy of blockchain, smart contract vulnerabilities, scalability of blockchain.	**9**		

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