

SEMESTER 7

**ELECTRICAL AND COMPUTER
ENGINEERING**

SEMESTER S7

POWER SYSTEM OPERATION AND CONTROL

Course Code	PEEET741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCEET501, PBEET604	Course Type	PE -Theory

Course Objectives:

1. To introduce analysis techniques for the operation and control of power system.
2. To discuss load scheduling and scheduling of energy.
3. To study power system security and state estimation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction- Optimum load dispatch - First order gradient method base point and participation factors. Economic dispatch versus unit commitment. Unit Commitment Solution Methods - Priority-List Methods – Security Constrained Unit Commitment.	9
2	Generation with limited supply-Take or pay fuel supply contract-Introduction to Hydrothermal coordination-Long range and short range scheduling Hydro-electric plant models-scheduling energy problems - types of scheduling problems. Scheduling energy - The Hydrothermal Scheduling Problem - Hydro scheduling with storage limitation - Introduction to Pumped storage hydro plants.	9
3	Inter change evaluation and power pools- Interchange contracts – Energy interchange between utilities - Interchange evaluation with unit commitment - Energy banking- power pools. Power system security- Factors Affecting Power System Security - Contingency Analysis: Detection of Network Problems - Generation Outages - Transmission Outages - An Overview of Security Analysis.	9

4	Introduction to State estimation in power system, Maximum Likelihood Weighted Least Squares Estimation - State Estimation of an AC Network - Sources of Error in State Estimation - Detection and Identification of Bad Measurements - Estimation of Quantities Not Being Measured - Network Observability and Pseudo-measurements - The Use of Phasor Measurement Units (PMUs) - Application of Power Systems State Estimation - Importance of Data Verification and Validation.	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse various methods of generation scheduling.	K4
CO2	Formulate hydro-thermal scheduling problems.	K5
CO3	Evaluate power exchange in interconnected power systems.	K5
CO4	Analyse security issues in power system networks.	K3
CO5	Analyse various state estimation methods.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Generation Operation and Control	Allen J. Wood & Bruce F. Wollenberg	John Wiley & Sons	3 rd edition 2023
2	Power System Analysis	John Grainger & William Stevenson	McGraw Hill	1994
3	Power System State Estimation: Theory and Implementation	Ali Abur, Antonio Gomez	CRC Press	2004

SEMESTER S7

ENERGY MANAGEMENT AND AUDITING

Course Code	PEEET742	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	-	Course Type	PE - Theory

Course Objectives:

1. To apply energy conservation principles and management techniques to different energy conversion systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	General aspects of energy management and energy audit: Energy Management – Definition, General principles of energy management and energy management planning Energy Audit: Definition, need, types and methodologies. Instruments for energy audit, Energy audit report - Power quality audit Energy conservation in buildings: ECBC code (basic aspects), Building Management System (BMS).	9
2	Energy Efficiency in Electrical Utilities: Electricity transmission and distribution system, cascade efficiency. Lighting: Modern energy efficient light sources, life and efficacy comparison with older light sources, energy conservation in lighting. Motors: Development of energy efficient motors and the present status, techniques for improving energy efficiency, necessity for load matching and selection of motors for constant and variable loads. Demand side Management: Introduction to DSM, benefits of DSM, different techniques of DSM. Power factor improvement, numerical examples. Ancillary services: Introduction of ancillary services – Types of Ancillary services	9

3	Energy Management in Electrical Utilities: Boilers: working principle - blow down, energy conservation opportunities in boiler. Steam: properties of steam, distribution losses, steam trapping. Identifying opportunities for energy savings in steam distribution. Furnace: General fuel economy measures, energy conservation opportunities in furnaces. HVAC system: Performance and saving opportunities in Refrigeration and Air conditioning systems. Heat Recovery Systems: Waste heat recovery system - Energy saving opportunities. Cogeneration: Types and schemes, optimal operation of cogeneration plants, combined cycle electricity generation.	9
4	Energy Economics: Economic analysis: methods, cash flow model, time value of money, evaluation of proposals, pay-back period, average rate of return method, internal rate of return method, present value method, life cycle costing approach. Computer aided Energy Management Systems (EMS).	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the significance of energy management and auditing.	K2
CO2	Discuss the energy efficiency and management of electrical loads.	K2
CO3	Apply demand side management techniques	K2
CO4	Explain the energy management opportunities in industries.	K2
CO5	Compute the economic feasibility of the energy conservation measures	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Publications of Bureau of Energy Efficiency (BEE).			
2	Energy Management and Conservation Handbook	D. Yogi Goswami, Frank Kreith,	CRC Press	2007
3	Energy management Hand Book	Wayne C. Turner	The Fairmount Press, Inc.	1997
4	Energy Management and Conservation Handbook	D. Yogi Goswami, Frank Kreith	CRC Press	2007
5	Industrial energy conservation	Charles M. Gottschalk	John Wiley & Sons	1996

SEMESTER S7
SPECIAL ELECTRICAL MACHINES

Course Code	PEEET743	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	PE -Theory

Course Objectives:

1. Describe the constructional details, working and drive circuits of various types of special electrical machines

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Stepper motors – basic principle - types - variable reluctance, permanent magnet, hybrid types – constructional features - principle of operation – comparison - modes of operation – monofilar and bifilar windings – modes of excitation – one phase ON mode, two phase ON mode, half-step mode – micro-stepping - static and dynamic characteristics – open-loop and closed loop control - applications – numerical problems.	9
2	Synchronous Reluctance Motor – Constructional details - principle of operation - phasor diagram - torque equation - applications. Switched reluctance motors – constructional details - principle of operation - torque equation – characteristics - power converter circuits - control of SRM - rotor position sensors- torque pulsations – sources of noise - noise mitigation techniques - applications.	9
3	PM Brushless DC motor- constructional details - permanent magnets – different types - demagnetization characteristics – arrangement of permanent magnets – magnetization of permanent magnets – axial and parallel magnetizations- principle of operation – Control of BLDC motor - applications. Permanent Magnet Synchronous Motors - construction - principle of operation – Control of PMSM – self-control – sensor-less control– applications - comparison with BLDC motors	9

4	<p>Linear Electric Machines: Linear motors – different types – linear reluctance motor - linear synchronous motors – construction – comparison. Linear Induction Motor – Construction- Thrust Equation, Transverse edge and end effects- Equivalent Circuit, Thrust-Speed characteristics, Applications.</p> <p>Single Phase Special Electrical Machines- AC series Motor, Repulsion Motor, Hysteresis Motor, Universal Motor- Construction - principle of operation - applications.</p>	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the constructional details, working and drive circuits for various types of stepper motor.	K2
CO2	Explain the constructional details, working and drive circuits for switched and synchronous reluctance motor.	K2
CO3	Explain the constructional details, working and drive circuits for brushless DC motor and permanent magnet synchronous motor.	K2
CO4	Explain the constructional details and working of linear induction motor	K2
CO5	Explain the constructional details and working of single-phase special electrical machines.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Special Electrical Machines	E. G. Janardhanan	PHI Learning Private Limited	Ist edition 2014
2	Special Electrical Machines	K. Venkataratnam	Universities Press	Ist edition, 2008
3	A detailed study on Special Electrical Machines	V. Vedanarayanan	Notion Press	Ist edition, 2021
4	Brushless PM and Reluctance Motor Drives	T. J. E. Miller	Clarendon Press, Oxford	1989
5	Permanent magnet synchronous and Brushless DC motor Drives	R. Krishnan	CRC Press.	Ist edition 2016

SEMESTER S7

DISCRETE TIME CONTROL SYSTEMS

Course Code	PEEET744	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide a strong foundation on the analysis and design techniques on classical and modern control theory in discrete domain

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Analysis of Sampled Data Systems: Review of Z Transforms; Sampling Theorem, Impulse Sampling, Sampling Rate Selection, Data Hold – ZOH, FOH, Pulse Transfer Function, Control configurations. Mapping between the s-plane and the z-plane. Stability analysis of closed-loop system in the z-plane, Jury's test, Schur-Cohn test, Bilinear Transformation, Routh-Hurwitz method in w-plane.	9
2	Design of Compensators: Direct design based on root locus: Design of Lag Compensator, Design of Lead Compensator, Design of Lead-Lag Compensator. Digital Controller Design in Frequency Domain: Direct design based on frequency response, Design of Lag Compensator, Design of Lead Compensator, Design of Lag-Lead Compensator, Realization of digital controllers.	11
3	Discrete-time State Space System: State variable model of discrete data systems with S/H devices - State transition equations, state diagrams. Relationship between state space representation and pulse transfer function, Transformation to canonical forms and phase variable form. Solution of state equation, Computation of state transition matrix using	9

	Cayley-Hamilton theorem and z-transform method.	
4	Design using State Space approach: Discretization of continuous time state-space equations, Controllability, Observability. State feedback controller design via Pole Placement. State Observer Design: Full order observers and Reduced order observers.	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Model and analyse discrete-time system using pulse transfer function approach.	K3
CO2	Design digital compensators for linear systems.	K3
CO3	Model and analyse discrete-time system using state space approach.	K3
CO4	Design discrete-time state feedback controllers and observers for a linear system.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital control system analysis and design	Philips and Nagle	Prentice Hall	1984
2	Discrete Time Control Systems	K. Ogata	PHI Learning Private Limited, New Delhi	2009.
3	Digital control and State Variable methods	M. Gopal	Tata McGraw –Hill	1997

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Control Systems	B C Kuo	2 nd Ed., Oxford University Press	1992
2	Digital control systems Theory, hardware software.	Constantine H. Houpis and Gary B. Lamont	McGraw Hill Book Company	1985
3	Digital control systems Volume I, Fundamentals , Deterministic control	Isermann	Springer Verlag	2 nd revised edition 1989
4	Digital Control of Dynamic Systems	G.F.Franklin, J. David Powell and M. Workman		3 rd Ed.

SEMESTER S7

DIGITAL IMAGE PROCESSING

Course Code	PEEET746	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	PE -Theory

Course Objectives:

1. To introduce the fundamental concepts of Digital Image Processing and study the various transforms required for image processing.
2. To study spatial and frequency domain image enhancement and image restoration methods.
3. To understand image compression and segmentation techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital Image Fundamentals: Image representation, Types of images, Elements of DIP system, Basic relationship between pixels, Distance Measures, Simple image formation model. Brightness, contrast, hue, saturation, Mach band effect. Colour image fundamentals-RGB, CMY, HIS models, 2D sampling and quantization.	9
2	2D Image transforms: DFT, Properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition. Image Compression: Image compression model, Lossy, lossless compression, Concept of transform coding, JPEG Image compression standard.	9
3	Image Enhancement: Spatial domain methods: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters. Frequency domain methods: low pass filtering, high pass filtering,	9

	homomorphic filtering.	
4	Image Restoration: Degradation model, Inverse filtering- removal of blur caused by uniform linear motion, Minimum Mean Square Error (Wiener) Filtering. Image segmentation: Region based approach, clustering, Segmentation based on thresholding, edge based segmentation, Hough Transform.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand different components of image processing system	K2
CO2	Analyse the various concepts and mathematical transforms necessary for image processing	K3
CO3	Illustrate the various schemes of image compression	K3
CO4	Analyze the filtering and restoration of images	K3
CO5	Understand the basic image segmentation techniques	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Image Processing	Gonzalez Rafael C	PEARSON	4TH
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	McGraw Hill	Ist

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Image Processing	Kenneth R Castleman	Pearson Education	2/e,2003
2	Fundamentals of digital image processing	Anil K Jain	PHI	1988
3	Digital Image Processing	Pratt William K	John Wiley	4/e,2007

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc24_ee133/preview
2	https://nptel.ac.in/courses/117105135
3	https://www.youtube.com/watch?v=KiJo4-IijL4
4	https://archive.nptel.ac.in/courses/117/105/117105135/

SEMESTER S7

FUNDAMENTALS OF CYBER SECURITY

Course Code	PEEOT741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	PE -Theory

Course Objectives

1. To familiarize various types of cyber-attacks and cyber-crimes.
2. To providing a comprehensive foundation in securing digital systems against cyber

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks. Introduction to Cyber security: Cybercrimes, Types of Cybercrimes - Recent Data Breaches - Recent Cyber security Trends - Case Study: Sim Swapping Fraud, ATM Card Cloning, Hacking email for money, Google Nest Guard, Phishing, Types of Phishing.	9
2	Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, Transposition techniques, Encryption and decryption, Symmetric and asymmetric key cryptography, steganography, Key range and key size. Case Studies of Cryptography: Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions, Conventional Encryption and Message Confidentiality, Location of Encryption Devices, Key Distribution.	9
3	Introduction to Ethical Hacking: Footprinting and Reconnaissance, Scanning Networks, Enumeration, Vulnerability Analysis, System Hacking, Malware Threats, Sniffing, Social Engineering, Denial-of-Service, SQL Injections.	9
4	Introduction to Vulnerability Scanning: Overview of vulnerability	9

	scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap.	
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts in security and contemporary cyber threats, including various types of cybercrimes and recent trends in cybersecurity.	K2
CO2	Summarize basic cryptographic algorithms and security issues	K2
CO3	Explain the methods and techniques used in ethical hacking to identify and mitigate security vulnerabilities.	K2
CO4	Explain the basic concepts in vulnerability Scanning.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1							1
CO2	1	1	1	1	1							1
CO3	1	1	1	1	1							1
CO4	1	1	1	1	1							1

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Anti-Hacker Tool Kit	Mike Shema	Mc Graw Hill	4 th edition
2	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole and Sunit Belpure	Wiley	
3	Fundamentals of Network Security	Eric Maiwald	McGraw-Hill	2004
4	Computer forensics - Guide to Computer Forensics and Investigations	Bill Nelson, Amelia Phillips and Christopher Steuart	Course Technology Inc.	4 th edition

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cybersecurity Essentials	Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short	John Wiley & Sons.	1st edition
2	Cryptography and Network Security –	William Stallings	Pearson Education, 2013	6th Edition
3	The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy	Patrick Engebretson	Syngress	2nd Edition, June 24, 2013
4	Ethical Hacking: The Complete Beginner's Guide to Learning Ethical Hacking (A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking)	Alice Ybarr	Paperback – Import	3 December 2022

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/OYsY5B9pqYU
2	https://youtu.be/jSsehESW37c
3	https://youtu.be/kpM4GopdXm0
4	https://youtu.be/kpM4GopdXm0

SEMESTER S7

POWER QUALITY

Course Code	PEEET751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	PE - Theory

Course Objectives:

1. To introduce the fundamental concepts of power quality, different power quality issues and its mitigation methods.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Power quality phenomenon - Sources and effects of power quality problems, Need for concern of Power quality Types of power quality disturbances – Transients – classification and origin, Short duration voltage variation – interruption, sag, swell, Long duration voltage variation, voltage unbalance, waveform distortion - notching, harmonics and voltage flicker Power Quality issues of Grid connected Renewable Energy Systems – operating conflicts	9
2	Harmonics - mechanism of harmonic generation, Triplen harmonics, Harmonic sources – switching devices, arcing devices and saturable devices, Effects of harmonics on power system equipment and loads – transformers, capacitor banks, motors and telecommunication systems, Effect of triplen harmonics on neutral current, line and phase voltages. Harmonic analysis using Fourier series and Fourier transforms – simple numerical problems	9
3	Harmonic indices (CF, DF, THD, TDD, TIF, DIN, C – message weights), Displacement and total power factor Overview of power quality standards: IEEE 519, IEEE 1433 and IEC 61000 Power quality Monitoring: Objectives and measurement issues, different monitoring instruments – Power quality analyzer, harmonic spectrum	9

	analyzer, flicker meters	
4	Mitigation of Power quality problems - Harmonic elimination - Design simple problems and analysis of passive filters to reduce harmonic distortion – demerits of passive filters – description of active filters - shunt, series, hybrid filters, sag and swell correction using DVR Power quality conditioners - DSTATCOM and UPQC - Configuration and working Power factor correction – Single phase active power factor converter – circuit schematic and control block diagram Grounding and wiring – reasons for grounding – wiring and grounding problems - solutions to these problems	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the sources and effects of power quality problems.	K2
CO2	Apply Fourier concepts for harmonic analysis.	K3
CO3	Explain the important aspects of power quality monitoring.	K2
CO4	Examine power quality mitigation techniques.	K2
CO5	Discuss power quality issues in grid connected renewable energy systems.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electrical Power System Quality	R. C. Dugan, M. F. Me Granaghen, H. W. Beaty	McGraw-Hill	2012
2	Power Quality	C. Sankaran	CRC Press	2002
3	Understanding Power Quality Problems	Math H. Bollen	Wiley-IEEE Press	1999
4	Power Quality problems and mitigation techniques	Bhim Singh, Ambrish Chandra and Kamal Al-Haddad	John Wiley and Sons Ltd	2015

SEMESTER S7

NONLINEAR CONTROL SYSTEMS

Course Code	PEEET752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To introduce the concept of nonlinear systems
2. To impart knowledge about different strategies adopted in the analysis of nonlinear systems
3. To familiarize with the design of different types of nonlinear controllers

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to nonlinear systems: Basic characteristics of nonlinear systems. Examples. State-space representation of nonlinear systems. Classification of nonlinearities. Phase plane analysis: Concept of phase plane, singular points. Definition of stability – asymptotic stability, instability; Construction using isocline method. Classification of equilibrium points; Systems with multiple equilibria. Periodic orbits - limit cycles.	10
2	Lyapunov Stability Theory: Lyapunov's direct method - Definite functions - Stability theorems; - Variable gradient method – La-Salle theorems. Stability of linear systems - Lyapunov equation for time-invariant systems - Lyapunov's linearization (indirect) method - Region of attraction (concept only).	7
3	Frequency domain Analysis of Feedback systems: Describing function method: Analysis through harmonic linearization- Determination of describing function of nonlinearities. Application of describing function for stability analysis of autonomous system with single nonlinearity (relay, dead zone and saturation only).	10

	Feedback Stabilisation, Kalman-Yakubovitch-Popov lemma (Concept only); Stability Analysis of feedback systems, Circle Criterion.	
4	Nonlinear Control Design: Lie Derivatives and Lie Brackets; Feedback linearization, Input state linearization and input – output linearization of SISO systems. (3 hours) Design via linearization - regulation via integral control; gain scheduling, tracking. Concepts of other nonlinear controllers – sliding mode, backstepping.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the qualitative behaviour of nonlinear systems about their equilibrium points.	K3
CO2	Analyse the stability of nonlinear systems.	K3
CO3	Analyse the behaviour of nonlinear systems using frequency domain analysis.	K2
CO4	Design feedback controller for nonlinear systems.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Nonlinear Systems	Hassan K Khalil	Prentice - Hall International (UK)	2002
2	Applied Nonlinear Control	Jean-Jacques E. Slotine and Weiping Li	Prentice-Hall, NJ	1991

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Nonlinear Control Systems: An Introduction	Alberto Isidori	Springer-Verlag	1985
2	Nonlinear System Analysis, Stability and Control	M. Vidyasagar	Prentice-Hall, India	1991

SEMESTER S7

DEEP LEARNING

Course Code	PEEET753	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic understanding of probability theory, linear algebra and machine learning	Course Type	Theory

Course Objectives:

1. To introduce the building blocks used in deep learning like neural networks, deep neural networks, convolutional neural networks and recurrent neural networks
2. To learn and understand various learning and optimization techniques such as Gradient Descent, Adam
3. To solve a wide range of problems in Computer Vision and Natural Language Processing

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Neural Network: Introduction to neural networks -Single layer perceptrons, Multi Layer Perceptrons (MLPs), Activation functions - Sigmoid, Tanh, ReLU, Softmax, Risk minimization, Loss function, Training MLPs with Backpropagation, Practical issues in neural network training - The problem of Overfitting, Vanishing and Exploding gradient problems, Difficulties in convergence, Local and spurious Optima, Computational challenges. Applications of neural networks	9
2	Deep Learning: Introduction to Deep Learning, Deep Feed Forward network, Training deep learning models, Optimization techniques - Gradient Descent (GD), GD with momentum, Nesterov accelerated GD, Batch, Mini-batch and Stochastic GD, AdaGrad, RMSProp, Adam	9
3	Convolutional Neural Network (CNN): Introduction to CNN - Convolution and Pooling, Convolution and Pooling as	9

	an infinitely strong prior, variants of convolution functions, Efficient convolution algorithms, Applications - Computer Vision	
4	Recurrent Neural Network (RNN): Introduction to RNN - Computational graphs, RNN design, Encoder-decoder sequence to sequence architectures, Deep RNNs, Modern RNN - LSTM and GRU, Applications - Natural Language Processing (NLP),	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the basic concepts of neural networks and its practical issues	K2
CO2	Outline the standard regularization and optimization techniques for deep neural network	K2
CO3	Implement the foundation layers of convolutional neural networks, pooling and convolution	K2
CO4	Implement sequence model using recurrent neural networks	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Neural Networks and Deep Learning	Charu C. Aggarwal	Springer	2018
2	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms	Nikhil Buduma and Nicholas Locascio	O'Reilly Media	2017
3	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Neural Networks and Deep Learning	Michael Nielsen	http://neuralnetworksanddeeplearning.com/	2018
2	Neural Networks: A Classroom Approach	Satish Kumar	Tata McGraw-Hill Education	2014
3	Artificial Neural Networks	Yegnanarayana, B	PHI Learning Pvt. Ltd	2009

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105215/
2	https://archive.nptel.ac.in/courses/106/106/106106184/
3	https://archive.nptel.ac.in/courses/106106201/
4	https://archive.nptel.ac.in/courses/106106224/

SEMESTER S7

COMPUTER VISION

Course Code	PEEET754	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	PE - Theory

Course Objectives:

1. To develop the knowledge of various methods, algorithms and applications of Computer Vision.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of image processing techniques: Digital filters, linear filters- Homomorphic filtering, Point operators- Histogram, neighbourhood operators, thresholding Mathematical morphology, Binary shape analysis, Binary shape analysis, Erosion, Dilation, Opening and Closing, Hit-or-Miss Transform ,connectedness, object labelling and counting, Boundary descriptors – Chain codes. Properties of Binary Regions, Geometric Features, Statistical Shape Properties	9
2	Feature Detection and Image Synthesis, Edge detection – edges, lines, active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts, energy- based methods- Cranny's Algorithm, Corner detection, Harris corner detection algorithm. Hough transform-Line and curve detection.	9
3	Shape from X - Shape from shading, Photometric stereo, Texture Occluding contour detection. Motion Analysis- Regularization theory, Optical Flow: brightness constancy equation, aperture problem, Horn-Shunck method, Lucas-Kanade method. Structure from motion	9
4	Object recognition-Shape correspondence and shape matching PCA,SVM, LDA, Bayes rule and ML methods. Eigen faces, Face detection, Face recognition, Application: Scene analysis Examples of real time applications: In-vehicle vision system.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand digital filtering operations for CV applications.	K2
CO2	Apply basic morphological and boundary operators for Computer vision applications	K3
CO3	Apply edge, corner detection algorithms to locate objects in an image.	K3
CO4	Apply optical flow algorithms to detect moving objects in a video.	K3
CO5	Analyse a given scene using appropriate computer vision algorithms to detect/recognize objects and to implement it in real time practical applications.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer and Machine Vision -Theory Algorithm and Practicalities	E. R .Davies	Academic Press,	2012.
2	Computer Vision: Algorithms and Applications	Richard Szeliski	ISBN 978-1- 84882-935-0, Springer	2011
3	Computer Vision: A Modern Approach	David Forsyth and Jean Ponce	Pearson India	2002

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Deep Learning,	Goodfellow, Bengio, and Courville,	MIT Press,.	2006
2	Mastering OpenCV with Practical Computer Vision Projects	Daniel Lelis Baggio, et al	Packt Publishing Limited,	2012
3	Computer Vision: Models, Learning, and Inference,	Simon J D Prince	Cambridge University Press	2012
4	Digital Image Processing and Computer Vision,	R. J. Schalkoff	John Wiley,	2004
5	Programming Computer Vision with Python: Tools and algorithms for analyzing images	Jan Erik Solem,	O'Reilly Media,	2012

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc19_cs58/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs93/preview
3	https://onlinecourses.nptel.ac.in/noc24_ee38/preview

SEMESTER S7
COMPILER DESIGN

Course Code	PEEOT751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PEEET414 Theory of Computation	Course Type	PE - Theory

Course Objectives

1. To provide a thorough understanding of the internals of Compiler Design, compiler parsing techniques, intermediate machine representation and optimization.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to compilers – Analysis of the source program, Phases of a compiler, Grouping of phases Lexical Analysis-The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Finite Automata, Recognition of Tokens. Syntax Analysis: Grammers,Context-Free Grammars,Derivation trees and Parse, Ambiguity	9
2	Top-Down Parsing: Recursive Descent parsing, Predictive parsing, LL(1) Grammars. Bottom-Up Parsing:Shift Reduce parsing – Operator precedence parsing (Concepts only) LR parsing – Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.	9
3	Syntax directed translation: Syntax directed definitions, Bottom- up evaluation of S-attributed definitions, L- attributed definitions, Bottom-up evaluation of inherited attributes. Type Checking : Type systems, Specification of a simple type checker. Run-Time Environments: Source Language issues, Storage organization, Storage- allocation strategies.	9
4	Intermediate Code Generation (ICG): Intermediate languages – Graphical	9

	representations, Three- Address code, Quadruples, Triples Code Optimization: Principal sources of optimization, Optimization of Basic blocks Code generation: Issues in the design of a code generator. The target machine, A simple code generator.	
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the concepts and different phases of compilation with compile time error handling	K2
CO2	Represent language tokens using regular expressions, context free grammar and finite automata .	K2
CO3	Illustrate top down and bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.	K3
CO4	Generate intermediate code for statements in high level language and understand different storage allocation strategies.	K3
CO5	Illustrate syntax directed translation schemes for a given context free grammar..	K2
CO6	Apply optimization techniques to intermediate code and generate machine code for high level language program	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compilers-Principles, Techniques and Tools	Aho A.V,Ravi Sethi and D. Ullman	Addison Wesley	2nd edition,2006
2	System Programming and Operating Systems,Tata	D. M.Dhamdhare,	McGraw Hill & Company	2nd edition ,1996

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compiler Construction – Principles and Practice	Kenneth C. Louden	Cengage Learning	Indian Edition, 2006
2	The Theory and Practice of Compiler Writing	Tremblay and Sorenson	Tata McGraw Hill & Company	English Edition 1984
3	Introduction to the Theory of Computation	Michael Sipser	Cengage Learning.	3rd edition, 2012

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs07/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs07/preview
4	https://onlinecourses.nptel.ac.in/noc21_cs07/preview

SEMESTER S7

ELECTRICAL SYSTEM DESIGN

Course Code	PEEOT752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCEET303, PCEET501	Course Type	PE - Theory

Course Objectives

1. To create awareness regarding electrical symbols, Indian Standard codes, Indian Electricity acts and NEC norms
2. To enable students to design the various electrical installations with necessary precautions to ensure life safety, risk prevention and continuous operation of the system
3. To help in energy-efficient electrical design in compliance with codes and regulations.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Awareness on IS Codes - IS 732, IS 3043, IS 2026- IS 3646-part 1 & 2 - IS 5216 part 1 & 2 Electricity supply code-2014, IE Act 1910, 2003, NEC LT system wiring components, selection of cables, wires, switches, distribution box, metering system, basics of star rating and labelling Principle of operation of Fuse, MCB, MCCB, ELCB/RCCB, isolator.	7
2	General requirements for electrical installations- Residential/ Commercial/ High rise building, method of load survey for electrical installation, Diversity factor Sizing and selection of wires, MSB, SSB, DB and protection devices. Design steps in electrical wiring, material estimation and development of single line diagrams. Electrical CAD (optional). Pre-commissioning test applicable to domestic installation Lighting design calculations - Definitions of Luminous flux, Luminous intensity, Illuminance. Illumination calculation, factors affecting Coefficients of Utilisation (CoU) - Light Loss Factor (LLF).	12

	Design and Estimation the quantity of material required in Electrical Installation for - Small residential building/Flat/Factory (Micro-Project)	
3	<p>Indoor and Outdoor substation- selection of transformer, switch gears and protective devices, Procedure for HT connection, design and estimation the quantity of material required for substations, Pre-commissioning tests for transformers</p> <p>Industrial loads, selection of starters, cable and switchgears, Power factor improvement – kVAR calculation, correction methods</p> <p>Design of MSB & SSB including Motor Control Centre (MCC) - Selection of bus bars (CU & Al) and Switchgears</p> <p>Specifications of LT Breakers and other LT panel components (Basics only)</p> <p>Selection of industrial UG cables - Calculation of ampacity, voltage drop, short circuit withstand capacity</p>	10
4	<p>Standby DG Systems with AMF panel – Essential protections. UPS system and its design for residential application</p> <p>Selection and installation of elevators and lifts</p> <p>Earthing and Soil Resistivity calculation– Earth electrodes. Methods of earthing - Plate earthing - Pipe earthing - Rod earthing. Methods of improving earth resistance - Size of earth continuity conductor</p> <p>Substation earthing and design (Theory only), substation lightning protection (Theory only)</p> <p>Solar PV Power generation – Design and installation of standalone and grid interactive Solar PV system -Smart meter/Net meter</p>	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the Indian standards and code of practice for efficient and effective energy usage with various electrical system design components.	K2
CO2	Design electrical wiring for residential and commercial consumers as per IS codes and NEC and integration of PV systems	K3
CO3	Design electrical installation for industrial consumers and high rise buildings.	K3
CO4	Analyse electrical system conditioning equipment and power backups.	K4
CO5	Design various earthing methods and protection	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	National Electrical Code, Bureau of Indian Standards.		Bureau of Indian Standards.	
2	Electrical Systems Design	M. K. Giridharan	IK International Publishers, New Delhi	2nd edition, 2016.
3	Electrical Design Estimating Costing	K. B. Raina, S. K. Bhattacharya	NEW AGE; Reprint edition	2010
4	Residential Commercial and Industrial Systems	H. Joshi	McGraw Hill Education	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	National Lighting Code 2010, Bureau of Indian Standards.		Bureau of Indian Standards.	2010
2	National Building Code of INDIA 2016 - Bureau of Indian Standards.		Bureau of Indian Standards.	2016
3	A Course in Electrical Installation Estimating and Costing.	J. B. Gupta	S.K. Kataria & Sons	Reprint 2013 edition (2013)
4	Electrical estimating and costing	S. Singh, and R. D. Singh	Dhanpat Rai and Co.	1997

SEMESTER S7

DESIGN OF SOLAR PV SYSTEMS

Course Code	OEEET721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	4/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	OE -Theory

Course Objectives:

1. To introduce a solar PV system and its grid integration aspects.
2. To give insight to basic knowhow for the implementation of Solar PV system

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Basic Concept of Energy -Source of Solar Energy -Formation of the Atmosphere - Solar Spectrum. Solar Constant -Air Mass -Solar Time-Sun–Earth Angles-Solar Radiation-Instruments to Measure Solar Radiation-Pyrheliometer –Pyranometer - Sunshine Recorder -Solar Radiation on a Horizontal Surface - Extra-terrestrial Region.- Terrestrial Region -Solar Radiation on an Inclined Surface -Conversion Factors -Total Solar Radiation on an Inclined/Tilted Surface -Monthly Average Daily Solar Radiation on Inclined Surfaces .	9
2	Solar Thermal system -Principle of Conversion of Solar Radiation into Heat, –Solar thermal collectors –General description and characteristics –Flat plate collectors –Heat transfer processes –Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector) – performance evaluation. Applications -Solar heating system, Air conditioning and Refrigeration system, Pumping system, solar cooker, Solar Furnace, Solar Greenhouse - Design of solar water heater	9
3	Solar PV Systems -Introduction -Fundamentals of Semiconductor and Solar Cells - Photovoltaic Effect -Solar Cell (Photovoltaic) Materials - Basic	9

	Parameters of the Solar Cell - Generation of Solar Cell (Photovoltaic) Materials-.Photovoltaic (PV) Module and PV Array - Single-Crystal Solar Cell Module, Thin-Film PV Modules, III–V Single Junction and Multifunction PV Modules-Emerging and New PV Systems -Packing Factor of the PV Module - Efficiency of the PV Module -Energy Balance Equations for PV Modules -Series and Parallel Combination of PV Modules.- Effect of shadowing-MPPT Techniques-P&O , incremental conductance method-Maximum Power Point Tracker (MPPT) using buck-boost converter.	
4	Solar PV Systems –stand-alone and grid connected -Design steps for a Stand-Alone system – Storage batteries and Ultra capacitors. Design PV powered DC fan and pump without battery-Design of Standalone System with Battery and AC or DC Load. Life cycle costing, Growth models, Annual payment and present worth factor, payback period, LCC with examples. Introduction to simulation software for solar PV system design	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basics of solar energy conversion systems.	K1
CO2	Design a standalone PV system.	K3
CO3	Demonstrate the operation of a grid interactive PV system.	K2
CO4	Utilize life cycle cost analysis in the planning of Solar PV System	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Solar Photovoltaics: Fundamentals, Technologies And Applications	Chetan Singh Solanki	PHI	3rd Edition
2	Solar Energy-Fundamentals, Design, Modelling and Applications	G.N. Tiwari:	Narosa Publishers	2002
3	Grid Integration of Solar Photovoltaic Systems,	D.P. Kothari, M Jamil.	CRC Press	2018
4	Solar Photovoltaics: Fundamentals, Technologies And Applications	Chetan Singh Solanki	PHI	3rd Edition

SEMESTER S7
HYBRID AND ELECTRIC VEHICLES

Course Code	OEEET722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	OE -Theory

Course Objectives:

1. Familiarise with the hybrid and electric vehicles and its drive train topologies
2. Discuss the propulsion unit for electric vehicles
3. Choose proper energy storage system for electric vehicles.
4. Selection of battery management strategy and study of various communication protocols for EV

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<p>Introduction to Hybrid and Electric Vehicles: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles.</p> <p>Vehicle Dynamics & Load Forces: mathematical models to describe vehicle performance, vehicle load forces (concept only): aerodynamic drag ,rolling resistance , grading resistance, vehicle acceleration, calculation of motor power from traction torque.</p> <p>Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies (Block diagram only), power flow control in various hybrid drive-train topologies (Block diagram only).</p> <p>Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies (Block diagram only), power flow control in electric drive-train topologies (Block diagram only).</p>	10
2	Electric Drives: Block diagram, Introduction to electric motors used in	8

	<p>hybrid and electric vehicles.</p> <p>DC Motor Drives: Introduction, Configuration and control of separately excited DC motors Motoring using a PM DC Machine - DC motor drive using DC-DC converter - Generating/Braking using a PM DC Machine (concept only)</p> <p>Induction Motor Drives: Introduction, Speed control of induction motor, V/f control of induction motor (block diagram only)</p>	
3	<p>Battery based energy storage systems: Types of battery-battery parameters-units of battery energy storage - capacity rate, - cell voltage - specific energy - cycle life - self-discharge- static battery equivalent circuit model - series-parallel battery pack equivalent circuits</p> <p>Other storage topologies (Basics only): Fuel Cell based energy storage systems- Supercapacitors- flywheel- Hybridization of different energy storage devices</p> <p>Types of charging stations (Basics only)- AC Level 1 & 2, DC - Level 3 (block diagram only) -Types of Connectors - CHAdeMO, CCS Type1 and 2, GB/T - PIN diagrams and differences</p>	10
4	<p>Battery management system: Introduction to energy management strategies, Classification of Battery management system (concept only)</p> <p>Vehicle Communication protocols: Need & requirements - Functions of Control Pilot (CP) and Proximity Pilot (PP) pins, Communication Protocols - CAN, LIN, FLEXRAY (Basics only)- Power line communication (PLC) in EV</p> <p>Autonomous Vehicles: Levels of automation, significance & effects of automation in vehicles</p>	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarise with the hybrid and electric vehicles and its drive train topologies	K2
CO2	Discuss the propulsion unit for electric vehicles	K3
CO3	Choose proper energy storage system for electric vehicles	K3
CO4	Selection of battery management strategy and study of various communication protocols for EV	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2	3											3
CO3	3											3
CO4	3											3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electric and Hybrid Vehicles: Design Fundamentals, 2003	Iqbal Hussein	CRC Press,	2003
2	Elementary Concepts of Power Electronic Drives:	K Sundareswaran,	CRC Press, Taylor & Francis Group	
3	Electric Drives	Krishnan	PHA	

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electrical Engineering – Introduction to Hybrid and Electric Vehicles	NPTEL (notes)		

SEMESTER S7

INTRODUCTION TO ENERGY STORAGE SYSTEMS

Course Code	OEEET723	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	OE - Theory

Course Objectives:

1. To introduce the importance and application of energy storage systems.
2. To familiarize with different energy storage technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Need and role of energy storage systems in power system, General considerations, Energy and power balance in a storage unit, Mathematical model of storage system: modelling of power transformation system (PTS)-Central store (CS) and charge–discharge control system (CDCS), Econometric model of storage system. Thermal energy: General considerations -Storage media- Containment- Thermal energy storage in a power plant, Potential energy: Pumped hydro- Compressed Air.	9
2	Kinetic energy: Mechanical- Flywheel, Power to Gas: Hydrogen- Synthetic methane. Electro chemical energy: Batteries-Battery parameters: C-rating– SoC – DoD -Specific Energy- Specific power (numerical examples), Fuel cells, Electrostatic energy (Super Capacitors), Electromagnetic energy (Superconducting Magnetic Energy Storage), Comparative analysis, Environmental impacts of different technologies.	9
3	Types of renewable energy sources: Wave - Wind – Tidal – Hydroelectric - Solar thermal technologies and Photovoltaics, Storage role in isolated power systems with renewable power sources, Storage role in an integrated power system with grid-connected renewable power sources.	9

4	Smart grid, Smart micro grid, Smart house, Mobile storage system: Electric vehicles – Grid to Vehicle (G2V)-Vehicle to Grid (V2G), Management and control hierarchy of storage systems. Aggregating energy storage systems and distributed generation (Virtual Power Plant Energy Management with storage systems), Battery SCADA, Hybrid energy storage systems: configurations and applications.	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p align="center">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p align="center">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the role of energy storage in power systems.	K3
CO2	Classify thermal, kinetic and potential energy storage systems and their applications.	K3
CO3	Compare electrochemical, electrostatic and electromagnetic storage technologies.	K3
CO4	Illustrate energy storage technology in renewable energy integration.	K2
CO5	Summarise energy storage technology applications for smart grids.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Energy Storage for Power Systems	A.G.Ter- Gazarian	TheInstitution of Engineering and Technology (IET) Publication, UK,	Second Edition, 2011
2	Energy Storagein Power Systems	Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt	Wiley Publication	2016.
1	Energy Storage for Power Systems	A.G.Ter- Gazarian	TheInstitution of Engineering and Technology (IET) Publication, UK,	Second Edition, 2011
2	Energy Storagein Power Systems	Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt	Wiley Publication	2016.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits	D. Rastler	Electric Power Research Institute (USA)	Technical Update, December 2010
2	The Role of Energy Storage with Renewable Electricity Generation	Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan	National Renewable Energy Laboratory (NREL)	January 2010
3	Electrical energy management of virtual power plants in distribution networks with renewable energy resources and energy storage systems	P. Nezamabadi and G. B. Gharehpetian	IEEE Power Distribution Conference	2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=o6Afp-MI_tQ&list=PLLy_2iUCG87AjWoOk0A3y4hpGQVTdtl6G&index=12 (NPTEL lecture IIT Roorkee)
2	https://www.youtube.com/watch?v=yar51GJVqgg (NPTEL lecture IIT Guwahati)
3	https://www.youtube.com/watch?v=frWxC5KL8kE (NPTEL lecture IIT Guwahati)
4	https://www.youtube.com/watch?v=AZIS_MCw8Qc (NPTEL lecture IIT Kanpur)