B. Tech - Electrical & Electronics Engineering (EVT)

Semester-VI

PEEEE0704A Microcontroller & Embedded Systems

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics of microcontrollers.
- To Understand the concepts of the embedded systems.
- To Define and understand the applications of microcontroller.
- To Analysis of the various cases of programming in embedded systems.
- To Examine the designing of embedded systems.

Course Outcomes (COs)

1. Understand about the internal organization and operation of microcontrollers.
2. Understand the design issues in the embedded system.
3. Apply the microcontroller-based application.
4. Analyze programs 8051 for application specific solution.
5. Evaluate the different designing issues in embedded systems.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	1
CO2	2	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	2	3	1	-	-	-	-	-	-	-	1	1	1	1
CO4	1	1	2	3	-	-	-	-	-	-	-	-	1	1	1
CO5	1	1	2	2	1	-	-	-	-	-	-	-	1	1	1

High-3 Medium-2 Low-1

Unit-I Introduction — 09 Hours

Introduction to Microprocessors, Microcontrollers and system design – Assembly and High-Level language programming – System Development Environment: assembler, compiler and integrated development environment.

Unit-II 8051 Microcontroller — 09 Hours

Introduction to single chip Microcontrollers,8051-architecture – 8051 assembly language programming, addressing modes – Instruction sets- interrupts, timers and serial communication.

Unit-III Embedded applications — 09 Hours

Programming the interrupts, timers and serial communication – system design with 8051. Application of Microcontrollers in data acquisition systems, process control, signal processing, data communication and distributed computing and networking.

Unit-IV Embedded programming — 09 Hours

Programming in Assembly Language (ALP) Vs. High level language – C program elements, Macros and Functions – Use of pointers– use of function calls – NULL pointers – multiple function calls in a cyclic order in the main function pointers –C program compilers – Cross compiler – optimization of memory codes.

Unit-V — 09 Hours

Embedded System Design:- Introduction, Embedded System project management – Embedded system design and Co-Design Issues in System Development process – Design cycle in the

development phase for an embedded system – Uses of Target system or its emulator and In-Circuit Emulator.

Total: 45 Hours

PRACTICALS

1 Basic arithmetic and Logical operations

2 Code conversion, decimal arithmetic and Matrix operations.

3 Square and Cube program, Find 2_s complement of a number

4 Unpacked BCD to ASCII

5 Counters and Time Delay Peripherals and Interfacing Experiments

6 Traffic light controller

7 Stepper motor control

8 Digital clock

9 Key board and Display

10 Serial interface and Parallel interface

Total: 75 Hours

Reference(s)

1. Mohammad Ali Mazidi and Janice Gillispie Maszidi ―The 8051 Microcontroller and Embedded Systems‖ Pearson education, 2003, ISBN- 9788131710265, 2ndEdition.
2. Kenneth J. Ayla, ―The 8051 Micro controller‖, Thomson learning, 3rd edition, 2004, ISBN-140186158X .
3. Alan Clements, ―Principles of Computer Hardware‖, Oxford University Press, 3rd Edition,2003, ISBN9780198564539

List of e-Learning Resources:

1.https://nptel.ac.in/

2.https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B.Tech - Electrical& Electronics Engineering (EVT)

Semester-VI

L-0 T-0 P-2 C-1

BSEEE0800A Quantitative Aptitude- II

Course Objectives

- To familiarize students with Quantitative Aptitude.
- To give exposure on Logical reasoning.
- To create deeper understanding in data interpretation and progression

Course Outcomes:

1. Understand the concepts of quantitative ability.
2. Understand the concepts of data interpretation.
3. Apply the concept of logical reasoning.
4. Analysis the concept of Inductive and Deductive reasoning.
5. Evaluate the concept of progression.

Articulation Matrix

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	2	-	-	-	-	-	1	-	1	1	-
CO3	2	3	2	2	1	1	-	-	-	-	1	1	2	1	-
CO4	1	3	2	2	1	1	-	-	-	1	1	1	1	2	1
CO5	1	3	2	2	2	1	-	-	-	1	1	1	2	1	1

High-3 Medium-2 Low-1

Unit- I: Quantitative Ability-II **6 Hours**

Logarithm, Permutation and Combinations, Probability, Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Time & Work, Ratio and Proportion, Area, Mixtures and Allegation

Unit- II: Data Interpretation level-II **6 Hours**

Applications based on Tables, Column, Graphs, Bar Graphs, Line Charts, Pie Chart, Venn Diagrams

Unit- III: Logical Reasoning level -II **6 Hours**

Problems based on Calendars, Clocks, Venn Diagrams, Seating Arrangement, Syllogism, Mathematical Operations

Unit- IV: Inductive and Deductive reasoning **6 Hours**

Statement & Conclusion, Statement & Assumption, Statement & Argument, Syllogisms, Assumptions, Work involving numbers and tables

Unit- V: Progression- Aptitude **6 Hours**

Arithmetic progression, Geometric progression, Harmonic Progression, Height and Distance, Boats and Stream

Total: 30 Hour

Reference Books:

1. Aggarwal, R. S. (2012). Quantitative Aptitude for Competitive Examinations. *S. Chand & Company Pvt Limited (Unit II, III)*.
2. Praveen, R. V. (2016). *Quantitative Aptitude and Reasoning*. PHI Learning Pvt. Ltd..
3. Allwein, G., & Barwise, J. (Eds.). (1996). *Logical reasoning with diagrams*. Oxford University Press.
4. Sharma, M., &Basu, S. (2024). BELL THE "CAT". *Managing India: The Idea of IIMs and its Changing Contexts*.

List of e-Learning Resources:

1. https://prepinsta.com/
2. https://www.indiabix.com/
3. https://www.javatpoint.com/

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B.Tech. Electrical and Electronics Engineering (EVT)
Semester-VI

L-3, T-0, P-0, C-3

PCEEE1100A: Special Electrical Machines

Course Objectives

- To remember the basics andfundamental concepts ofthe Synchronous Reluctance motors
- To understand the operations of Stepper motorand performing the operation using control circuits
- To apply the construction according to working,circuit and power converters control of Switched Reluctance motors
- To analyze the basics fundamental of Permanent Magnet Synchronous Motorswith itsworking, phasor diagrams and characteristics
- To create theconverter circuits and controllers for Permanent Magnet Brushless D.C. motors

Course Outcomes (COs)

1. Understandthe types and rotor design of the Synchronous Reluctance motors for various performance parameters.
2. Apply the control circuits for observing the different characteristics of Stepper motor operation.
3. Analyzethe sensor less operationof the Switched Reluctance motorson the basis of construction.
4. Analyze the operation of Permanent Magnet Brushless D.C. motors with permanent magnet along with converter circuits.
5. Analyze the operation of Permanent Magnet Synchronous Motorson the basis of its controlling, phasor diagrams and characteristics

Articulation Matrix

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	1	-	-	-	-	-	1	1	-
CO2	2	3	1	-	-	1	-	-	-	-	-	-	1	1	-
CO3	2	3	1	-	-	-	1	-	-	-	-	-	1	1	-
CO4	3	1	-	-	-	-	1	-	-	-	-	-	-	1	1
CO5	2	1	-	-	-	1	-	-	-	-	-	-	-	1	-

High-3 Medium-2 Low-1

UNIT I: Synchronous Reluctance Motors **9 Hours**

Constructional features – Types – axial and radial flux motors – operating principles – variable reluctancemotors – voltage and torque equations - phasor diagram - performance characteristics – applications

UNIT II: Stepper Motors **9 Hours**

Constructional features – principle of operation – variable reluctance motor – hybrid motor – single and multi stack configurations – torque equations – modes of excitation – characteristics – drive circuits – Microprocessor control of stepper motors – closed loop control

UNIT III: Switched Reluctance Motors (SRM) **9 Hours**

Constructional features – Rotary and linear SRM - principle of operation – torque production – steady state performance prediction- analytical method -power converters and their controllers – methods of rotor position sensing – sensor less operation – characteristics and closed loop control – applications

UNIT IV: Permanent Magnet Brushless D.C. Motors **9 Hours**

Permanent Magnet materials –magnetic characteristics – Permeance coefficient -principle of operation – types – magnetic circuit analysis – EMF and torque equations –commutation - power converter circuits and their controllers – motor characteristics and control– applications

UNIT V: Permanent Magnet Synchronous Motors (PMSM) **9 Hours**

Principle of operation – Ideal PMSM – EMF and torque equations – armature MMF – synchronous reactance – sine wave motor with practical windings - phasor diagram – torque/speed characteristics - power controllers - converter volt-ampere requirements

Total: 45 Hours

Reference(s)

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives' (1989), Clarendon Press, Oxford
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls' (1984), Clarendon Press London
3. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application'(2001), CRC Press, New York
4. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice' (1982), Peter Perengrinus London
5. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors' (1988), Clarendon Press, London
6. Special Electrical Machines by E.G. Janardanan (PHI Learning).
7. Special Electrical Machines by Simmi P. Burman (S.K. Kataria& Sons)

List of e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ee55/preview
2. https://www.coursera.org/learn/motors-circuits-design

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

Mandsaur

MandsaurUniversity

B. Tech - Electrical & Electronics Engineering (EVT)

Semester-VI

L-2 T-1 P-2 C-4

PCEEE1200A: Power Electronics

CourseObjectives:

- To understand the advantages and applications of power electronic devices
- To analyse phase-controlled rectifiers and their operation with different loads
- To grasp principles of choppers, including control strategies and circuit types
- To explore the operation of inverters, focusing on single-phase and 3-phase configurations
- To Learn about cycloconverters, SMPS, and UPS, understanding their principles and applications

Course Outcomes:

1. Understand and apply knowledge of power electronic devices in real-world situations
2. Design and operate phase-controlled rectifiers effectively
3. Implement chopper circuits using different control strategies
4. Proficiently design and control inverters for various applications
5. Apply learned concepts to design cycloconverters, understand SMPS principles, and apply UPS in practical scenarios

Articulation Matrix

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
CO2	1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	1	1	-	1
CO4	1	2	3	1	1	-	-	-	-	-	-	1	1	1	-
CO5	1	2	2	2	1	-	-	-	-	-	1	1	2	1	1

High-3 Medium-2 Low-1

Unit I: Power electronics devices **09 Hours**

Advantagesandapplicationofpowerelectronicdevices,Thyristor,PowerBJT,PowerMOSFET,Power IGBT, TRIAC,GTO: I-V Characteristics; Turn on methods, Two-transistormodel of SCR, Firing circuit for thyristor; Voltage and current commutation of a thyristor; GatedrivecircuitsforMOSFETand IGBT,ThyristorProtection,Series-parallelconnectionofSCR

Unit II: Phase Controlled Rectifiers **09 Hours**

Principle of phase controlled converter operation, single phase half wave & full wave converterwith R, R-L and R-L-E load, use of freewheeling diode, 3-phase full converter with R & R-Lload, single phase semi converter with R & R-L load, 3 phase semi-converter with R & R-L loadandeffect ofsourceinductance.

Unit III: Choppers **09 Hours**

Principle of operation, various control strategies, classification, types of chopper circuits (TypeA,B,C,D&E),concepts ofdutyratioandaveragevoltage.

Unit IV: Inverters **09 Hours**

Single phase bridge Inverter, 3-Phase Inverters-180^0 mode conduction, 120^0 mode conduction,Voltage control of 3-Phase Inverters by Sinusoidal PWM, Current Source Inverter, series andparallelinverter

Unit V: Cycloconverters **09 Hours**

Single-phase to single-phase circuit (step-up and step-down), three-phase half wave circuit,SMPS: principle of operation and classification UPS: principle of operation, classification andapplications.

Total 45 Hours

PRACTICALS:

1. Study introduction to power electronics and its application
2. Study power semiconductor devices
3. Plot and verify SCR characteristics
4. Plot and verify V-I characteristics of a Triac
5. Plot V-I characteristics of UJT
6. Plot V-I Characteristics of a DIAC
7. Study and perform single-phase half-wave circuit with RL load
8. Study 3Φ fully controlled converter
9. Perform speed control of DC motor using SCR
10. Study and perform DC-DC step-up converter
11. Study type A, B & C chopper circuit
12. Study and perform single-phase voltage source bridge inverter
13. Study of three-phase 120˚mode voltage source inverter
14. Study of three-phase to three-phase cyclo-converter
15. Fabrication of three phase bridge rectifier using two SCRs and two diodes
16. Fabrication of three phase bridge rectifier using diodes

Total 75 Hours

ReferenceBooks:

1. M.H.Rashid. (1993). PowerElectronicsCircuits,DevicesandApplications,Pearson2Education,Singapore.
2. M Ramsmoorthy. An Introduction to transistor and their application, Affiliated East-WestPress.
3. P.C.Sen,PowerElectonics,TMH.
4. M.D.Singh,K.B.Khanchandani. (2001).PowerElectronics,TMH,Delhi
5. ChakravartiA., Fundamental ofPowerElectronicsandDrives,Dhanpat Ray&Co.
6. Dr.P.S.Bhimbhra,PowerElectonics,Khanna Pub.
7. VedamSubramanyam. (2006). PowerElectronicsNewAgeInternationalRevisedIIed.
8. MohanUndelandRobin. (2002). PowerElectronics-Converters,ApplicationsandDesign,JohnWiley&Sons.

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B.Tech Electrical & Electronics Engineering (EVT)

Semester-VI

L-2, T-1, P-2, C-4

PCEEE1300A: Power System II

Course Objective:

- To learn basics principles of interconnected power system and problem associated with it
- To develop bus admittance matrix and solution of power flow equations
- To understand basic pricing principles
- To understand real power flow control and operation
- To know swing equation and equal area criterion for stability

Course Outcomes (COs)

1. Understand the modern interconnected power systems and problems associated with it
2. Analyze power system, formulate admittance matrix and solve power flow equation using Numerical methods
3. Analyze unit commitment and economic dispatch and their importance
4. Apply the process of frequency adjustment to control the real power and design power frequency controller
5. Evaluate equal area criterion and will know the step by step solution of swing curve

Articulation Matrix

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
CO2	1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	1	1	-	1
CO4	1	2	3	1	1	-	-	-	-	-	-	1	1	1	-
CO5	1	2	2	2	1	-	-	-	-	-	1	1	2	1	1

High-3 Medium-2 Low-1

Unit I: Interconnected power system — 09 Hours

Problems associated with modern interconnected power Systems, deregulation, power systems restructuring, distributed generation, congestion, available transfer capacities, pricing of energy and Transmission services.

Unit II: Review of the Structure of a Power System and its Components — 09 Hours

Per unit calculations, Analysis of Power Flows, Formation of Bus Admittance Matrix, Real and reactive power balance equations at a node, Load and Generator Specifications, Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel, Coupled and Decoupled Newton-Raphson methods for the solution of the power flow equations, Regulating Transformers

Unit III: Economic Operation and Management of Power System — 09 Hours

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Economic Operation withand without Transmission losses, Transmission loss coefficient, Economic Dispatch, UnitCommitment, Function of Load Dispatch Centers, Demand side-management.

Unit IV: Control of Frequency and Voltage — 09 Hours

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing,

Automatic Generation Control, Generation and absorption of reactive power by variouscomponents of a Power System, Excitation System Control in synchronous generators,
Automatic Voltage Regulators, ALFC of Single and Two Area Systems.

Unit V : Power System Stability 09 Hours

The Stability Problem, Rotor Dynamics and the Swing Equation, The Power-Angle Equation,Synchronizing Power Coefficients, Equal- Area Criterion for Stability, Multi-machine StabilityStudies: Classical Representation, Step-By-Step Solution of the Swing Curve, Factors AffectingTransient Stability.

Total: 45 Hours

PRACTICALS: -

1. Computation of parameters and modeling of transmission lines
2. Develop a program in Matlab for information of Y-bus matrix for N bus system
3. Determine the bus impedance matrices for the given power system network
4. Load flow solution for 3-bus system using Gauss-Seidel, Newton Raphson and FDLF methods upto 3 iteration
5. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method
6. Familiar with modeling and analysis of power systems under faulted condition and to compute the fault level, post-fault voltages and currents for different types of faults, both symmetric and unsymmetrical
7. Familiar with modeling and analysis of the frequency and tie-line flow dynamics of a power system without and with load frequency controllers (LFC) and to design better controllers for getting better responses
8. Familiar with modeling and analysis of the frequency and tie-line flow dynamics of a two area power system without and with load frequency controllers (LFC) and to design better controllers for getting better responses
9. Familiar with various aspects of the transient and small signal stability analysis of Single-Machine-Infinite Bus (SMIB) system
10. Understand the fundamentals of economic dispatch and solve the problem using classic method with and without line losses
11. Effect of compensation on voltage profile of IEEE 6-bus system
12. Study of any software tools (PSAT, EDSA, MY POWER, ETAP etc)
13. Carry out power flow calculations using MATLAB and Power World program
14. Look at the influence of including a tap-changer and a phase-shifter on power flow and bus voltages

Total: 75 Hours

Reference(s):

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education
2. O. I. Elgerd. (1995). “Electric Energy Systems Theory”, McGraw Hill Education
3. D. P. Kothari and I. J. Nagrath.(2011).“Modern Power System Analysis”, McGraw Hill Education,4th Edition
4. Reactive power Control in Electric Systems- by T.J.E. Miller, John Wiley & Sons
5. C.L. Wadhwa, “Electrical Power Systems”, New Age International Publishers, 6th Edition
6. A. R. Bergen and V. Vittal. (1999). “Power System Analysis”, Pearson Education Inc
7. Prabha Kundur. (1993). “Power system stability and control”, Mc-Graw Hill Inc, New York
8. Taylor C.W. (1993). “Power System Voltage Stability”, Mc-Graw Hill Inc, New York
9. Weedy B.M. “Electric Power System” John Wiley and Sons, 3rd edition

List of e-Learning Resources:

1. https://nptel.ac.in/
2. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VI

L-0 T-0 P-4 C-4

PCEEE1400A Electrical CAD

Course Objectives

- To build sound practical knowledge in Electrical CAD.
- To acquire practical skills in creating/ designing electrical instrument and their connections by software based techniques.

Course Outcomes (COs)

1. Apply software based engineering tools and techniques for electrical instrument and their connections
2. Analyzethe designs of the motor windings types.
3. Design the starters and its connections.

Articulation Matrix

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CO2	3	1	1	-	2	1	-	-	-	-	1	-	1	-	1
CO3	2	1	2	-	2	1	1	-	-	-	1	-	1	1	1

High-3 Medium-2 Low-1

PRACTICAL

1. Introduction to E-CAD
2. Aided drafting
3. Basic diagram
4. XLPE cable
5. Pin insulater
6. DC lap winding
7. DC wave winding
8. DOL starter
9. Star delta starter
10. Un-bifurcated winding

Total: 60 Hours

B Tech.: Electrical and Electronics Engineering

Semester-VI

L-2 T-1 P-2 C-4

PEEEE0602A: Communication Engineering

Course Objectives:

- To understand the fundamental characteristics of signals and systems
- To understand the basics of communication system and analog modulation techniques
- To analyze the concept of Frequency modulation and Pulse Modulation techniques
- To create deeper understanding of various aspects in the design of communication & multiple access systems for satellite communication and design of Earth station and satellite link

Course Outcomes(COs:

1. Understand the Fourier transform techniques, probability & stochastic theories
2. Understand the need of modulation in transferring a signal through either wireless or wired communication systems
3. Apply analog modulation techniques and receiver fundamentals in analog communication.
4. Analyze and understand the performance of communication systems in the presence of noise and interference
5. Create deeper understanding of multiple access technique for satellite communication system

Articulation Matrix

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

High-3 Medium-2 Low-1

Unit I: Signal Processing
9 Hours

Types of signal, deterministic & random, periodic &non Periodic, analog & discrete, energy & power signals, Representation of sinusoid in different forms & their conversion. Fourier series, Fourier Transform and its properties, Probability and random variables: Overview of probability, types of probability, axioms of probability, concept of Random variable, Random process, Correlation function (auto & cross) cumulative distribution function, Probability density function, joint cumulative & distribution and probability density.

Unit II: Analog Modulation Techniques **9 Hours**

Block schematic of a typical Communication system.Need of modulation in a communication system, Amplitude (Linear) Modulation: AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection. Angle (Non-Linear) Modulation: Frequency and Phase modulation. Relationship between phase & freq. modulation, FM wave & its spectrum, methods of generation & detection of FM, pre-emphasis & de- emphasis

.

Unit III: Transmitter and Receiver **9 Hours**

Classification of radio transmitters, Block diagram of AM transmitter, Armstrong FM transmitter, Simple FM transmitter using Reactance modulator. Classification of radio receivers, TRF receivers, Superheterodyne receivers, Tracking and alignment of receivers, Intermediate frequency, AGC, AFC, SSB receiver.

Unit IV: Digital Modulation Techniques **9 Hours**

Nyquist sampling theorem, TDM, Pulse modulations & PCM, Quantization error, Necessity of nonlinear quantizer, A-law, μ -law, FSK & PSK, QPSK, QAM, Source of noise, Noise figure, Noise bandwidth, effective noise temperature, Performance of AM, FM & digital system in presence of noise.

Unit V: Satellite System **9 Hours**

Satellite system block diagram, satellite freq. bands, Elements of orbital mechanics. Equations of motion. Satellite multiple access Format like TDMA, FDMA, transponders, earth station & satellite eclipses, Satellite link design.

Total: 75 Hours

Reference(s)

1. Singh &Sapre(2017), Communication System, TMH
2. Simon Haykins,(2001) Communication system, John Wiley.

3. Taub and Schilling,(2007) Principles of Communication Systems , Tata McGraw Hill.
4. B.P. Lathi, Modern(2011), Digital and Analog communication system.
5. Wayne Tomasi(2003), Electronic Communication system.
6. D.Roddy(2009),"Satellite Communication (4/e)", McGraw-Hill.
7. Schaum outline Series(1993), Analog and digital communication
8. John G. Prokis,MasoudSalehi, Gerhard Bauch(2004), Contemporary communication sytems using MATLAB, Cengage learning.

List of e-Learning Resources:

3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/
4. https://www.youtube.com/watch?v=TPm0XSPxld8&list=PL7748E9BEC4ED83CA

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B.Tech - Electrical& Electronics Engineering (EVT)

Semester-VI

PEEEE0603A Testing and Certification of Electric Hybrid Vehicles

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics knowledge in the field of E-vehicle certification.
- To Understand the concept of static testing of E-vehicle.
- To Understand the concept of dynamic testing of E-vehicle.
- To Study about various E-vehicle component testing.
- To Understand the fundamentals of charging station & hybrid electric vehicle testing.

Course Outcomes (COs)

1. Understand the fundamental concepts of the field of E-vehicle certification.
2. Understand the concept of static testing of E-vehicle.
3. Apply the concept of dynamic testing of E-vehicle.
4. Analyze the various E-vehicle component testing.
5. Evaluate Gain the insight of charging station & hybrid electric vehicle testing.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	1	1	-	1	1
CO2	2	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	1	-	-	-	-	-	-	-	1	-	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-

High-3 Medium-2 Low-1

Unit-I Introduction **09 Hours**

Specification & Classification of Vehicles (including M, N and O layout), Homologation & its types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks, Hardware in The Loop (HIL) concepts for EV/HEVs.

Unit-II Static Testing of Vehicle **09 Hours**

Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The requirement of temporary cabin for drive– away – Chassis, electric vehicle – Safety norms, Energy consumption and power test.

Unit-III Dynamics Testing of Vehicle **09 Hours**

Hood Latch, Gradeability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test, Electric vehicle – Range Test..

Unit-IV Vehicle Component Testing **09 Hours**

Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500kg), Body block test, Head form test, Driver Field of vision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, Airbag Test, Accelerator Control System, Motor power, Safety Requirements of Traction Batteries, EMI-EMC (CI, BCI, RE,RI and CTE).

Unit-V Tests for Hybrid Electric Vehicles, Retro-Fitment and Charging Station **09 Hours**

Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retro-fitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system..

Total: 45 Hours

PRACTICALS

1. To document and visually inspect Electric Vehicles (EVs) in accordance with Central Motor Vehicle Rules (CMVR) regulations, utilizing photographs and physical verification techniques to ensure compliance with safety standards, vehicle specifications, and registration requirements.
2. To measure and assess the tread depth of Electric Vehicle (EV) tires using standardized methods, aiming to ensure adequate tire traction, road grip, and safety performance.
3. To accurately determine the weight of an Electric Vehicle (EV) using weighing scales and load cells, aiming to ensure compliance with vehicle weight regulations, assess load distribution.
4. To evaluate and measure the noise emissions of Electric Vehicles (EVs) during pass-by situations and within the vehicle interior, utilizing standardized testing procedures and equipment to assess compliance with noise regulations.
5. To analyze the performance, efficiency, and safety aspects of hydraulic brake systems in Electric Vehicles (EVs), aiming to evaluate braking effectiveness, stability, and reliability under various driving conditions.
6. To assess the effectiveness and efficiency of the cooling system in Electric Vehicles (EVs), aiming to maintain optimal operating temperatures for vehicle components, including the battery, motor, power electronics, and interior cabin.
7. To measure and analyze the speed characteristics of an Electric Vehicle (EV) under various driving conditions, aiming to assess acceleration, top speed, and dynamic performance.

Total: 75 Hours

Reference(s)

1. “Vehicle Inspection Handbook”, American Association of Motor Vehicle Administrators
2. Michael Plint & Anthony Martyr, “Engine Testing & Practice”, Butterworth Heinmenn, 3rd ed, 2007.
3. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI, PUNE
4. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007.

List of e-Learning Resources:

5. https://nptel.ac.in/
6. https://www.coursera.org/

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B. Tech - Electrical & Electronics Engineering (EVT)

Semester-VI

PEEEE0604A: Electrical Vehicles Controls and Drives

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics of electric motors.

- Understand the concepts of the control unit in electric motor.
- Define and understand electric vehicle drives.
- Analysis of the various constructional features of Hybrid Electric Drive Trains.
- Examine the working of Electric Propulsion Systems.

Course Outcomes (COs)

1. Understand the need and possibility of extracting electrical motor for electrical vehicle
2. Understand the need of different controlling system for electric vehicle
3. Apply the scheme of electric vehicle drives.
4. Analyze the concept of Hybrid Electric Drive Trains
5. Evaluate the performance parameters of Electric Propulsion Systems

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

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

High-3 Medium-2 Low-1

Unit-I Electric motors **09 Hours**

Electric motors, Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor Motor Controllers Component sizing, Physical locations, Mechanical connection of motor Electrical connection of motor.

Unit-II Control Unit and Control Strategies **09 Hours**

Controller Overview, Switch Controller, Solid-State Controller, Electronic Controllers, AC Controller, DC Motor Controller- The Lesson of the Jones Switch, An Off-the-Shelf Curtis PWM DC Motor Controller, AC Controllers, Today‘s Best Controller Solution, Zilla Controller (One of the Best DC Controller for Conversions) ZAPI., Control Strategies, Max. SOC-of-PPS Control Strategy, Thermostat Control Strategy (Engine-On–Off)

Unit-III Electric Vehicle Drives **09 Hours**

Electric Vehicle Drives Configurations of Electric Vehicles, Performance of Electric Vehicles, Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption

Unit-IV Concept of Hybrid Electric Drive Trains **09 Hours**

Concept of Hybrid Electric Drive Trains Concept of Hybrid Electric Drive Trains, Architectures of

Hybrid Electric Drive Trains Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling, Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Train.

Unit-V Electric Propulsion Systems **09 Hours**

DC Motor Drive, Principle of Operation and Performance, Chopper Control of DC Motors, Multi quadrant Control of Chopper-Fed, DC Motor Drives, Two-Quadrant Control of Forward Motoring and Regenerative Braking, Single Chopper with a Reverse Switch, Class C Two-Quadrant Chopper, Four-Quadrant Operation, Induction Motor Drives, Basic Operation Principles of Induction Motor, Steady-State Performance, Constant Volt/Hertz Control, Power Electronic Control, Field Orientation Control, Direction Rotor Flux Orientation Scheme, Indirect Rotor Flux Orientation Scheme, Voltage Source Inverter for FO, Voltage Control in Voltage Source Invert, Current Control in Voltage Source Inverter.

Total: 75 Hours

PRACTICALS

1. Demonstration of wiring layout of electric vehicle.
2. Current/Voltage Control of an Electric vehicle.
3. Control Circuit of induction motor.
4. Demonstration of Controllers & Actuators in an Electric Vehicle
5. V/f control of three-phase induction motor.
6. Speed control of BLDC motor in two-wheeler.
7. Speed control of Switched Reluctance Motors (SRM) motor in three-wheeler.
8. Simulation of Four quadrant operation of three-phase induction motor.
9. MOSFET based step up and step-down chopper.
10. V-I Characteristics of SCR, IGBT & MOSFET.

Total: 75 Hours

Reference(s)

1. M. Ehsani,:Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press,2005.

2. K.T.Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, 1st Edition, John Wiley and Sons, 2011.

List of e-Learning Resources:

7. https://nptel.ac.in/
8. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

Mandsaur
Mandsaur University

B.Tech - Electrical& Electronics Engineering (EVT)
Semester-VI
PEEEE0701A Power Quality Problems and Solutions

L-2 T-1 P-2 C-4

Course Objectives

- To learn about basics of the various power quality phenomenon
- To understand the concepts of voltage sags and interruptions
- To apply the basic concepts of sources of transient over voltages
- To analyze the various causes of harmonic distortion
- To examine the behavior control techniques to improve power quality

Course Outcomes (COs)

1. Understand the severity of power quality problems in distribution system.
2. Apply the concepts of the voltage sag and interruption based power quality problems
3. Analyze of various filters used in power quality improvement
4. Evaluate and analyze of conventional load compensation methods
5. Design and examine of various control techniques used in power quality improvements

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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CO2	1	3	2	-	-	-	-	-	-	-	-	1	1	-	-	-
CO3	1	2	3	1	1	-	-	-	-	-	-	1	-	-	1	-
CO4	1	2	2	3	-	-	-	-	-	-	-	1	-	1	1	-
CO5	1	1	2	1	1	-	-	-	-	-	-	1	2	1	1	-

High-3 Medium-2 Low-1

UNIT-I Power Quality **09 Hours**

Voltage quality, power quality evaluations procedures term and definition: general classes of power quality problem, causes & effect of power quality disturbances.

UNIT-II Voltage Sags and Interruption **09 Hours**

Sources of sags and interruption, estimating voltages sag performance, fundamental principles of protection, monitoring sags

UNIT-III Transients Over Voltages **09 Hours**

Sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, fundamentals of harmonics and harmonics distortion, harmonics sources from commercial load and from industrial loads

UNIT-IV Filters **09 Hours**

Harmonics distortion evolutions, principles for controlling harmonics, harmonics studies devices for controlling harmonic distortion, filters, and passive input filter standards of harmonics

UNIT-V Control Techniques **09 Hours**

Electro-magnetic compatibility, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control

Total 45 Hours

PRACTICALS

1. Study about the power quality and its parameters
2. Study of basic steps of power quality problem
3. Study about steady-state &non steady-state phenomenon in power quality
4. Study of various mitigation of voltage sag & mitigation technique
5. Study about frequency control method
6. Study about constant tolerance band control &variable tolerance band control
7. Study about the sources of transient over voltage
8. Study about harmonic distortion, causes & over-come methods

Total: 75 Hours

Reference(s)

1. R.C. Duggan (2017), Power Quality, McGraw Hill Education.
2. A.J. Arrillga (2019), Power System harmonics, Wiley Publications.
3. Derek A. Paice (2019),Power electronic converter harmonics, Wiley-IEEE Press.

List of e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee60
2. https://www.udemy.com/course/introduction-to-power-quality

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B. Tech - Electrical & Electronics Engineering (EVT)
Semester-VI
PEEEE0703A Smart Grid and Energy Management

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics of smart grid.
- To Understand the concepts of the various smart grid technologies.
- To Define and understand the need and working of smart meters and its infrastructure.
- To Analysis of the power quality management in smart grid.
- TO Examine the working of computation methods for smart grid applications.

Course Outcomes (COs)

1. Understand about the evolution of electric grid, concept, definitions and need for smart grid.
2. Understand the International policies in smart grid, diverse perspectives from experts and global Smart Grid initiatives
3. Apply the Advanced Metering Infrastructure (AMI) drivers and its benefits.
4. Analyze power quality issues of grid connected renewable energy sources.
5. Evaluate the IP based Protocols, basics of web service and cloud computing to make smart grids smarter.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

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CO2	2	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	1	1	3	2	-	-	-	-	-	-	-	1	-	-	1
CO4	1	1	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	1	1	2	2	1	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

Unit-I Introduction to Smart Grid **09 Hours**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

Unit-II Smart Grid Technologies **09 Hours**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation Wide area monitoring, Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

Unit-III Smart Meters and Advanced Metering Infrastructure **09 Hours**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Unit-IV Power Quality Management in Smart Grid **09 Hours**

Power Quality & EMC in Smart Grid, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit-V High Performance Computing for Smart Grid Applications **09 Hours**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad

band over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Total: 45 Hours

PRACTICALS

8. Characterization of a photovoltaic panel without a load.
9. Characterization of a photovoltaic panel with a load.
10. Connecting a photovoltaic system to the real network by using a single-phase inverter grid system.
11. Modelling of PV system
12. Modelling of DFIG based wind power system.
13. Simulation of Grid connected PV MPPT (P&O) single stage
14. Simulation of Grid connected PV MPPT (P&O) double stage.
15. Virtual inertia emulation using PV Battery systems and its studies under varying loads
16. Grid connected DFIG wind generation analysis under varying wind, and grid conditions.
17. Fuel Cell grid integration studies and analysis.

Total: 75 Hours

Reference(s)

1. A. S boyer, SCADA:supervisory Control and Data Acquisition, The Instrumentation system and Automation Society,4 th Edition 2009.
2. Vehbi C. Güngör, Dilan Sahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
3. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids.

List of e-Learning Resources:

9. https://nptel.ac.in/
10. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**