Mandsaur Universitu

B.Tech Electrical & Electronics Engineering (EVT)
Semester-V

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

PEEEE0501A Microprocessors & Microcontroller

Course Objectives:

- To learn the basic concept of microprocessor architectures and its pin diagram
- To learn various decision making aspects in applications with help of microprocessors and its programming
- To learn interfacing methods of various ICs with processor
- To learn the basic concept of microcontroller architectures and its pin diagram

Course Outcomes:

1. Understand the concept of microprocessors 8086 architectures and its working
2. Apply various assembly language programs and interfacing them on software
3. Understand the concept of microcontroller 8051 architectures and its working
4. Analyze to interface various ICs with microprocessors and microcontroller
5. Apply the AVR family microcontrollers and its applications

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

High-3 Medium-2 Low-1

Unit-I Microprocessor 8086 **12 Hrs**

Introduction to 16-bit 8086 microprocessors, architecture of 8086, pin configuration, mode, timing diagram, memory interfacing, interrupts, instruction set of 8086, addressing mode, assembler directives & operations, assembly and machine language programming, subroutine call and returns, concept of stack, stack structure of 8086, timing and delay subroutines.

Unit-II Input-output interfacing **8 Hrs**

Memory mapped I/O and peripheral mapped I/O. PPI 8255 architecture and modes of operation, interfacing keyboard, display to 16-bit microprocessor and its programming, DMA controller (8257) architecture.

Unit-III Microcontroller 8051 **10 Hrs**

Intel family of 8- bit microcontrollers, architecture of 8051, pin description, I/O configuration, interrupts; interrupt structure and interrupt priorities, port structure and operation, accessing internal & external memories, addressing modes, instruction set of 8051 and its programming.

Unit-IV Microcontroller 8051 interfacing **8 Hrs**

interfacing to ADC and DAC, stepper motor interfacing, timer/ counter functions, 8051 serial communication and its basic modes, serial communication programming in assembly language as well

as in C.

Unit-V The AVR RISC Microcontroller **7 Hrs**

Introduction to AVR family microcontroller, ALU, memory access and instruction executions. I/O memory, EEPROM, I/O ports.

Total: 45 Hours

Practical List:

1. To study the 8086 Microprocessor
2. To study different register organization of 8086 Microprocessor
3. To perform the addition and subtraction of two 16- bit number using microprocessor 8086
4. To perform multiplication and division of 8- bit number using microprocessor 8086.
5. To perform logical operation like AND, OR, and NOT using microprocessor 8086
6. To perform logical operation like NAND, NOR, and X-OR using microprocessor 8086
7. To perform and form squares and cubes series using microprocessor 8086
8. To perform and form increment/decrement series
9. To study the 8051 Microcontroller
10. To perform arithmetic program in microcontroller 8051

Total: 75 Hours

Reference Books:

1. Hall Douglas V. Microprocessor and interfacing, Revised second edition 2006, Macmillan, McGraw Hill..
2. A.K. Ray &K. M. Bhurchandi, Advanced Microprocessors and peripherals- Architecture, Programming and Interfacing, Tata McGraw-Hill.
3. Kenneth J. Ayala, The 8086 microprocessor: programming and interfacing the PC.
4. Muhammad Ali Mazidi and Janice Gillespie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education,2005.
5. Udayashankara and M.S. Mallikarjunaswamy, 8051 Microcontroller: Hardware, Software & Applications, Tata McGraw-Hill, 2009.
6. McKinley, The 8051 Microcontroller and Embedded Systems-using assembly and C, PHI, 2006 / Pearson, 2006.

List of e-Learning Resources: Simulator such as: Emulator 2.57- used 8086.

1. Latest up configuration: http://www.intel.com/pressroom/kits/quickreffam.html.
2. https://nptel.ac.in/courses/117104072
3. https://www.coursera.org/learn/comparch

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

Mandsaur University, Mandsaur

B.Tech Electrical & Electronics Engineering (EVT)

Semester-V

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

PEEEE0502A Electrical Wiring, Estimating, Costing & Contracting

Course Objectives

- To emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost Aviability.
- To design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.
- To successfully estimate costing of the products/projects that are part of our everyday usage.
- To the basic knowledge on methods and types of estimation and its merits and demerits
- To prepare the schedule of materials with specifications and estimates for different types of electrical installations.

Course Outcomes (COs)

1. Understand the fundaments of different electrical wiring
2. Understand the estimating and costing of electrical equipment, contracting procedure in electrical engineering etc
3. Apply the estimate and costing of a transmission line/Overhead and underground distribution project.
4. Analyze the quantity of material and cost for single phase and three phase motor connections.
5. Evaluate the quantity and cost of material used in the transmission and distribution lines.

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	PSO1	PSO2	PSO3
CO1	1	-	1	-	1	3	-	-	-	2	2	2	-	2	1
CO2	3	1	1	-	2	1	1	-	-	2	3	1	2	3	2
CO3	3	3	3	2	-	1	1	-	2	-	2	2	3	3	3
CO4	2	1	2	-	1	1	1	-	-	1	1	3	2	2	1
CO5	3	2	1	2	3	1	1	1	1	2	1	2	3	1	3

High-3 Medium-2 Low-1

UNIT I: Classification of electrical machines **9 Hours**

Electrical Symbol Standards: -

Need of electrical symbols, list of symbols, electrical diagrams and methods of representation for wiring circuit.

Design of Simple Electrical Circuits-Light, Fan Circuit & Alarm Circuit: -

Introduction to simple light & fan circuit, system of connection of appliances and accessories and examples. Introduction to simple alarm circuit with or without relays and its examples.

UNIT II: Design considerations of electrical installations **9 Hours**

Electric supply system, three-phase four wire distribution system, protection of electric installation against overload, short circuit and earth fault, earthing, general requirement of electrical installation, testing of installation, Indian electricity rules, types of loads, service connections, service mains, sub circuit, location of outlets, location of control switches, location of main board and distribution board, load assessment, permissible voltage drop and sizes of wires, estimation and costing of electrical installation.

UNIT III: Design & Drawing of Panel Boards **9 Hours**

Introduction, design condition, standard sizes of boards and examples.

Substations: -

Introduction, types of substations, outdoor substations- pole mounted type and indoor substations- floor mounted type and examples of quantity estimation.

UNIT IV: Motor control circuit **9 Hours**

Introduction to A. C. Motors, Starting - 3-phase squirrel phase induction motor, multi speed squirrel phase motors, wound rotor motors, synchronous motors, stopping of motors, contractor control circuits components, basic control circuit, motor protection, schematic and wiring diagrams for motor control circuits.

UNIT V: Overhead & Underground Transmission and Distribution Lines **9 Hours**

Introduction, supports for transmission lines, Distribution lines materials used, Underground cables, Mechanical design of overhead lines, Design of underground cables, examples for quantity estimation.

Principles of Contracting and Tender notices: -

Prepare Terms, conditions, and types of contract system, Define Tender, tendering procedure and preparation of simple tender, Prepare Terms and conditions of tender, procedure for inviting and scrutinizing of tender, Define Earnest Money Deposit, Security Deposit and S.O.R.

Total 45 Hours

Suggested Practical List:

1. Draw plan of electrical installation scheme for given 1BHK residential unit using Auto-cad.

2. Draw plan of electrical installation scheme for given small commercial unit using Auto-cad.

3. Draw plan of electrical installation scheme for given small factory / industrial unit using Auto-cad.

4. Draw plan of electrical installation scheme for given HT (11kV) connection using Auto-cad.

5. Draw plan of electrical installation scheme for given LT (415V) line connection using Auto-cad.

6. Draw plan of public lighting installation scheme of given premises using Auto-cad.

7. Prepare tender documents, quotations, and bills for specified work.

Total 75 Hours

Reference(s)

1. Dr .S.L. Uppal of Electrical Wiring, Estimating and Costing 6th addition by Khanna Publishers-2013.
2. K.B. Raina & S.K. Bhattacharya of Electrical Design Estimating and Costing 1st addition by new age international (p) limited. Publishers-2014.
3. Surjit Singh by of Electrical estimating & costing 2nd addition By Khanna Publishers-1997
4. A.K. Sawhney of Electrical & Electronics measurement &instrumentation 3rd addition By Khanna Publishers-2012.

List of e-Learning Resources:

1. https://www.youtube.com/watch?v=N4o1GlhcmM&list=PLKy4DMxFIp72HDABtAj6ZAknEgc5dIwBr

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B.Tech - Electrical& Electronics Engineering (EVT)

Semester-V

PEEEE0503A Modelling and Simulation of EHV

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

Course Objectives

- To Understand the modelling of vehicle performance parameters.
- To Model the battery electric vehicles.
- To Describe the drivetrain characteristics.
- To Know the concepts of energy management system.
- To Know the vehicle dynamic control systems.

Course Outcomes (COs)

1. Understand the modelling of vehicle performance parameters.
2. Understand the Model battery electric vehicles.
3. Apply the fundamental concepts of the drivetrain characteristics.
4. Apply the concepts of energy management system.
5. Analyze the performance of the vehicle dynamic control systems

Articulation Matrix

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

High-3 Medium-2 Low-1

Unit-I Modelling in Performance Parameter **09 Hours**

Modelling Vehicle Acceleration - Acceleration performance parameters, modelling the acceleration of an electric scooter, modelling the acceleration of a small car.

Unit-II Modelling of Battery Electric Vehicles

09 Hours

Electric Vehicle Modelling - Tractive Effort, Rolling resistance force, Aerodynamic drag, Hill climbing force, Acceleration force, Total tractive effort, Modelling Electric Vehicle Range - Driving cycles, Range modelling of battery electric vehicles, Constant velocity range modelling, Range modelling of fuel cell vehicles, Range modelling of hybrid electric vehicles.

Unit-III Drive Train Characteristics

09 Hours

Modelling and Characteristics of EV/HEV Powertrains Components- ICE Performance Characteristics, Electric Motor Performance Characteristics - Battery Performance Characteristics-Transmission and Drivetrain

Characteristics-Regenerative Braking Characteristics-Driving Cycles Modelling and Analysis of Electric and Hybrid Electric Vehicles Propulsion and Braking - Longitudinal Dynamics Equation of Motion - Vehicle Propulsion Modelling and Analysis - Vehicle Braking Modelling and Analysis.

Unit-IV Energy Management
09 Hours
Handling Analysis of Electric and Hybrid Electric Vehicles - Simplified Handling Models Energy/Power Allocation and Management - Power/Energy Management Controllers - Rule-Based Control Strategies - Optimization-Based Control Strategies.

Unit-V Vehicle Dynamic Control
09 Hours
Control of Electric and Hybrid Electric Vehicle Dynamics - Fundamentals of Vehicle Dynamic Control (VDC) Systems, VDC Implementation on Electric and Hybrid Vehicles – Case Studies, Rechargeable Battery vehicles, Hybrid Vehicles, Fuel Cell Powered Bus. Simulation Tools: Matlab/Simulink, ADVISOR and AVL Cruise.

Total: 45 Hours

PRACTICALS

1. To develop mathematical models and analyze the characteristics of Electric Vehicles
2. To develop and simulate models of Electric Vehicles (EVs) using MATLAB software, focusing on performance parameters.
3. To develop and simulate mathematical models of Hybrid Electric Vehicles (HEVs) using MATLAB software, aiming to analyze the dynamic behavior.
4. To develop various strategies for improving vehicle energy/fuel efficiency.
5. To develop vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill).
6. To develop series HE powertrain mathematical model.
7. To develop computer model of the HEV aiming to energy flow.
8. Computer Workshop. Fuel efficiency evaluation of a series HEV in city and high-way cycles: study and analyze two strategies for ICE/Battery power split.

Total: 75 Hours

Reference(s)
1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.
2. Amir Khajepour, Saber Fallah and AvestaGoodarzi, "Electric and Hybrid VehiclesTechnologies, Modelling and Control: A Mechatronic Approach", John Wiley & Sons Ltd, 2014.
3. Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology:

Modelling, Control, and Simulation", IGI Global, 2013.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles_ Fundamentals, Theory, and Design, Second Edition", CRC Press, 2010.
5. Advanced Practical Physical Chemistry, J.B.Yadhav, Krishna Prakasan Media, 2016.
6. Experiments in Applied Chemistry, Sunita Rattan, S.K. Kataria& Sons, 2012

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-V

PEEEE0504A Control System for Electric Vehicles

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

Course Objectives

- To Learn about basics of system modeling.
- To Understand the concepts of the system simulation.
- To Define and understand model-based controlling in electric vehicles.
- To Analysis of the state space representation of control systems.
- To Examine the aspects of stability in control systems.

Course Outcomes (COs)

1. Understand about the principles of system modeling.
2. Understand the need of simulation in control systems and its applications.
3. Apply the different types of controllers.
4. Analyze the non-linear control system through state space analysis.
5. Evaluate the concept of stability in control systems.

Articulation Matrix

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CO/PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	2	3	1	-	-	-	-	-	-	-	1	-	-	-
CO4	1	1	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	1	1	2	1	1	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

Unit-I Introduction to System modelling **09 Hours**

Importance of control system in Electrical vehicle, Study of control architecture in Electric vehicle, Systems models and their classifications, principles used in modelling of systems, Fundamental studies of Modelling of vehicle dynamics and control, Longitudinal Vehicle dynamics, Vertical Dynamics model and Lateral vehicle dynamics model, Integrated Vehicle Dynamics.

Unit-II System simulation and validation

09 Hours

System simulation, advantages and disadvantage, steps in simulation study, Simulation of Mechanical and Electrical Systems, Introduction to modelling and Simulation for Software in loop (SIL) and Hardware in loop (HIL), Study of control architecture.

Unit-III Model based control approach for Electric Vehicle

09 Hours

Introduction to P, PI & PID Controller, and Internal Model Control (IMC) Design, Introduction to Model based control system design for Electric Vehicle.

Unit-IV State Space Representation

09 Hours

Introduction to State Space, State Space Representation, State Space Representation: Companion Form (Controllable Canonical Form), Extended

Controllable Canonical Form Observable Canonical Form, Concept of Diagonalization, State transition matrix, Solution of state Equation, Steady State Error for State Space System. Controllability and Observability in State space.

Unit-V Stability aspects of control systems
09 Hours

Stability concept, Stability definition in the sense of Lyapunov, Stability of continuous time Linear systems, Lyapunov stability theorem, Vehicle stability analysis.

Total: 45 Hours

PRACTICALS

1. Familiarization of Electric Vehicle Control Modules
2. Modelling Studies of Electric Vehicles
3. Model Identification techniques for Electric Vehicle
4. Tuning Techniques for PI/PID Controller
5. PI/PID controller for Electric Vehicle
6. IMC based control techniques
7. Model based control techniques for Electric Vehicle
8. Modelling, Control in State space for Electric Vehicle
9. Study of Observer design for Electric Vehicle

Total: 75 Hours

Reference(s)

1. R. T. Stefani, B. Shahian, C. J. Savant, Jr., and G. H. Hostetter, Design of Feedback Control Systems, Oxford University Press, Fourth Edition.
2. Katsuhiko Ogata, Modern Control Engineering, PHI, Twelfth Edition.
3. Wuwei Chen, Hansong Xiao, Qidong Wang, Linfeng Zhao and Maofei Zhu, Integrated Vehicle Dynamics and Control, Wiley, First Edition
4. Ashish Tewari, Modern Control Design: with MATLAB and SIMULINK, Wiley, First Edition

List of e-Learning Resources:

3. https://nptel.ac.in/
4. https://www.coursera.org/

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

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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CO/PO / PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
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:

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

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

Reference Book

1.Aggarwal, R. S. (2022). A Modern Approach to Verbal & Non Verbal Reasoning. *S. Chand & Company Pvt Limited*.

2.Aggarwal, R. S. (2012). Quantitative Aptitude for Competitive Examinations. *S. Chand & Company Pvt Limited (Unit II, III)*.

Total: 30 H

Unit-V: Verbal Reasoning

Verification of Truth, Logical sequence of Words, Character Puzzels, Seri

6 Hou

Unit-IV: Logical Reasoning

Analogy, Blood Relation, Directional Sense, Number and Letter Serie

6 Hours

Unit-III: Basic Data Interpretation

Tables, Column, Graphs, Bar Graphs, Line Charts, Pie Char, Venn Diagrams

6 Hou

Unit-II: Quantitative Aptitude-N

Place value, Face Value, Divisibility test, Prime and Co-prime numbers, number series based on basic formula, Fractions and factors

6 Hou

Unit-I: Quantitative Aptitude

Number Systems, LCM and HCF, Decimal Fractions, Simplification, Square Roots and Cube Roots Average, Problems on Ages, Surds & Indices, Percentages, Problems on Numbers

6 Hou

Articulation Matrix

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CO/PO/PSO	CO1	CO2	CO3	CO4
PO-1			3	2
PO-2			2	3
PO-3			1	2
PO-4			1	2
PO-5	-	2		1
PO-6		-	1	1
PO-7		-	-	-
PO-8		-	-	-
PO-9		-	-	-
PO10 - PO11 - PO12 PSO1 PSO2 PSO3	-	-	-	-
	1		1	2
	-		1	1
		-	-	-

2. Understand the basic concepts of logical reasoning Skills.
3. Apply the concept of logical reasoning.
4. Analyzecampus placements aptitude papers covering Quantitative Ability, LogicalReasoning Ability and compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc..
5. Evaluate the concept of Logical and Verbal Reasoning.

Course Outcomes:

1. Understand the concepts of quantitative ability.

- To cater to the needs of outgoing students.
- To prepare students for various examinations and campus interviews.
- To acquaint students with frequently asked patterns in quantitative aptitude and logical reasoning.
- To provide students with strategies and techniques to excel in these areas.
- To give exposure on Logical reasoning.

Course Objec

BSEE0700 AQuantitative

B.Tech - Electrical & Electronics Engineering (EVT) Semester-V

L-0 T-0 P-2

Ma nd

MANDSAUR UNIVERSITY
MAKING FUTURE READY!

List of e-Learning Resources :

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

Subject Expert

Academic Coordinator

HoD

Approved by Academic Council

3. Praveen, R. V. (2016). *Quantitative Aptitude and Reasoning*. PHI Learning Pvt. Ltd..
4. Allwein, G., & Barwise, J. (Eds.). (1996). *Logical reasoning with diagrams*. Oxford University Press.
5. Sharma, M., &Basu, S. (2024). BELL THE "CAT". *Managing India: The Idea of*

Mandsaur University, Man...

B.Tech Electrical & Electronics Engineering (EVT) Semester-V

PCEEE0700A: Energy Conservation & M...

L-3 T-1 P-0

Course Objectives

To Understand and Analyze Energy Data

- To Carryout Energy Accounting and Balancing.
- To Conduct Energy Audit and Suggest Methodologies for Energy Savings.
- To Understand and Analyze the performance of electric drives.
- To Utilize the Available Resources in Optimal ways.

Course Outcomes (C...

1. Understand Conceptual knowledge of the need and approach of energy audit and management.
2. Apply and analyze energy conservation based on the fundamental laws of thermal engineering.
3. Understand various aspects of economics which can affect the engineering profession in terms of demand and decision making related to it.
4. Understand the concepts of different energy efficient electrical drives.
5. Analyze the energy data of various industries.

Articulation Matrix

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

High-3 Medium-2 Lo...

Unit-I: General Energy Pr... **9 Hou...**

Energy use Patterns and Scope for Conservation. Energy Audit: Energy Monitoring, Energy Accounting and Analysis, Auditing and Targeting. Energy Conservation Policy, Energy Management & Audit, Energy Audit, Types of Energy Audit, Energy Management (Audit), Qualities and Function of Energy Managers, Loss of Energy in Material Flow, Energy Performance, Maximizing System Efficiency, Energy Auditing Instruments, ...

Unit-II: Thermod... **9 Hou...**

Thermodynamics of Energy Conservation, Basic principle, Irreversibility and Second Law Efficiency Analysis of Systems, Primary Energy Sources, Optimum Use of Prime Movers, Energy Efficient House-keeping, Energy Recovery in Thermal Systems, Waste Heat Recovery Techniques, Thermal Insulation. ...

List of e-Learning Resources:	1. Energy Management – W.R. Murphy & G. Mckey Butler worths. 2. Energy Management Head Book- W.C. Turner, John Wiley 3. Energy Management Principles- Craig B. Smith, Pergamon Press 4. Energy Conservation- Paul O Callagan- Pergamon Press 5. Design & Management of Energy Conservation. Callaghan,	**Reference**	Energy Conservation Task before Industry, Energy Conservation Equipments, Co-Generation, Energy Conservation Process, Industry Sugar, Textiles, Cement Industry etc, Electrical Energy Conservation in Building and Lighting	**Unit-V:**	Energy Efficient Electric Drives, Energy Efficient Motors V.S.D. Power Factor Improvement in Power System. Energy Conservation in Transportation System Especially in Electric Vehicle. Energy Flow Networks, Matrix Chart.	**Unit-I**	Restructuring of Electric Tariff from Energy Conservation Considerations, Economic Analysis Depreciation Method, Replacement Analysis, and Special Problems Inflation Risk Analysis. Payback Period, Energy Economics, Cost Benefit Risk Analysis, Payback Period, Load Curve	**Unit-II: Financial Management and Audit**
Subject Expert										
HoD										

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

PCEEE0800A: Switch Gear & Protection

L-2 T-1 P-2

Course Objectives

- To introduce students to power system protection and switch gear
- To teach students theory and applications of the main components used in power system protection for electric machines, transformers, bus bars, overhead and underground feeders
- To teach students the theory, construction, applications of main types Circuit breakers, Relays for protection of generators, transformers and protection of feeders from over- voltages and other hazards. It emphasis on neutral grounding for overall protection
- To develop an ability and skill to design the feasible protection systems needed for each main part of a power system in students

Course Outcomes (COs)

1. Understand various types of protective systems in power system
2. Understand the operation of various types of relays and analyze their characteristics and applications in power station
3. Apply the protection schemes for transmission line, feeder and apparatus against various faults.
4. Analyze the performance of circuit breaker for the protection of power system equipment.
5. Analyze the importance of neutral Grounding, effects of ungrounded neutral grounding on system performance, methods and practices.

Articulation Mat

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

High-3 Medium-2 Low-

Unit-I Fault Analysis	Fault Analysis per unit, representation and its advantages, faults in power systems (Symmetrical & Unsymmetrical), Single line and equivalent impendence diagram representation of power system components. Symmetrical components and its application to power systems, fault analysis, Sequence networks and their	9 Hou
Unit-II Protective R	Requirement of relays, Primary & Backup protection, Desirable qualities of relays, Concept of Pickup, reset & drop-off, Drop off/ Pickup ratio, inverse time & definite time charterstics, Attracted armature, Balanced Beam, Induction disc, Induction cup, Moving coil & moving Iron, Rectifier, thermal, Bimetal directional relay, Frequency, DC, Over current, Over Voltage, Directional, Differential and Distance relays, Impedance mho & reactance relay. Introduction of	9 Hou
Unit-III Circuit B	Elementary principle of arc quenching, Recovery & Re-Striking voltage, Arc quenching devices, Description and operation of Bulk oil, Minimum oil, Air	9 Hou

List of e-Learning Resources:

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

Reference

1. B. Ravindran and M Chander, "Power System protection and Switchgear", New Age International.
2. Fundamentals of Power System protection Y.G.Paithankar& S.R. Bhide; E.E.E.
3. CL Wadhwa, Electrical Power systems, New age International.
4. HaddiSaadet, "Power System Analysis, TMH
5. A.R. Bergen, Vijay Vittal, "Power System Analysis, Pearson Education, Asia.
6. Switchgear & protection Sunil S. Rao. Khanna Publication.
7. Ravindra P. Singh, Switchgear & Power System Protection,PHI Learning.
8. Badrirka, Power System protection and switchgear, TMH

Total: 75 Hours

Suggested List of Experiments

9. 1. Determination of drop out factor of an instantaneous over current relay.
2. Determination of operating characteristic of IDMT relay.
3. Determination of operating characteristic of differential relay.
4. Study and operation of gas actuated protective relay.
5. Study and operation of static over current relay.
6. Determination of transmission line parameters using MATLAB.
7. Analysis of power system faults (Symmetrical & Asymmetrical) using MATLAB.
8. Study of SF6 circuit breaker.

Total 45 Hours

Unit-V Surge Protection & insulation co-ordination **9 Hours**

Switching surges, Phenomena of Lightning, over voltage due to lightning, Protection against lightning, lightning arrestors, selection of lightning arrestors, Surge absorbers and diverters, Rod gap, Horn gap expulsion type & valve type lightning arrestors, solid resistance and reactance earthing, Arc suppression coil, Earthing transformers, Earth wires, Earthing of

Protection of Generators: Earth Fault, Percentage, Differential, Loss of excitation, Prime mover failure, Over current, Turn to turn fault, Negative phase sequence, heating, reverse power protection schemes, **Protection of Transformers:** Internal & external fault protection, Differential, Earth fault, Over Current, Overheating, Protection schemes.

Unit-IV System Protection **9 Hours**

breakers and DC circuit breakers , Their comparative merits, LT Switch gear, HRC fuses, Current limiting reactor & their design features , Influence of reactors in CB ratings Testing of circuit breaker.

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B.Tech - Electrical & Electronics Engineering (EVT) Semester-V

PCEE E0900 A: Control

L-2 T-1 P-2

Course Objectives

- To learn Principles and applications of control systems in everyday
- To understand the time domain analysis of different order control system
- To understand the basic criterion of stability
- To develop the concepts about frequency domain analysis
- To learn the designing of

Course Outcomes (COs)

Understand the concepts of different types of control systems

Understand the different entity types of signals, time response analysis of di

Analyze the stability in time domain analysis of system Analyze the working control systems in frequency domain Evaluate the compensation networks

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)*

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

High-Medium-Low

Unit II Hour

Time Response Analysis of First Order and Second O

09

Mathematical Modeling of Physical Systems: Representation of physical system (Electro-Mechanical) by differential equations, determination of transfer function by block diagram reduction techniques and signal flow graph method, Laplace transformation function, inverse Laplace transformation function.

Unit II Introd

Elements of control system, concept of open loop and closed loop systems, examples and application of open loop and closed loop systems, brief idea of multi

09 Hours

Characteristic equations, response to step, ramp and parabolic inputs. Transient response analysis, steady state errors and error constants.

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Unit V **Hour**

The Design Problem and Preliminary Consi

Phase lead, Phase lag and Phase lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.

09

Unit IV Frequency Response

Frequency response, correlation between time and frequency responses, polar and Bode plots. **Stability in Frequency Domain:** Nyquist stability criterion, assessment of relative stability: gain margin and phase margin.

09 Hours

Unit III Stability and Algebrai

Concept of stability and necessary conditions, Routh-Hurwitz criteria and its limitations. Root Locus technique: The Root Locus concepts, construction of root

09 Hours

PRACTICA

1. To study the various MATLAB operators and characters.
2. To study the various MATLAB functions used in the Control Systems
3. Program for arithmetic operator on matrix.
4. Program to find transpose and diagonal of a matrix.
5. Program to find transfer function of system.
6. Plot a sine wave by using plot command.
7. Plot bode plot for the given transfer function.
8. Draw root locus for given transfer function.
9. Plot Nyquist plot for given transfer function and to compare their relative stability.

To study the above MA

Total: 75 H

Total 45 Hou

Reference

1. B. S. Manke, Linear Control System, Khanna Publisher.
2. Control Systems Theory and Applications - S. K. Bhattacharya, Pearson.
3. Control Systems - N. C. Jagan, BS Publications.
4. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2007.
5. K. Ogata, Discrete Time Control Systems, Prentice Hall, 2/e, 1995.

List of e-Learning Resources:

3. https://nptel.ac.in/
4. https://

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1.	**PRACTICA**				
To verify Maximum power transfer theorem using MATLAB	To calculate voltage using voltage division rule with the help of MATLAB Simulink. To calculate current using current division rule with the help of MATLAB Simulink. To verify Thevnin's Theorem using MATLAB Simulink. To verify Superposition Theorem using MATLAB Simulink. To verify Reciprocity Theorem using MATLAB	To study the fundamentals tools of MATLAB			

CO2				CO1	SO	*(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)*	**Articulation Mat**
CO3					PO1		
2					PO2		
2					PO3		
1					PO4		
2		-	-		PO5		
3		-	-		PO6		
-					PO7		
-					PO8		
-					PO9		
-					PO10		
-					PO11		
1			-		PO12		
1			-		SCO/PO/OP		
1			-		PSO1		
1					PSO2		

High-3 Medium-2 Lo

1. Understand the concepts of circuit abstraction and analysis of the circuit in MATLAB 2. Understand the different types of methods used to solve the networks in MATLAB 3. Apply the digital logical circuits in MATLAB 4. Analyze the working of electrical and electronics circuits in MATLAB. 5. Analyze the working of multiple correlated waveforms and signals in	**Course Outcomes (C**	• Define basics of the circuit's elements, construction and analysis of circuits in MATLAB. • Understand the different network theoremsto solve the circuits in MATLAB. • Define the basics of the digital logics and circuits in MATLAB. • Develop the concepts about the electrical and electronics simulationin MATLAB. • Define fundamental analysis of the multiple	**Course Objec**

PCEE1000 Electrical s:

B.Tech - Electrical & Electronics Engineering (EVT) Semester-V

L-0 T-0 P-4

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To study and verify half wave rectifier circuit in MATLAB Simulink.	Measurement of	To analyze single phase AC Circuits using MATLAB Simulink.
To study and verify half wave rectifier circuit MATLAB Simulink.		To analyze DC Circuits using MATLAB Simulink.
To measure active power for star and delta connected loads using MATLAB Simulink.		To determine Z parameters of two port network using MATLAB Simulink.
To measure active power for star and delta connected loads using MATLAB Simulink.		To determine Y parameters of two port network using MATLAB Simulink.
To measure three phase power by two wattmeter using MATLAB Simulink.		To determine ABCD parameters of two port network using MATLAB Simulink.
Total 60 Hours		

Reference

1. Amos Gilat: MATLAB Basics, Wiley Publications.
2. Rudra Pratap Singh: Getting Started with MATLAB Simulink, Oxfo

List of e-Learning Resources:

5. https://www.mathworks.com
6. ...

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Mandsaur University, Mandsaur

B.Tech Electrical & Electronics Engineering (EVT) Semester -V

PEEE0402 Flexible ACTransm.

Course Objectives:

- To understand the concept of FACTS controllers and the types of devices facused with an emphasis on working principle and the operation of TCSC in various modes and its applications

Course Outcomes:

1. Understand the fundamentals of FACTS Controllers
2. Understand & apply the concept of SVC
3. Analyze different types of series types of FACTS controllers
4. Analyze role of STATCOM in improving the power system dynamics
5. Analyze the performance of steady state and transients of facts controllers

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*

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

Hi gh -3 Me diu m -2 Lo

Unit-I: Introduction to Static Synchronous Compensator (STATCOM): operating principle, V-I characteristics; Unified Power Flow Controller (UPFC): principle of operation, modes of operation, applications, modeling of UPFC for power — **9 Hou**

Unit-II: Thyristor Controlled Series Capacitor (TCSC): operation of the TCSC, different modes of operation, modeling of TCSC, variable reactance model, modeling for power flow and stability studies. Applications, improvement of the system stability limit, enhancement of system dampin — **9 Hou**

Unit-III: Static VAR Compensator (SVC) and STATCOM: Voltage control by SVC, advantages of slope in dynamic characteristics, influence of SVC on system voltage. Applications, enhancement of transient stability, steady state power transfer, enhancement of power system dampin g, prevention of — **9 Hou**

Unit-IV: Emerging FACTS Controllers: Introduction to Flexible AC transmission system, reactive power control in electrical power transmission lines, uncompensated transmission line, series and shunt compensation. Overview of FACTS devices: Static VAR Compensator (SVC), Thyristor Switched Series capacitor (TCSC), Unified Power Flow controller — **9 Hou**

Course Structure

L-2 T-1 P-2

Subject Expert	**List of e-Learning Resources:**	5. 1. Mohan Mathur, K.R. R.,Rajiv. K.Varma, Padi "Thyristor–Based Facts yar," Controllers for FAC Electrical TS Transmission Systems", Cont IEEE press and John roller Wiley & Sons, Inc. s in 2. A.T. John, "Flexible PoweAC Transmission r System", Institution of Tran Electrical and smiss Electronic ion Engineers (IEEE), 1999. and 3. Narain G. Hingorani, Distr Laszio. Gyugyl, ibuti "Understanding FACTS on", Concepts and New Technology of Age Flexible AC Inter Transmission System", natio Standard Publishers, nal(P Delhi 2001.) 4. Vijay K. Sood, Limit"HVDC and FACTS ed, Controller: Application Publi of Static Converters in shers power , systems", IEEE Power New Electronics and Power Delhi Systems series, Kluwer , Academic publishers, 2008. Boston, First edition January 2004.	Cont U roller ni inter t- actio V: ns, C SVC o- – or SVC di inter na actio ti n, on co- of ordin F ation A of C multi T ple S contr C ollers using linea r contr ol techn iques , quant itativ e treat ment of 9 contr H ol ou
		Total: 45 Hours	**Total: 75 Hours**

Mandsaur University, Man

B Tech: Electrical and Electronics Engineering (EVT) Semester-V

PEEE0403 Analog Electronics with

L-2 T-1 P-2

Course Objectives

- To understand the working of transistors at high frequency
- To know the working of a transistor amplifier.
- To understand and analyze various types of Multivibrators.
- To design simple linear and nonlinear circuits using op. amp.
- To understand and analyze

Course Outcomes (C

1. Understand the working principles of various types of oscillators.
2. Analyze transistor amplifier and power amplifier.
3. Analyze various types of Multivibrators.
4. Analyze various Microphones and Loud Speakers.
5. Create linear and nonlinear circuits using

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) and 1 for slight (low)

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

High-3 Medium-2 Low-1

Unit-I Multivibrators

Introduction to Multivibrators, Astable (free running Multivibrators), Monostable and Bistable Multivibrators and their analysis, Multivibrators using 555 timer IC, switched

9 Hours

Unit-II Amplifiers

Power Amplifiers: Class A, Class B and Class C, power amplifiers, Push

Small signal amplifier, Frequency response of an amplifier and its band width, Gain – Bandwidth product. Hybrid parameters: Definitions, Analysis of transistor amplifier using h-parameters, Current gain, Voltage gain, Input-output impedance and power gain. Multistage Amplifiers: Cascading of transistor amplifiers, R-C coupled amplifiers, Voltage gain at low, Mid and high frequency.

9 Hours

Unit-III Feedback

Positive and negative feedback and their properties, Effect of positive and negative feedback on gain, noise, distortion, input and output impedance of an amplifier, Gain-stability. Voltage series, Voltage shunt, Current series, Current shunt feedback. Sinusoidal Oscillators: Principle of operation, Barkhausen criterion for sustained oscillations, R-C Phase shift Oscillator,

9 Hours

U ni t- I V A co	Microphones – Carbon, moving coil, ribbon, crystal, condenser, type microphones, their working principle and characteristic. Loud Speakers – Moving Coil, electrodynamics horn type loudspeakers, multi-way speaker system, cross over network, Reverberations.	9 H ou	
U ni t- V O pe ra ti on al A m pl ifi er s	Pin diagram representation of a typical Operational Amplifier, Ideal Op-Amp, Concept of virtual ground, Common-Mode Rejection Ratio (CMRR), Inverting and non-inverting modes and their characteristics. Applications of Op-Amp: Scalar, Adder, Subtractor, Multiplier, Divider, Log, Differentiator , Integrator. Active filters, LPF, HPF, BPF, BEF filters.	9 H ou	
			T ot al :4 5 H

R ef er en ce

1. Tobey; OP- Amps their design and Application.
2. Gaikward RA; OP- Amp and linear Integrated circuits; PHI.
3. Salivahanan; Linear Integrated Circuits; TMH.
4. Kennedy J; Principles of communications; TMH.
5. R.G.Gupta; Audio and Video System; TMH.
6. Linear Integrated Circuits:D. Raychowdhary and Shail Jain.
7. Introduction to System Design using integrated ckt: B.S. Sonde (New Age Pub.).
8. Integrated Circuits:Botkar (Khanna).
9. Applications of linear Integrated circuits:Clayton.
10. Salivahanan: Electronic Circuits Analysis and Design, TMH.
11. Rashid: Electronic Devices and Circuits, Cengage learning.
12. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad.
13. Linear Integrated Circuits by D Choudhury Roy.

Total: 75 Hours

List of e-Learning Resources:

1. https://www.youtube.com/watch?v=tjUUU9f2Wpc&list=PLDVC8J0Twuc9DCeiUaM0PRakAqa-lYwmP

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B. Tech - Electrical & Electronics Engineering

Semester-V

PEEEE0404A Electric Vehicles Architecture

L-2 T-1 P-2

Course Objectives

• To Learn about basics of hybrid drive train.

• TO To Understand the concepts of power flow in HEV.

• To Define and understand various modes of power flow in HEV.

• To Analysis of the parallel drive.

Course Outcomes (C

1. Understand the architecture of hybrid drive trains and its operations.
2. Identify the need of the power flow in series and parallel HEV
3. Design and analyze of the power flow in series-parallel HEV.
4. Evaluate and analyze parallel drive train and torque coupling

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)

CO/PO/PSO	CO2 CO3				C O .
PO1	2				
PO2	1				
PO3	1				
PO4	1			-	
PO5	2	-	-	-	
PO6	-				
PO7	-				
PO8	-				
PO9	-				
PO10	-				
PO11	-				
PO12	-	1		1	
PSO1	-	1			-
PSO2	1		-	-	
PSO	-				

High-3 Medium-2 L

Unit-I Basic Architecture of Hybrid D — 09 Hours

Hybrid Electric Vehicles (HEV): The gasoline ICE and battery, Diesel ICE and battery, Battery and FC, Battery and capacitor, Battery and flywheel, Battery and battery hybrids. Energy use in conventional vehicles, Energy saving potential of hybrid drive trains: Regenerative braking, More efficient operation of the ICE, including reduction of idle, Smaller ICE, Potential for higher weight, Electrical losses. Various HEV configurations and their operation modes: Series

Unit-II Power Flow in — 09 Hours

Power Flow Control: Optimal ICE operating point, Optimal ICE operating line, Safe battery voltage. Power Flow Control in Series Hybrid: Mode 1, normal driving or acceleration, Mode 2, light load, Mode 3, braking or deceleration, Mode 4, vehicle at stop. Power Flow Control in Parallel Hybrid: Mode 1, start up, Mode 2, normal

Unit-III Power Flow in — 09 Hours

Power Flow Control in Series-Parallel Hybrid: Mode 1: At startup, Mode 2: During full throttle acceleration, Mode 3: During normal driving, Mode 4: During normal braking or deceleration, Mode 5: To charge the battery during driving, Mode 6: When the vehicle is at standstill, The operating modes of

List of e-Learning Resources													
	2. K.T. Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, 1st Edition, John Wiley and Sons, 2011.	1. M. Ehsani,:Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press ,2005.	**References**										
				Total: 75 Hours	10	9. Calculate the torque contribution from each power source (engine, motor) and analyze how they combine at the output shaft.	2. To quantify the effectiveness of regenerative braking in capturing kinetic energy during deceleration and storing it in the hybrid drivetrain's energy storage system. 3. Calculate the power flow through each component under steady-state operating conditions. 4. Measurement of the current and voltage during charging and discharging to understand the power flow between the battery and motor/generator. 5. To evaluate the performance of the HEV in electric-only mode, with the engine disabled. 6. Measurement of power flow from the battery to the motor during acceleration and observe the battery state of charge (SOC) over time. 7. Compare the power flow characteristics of different HEV architectures (e.g., series, parallel, and series-parallel) under identical driving conditions. 8. Analyze the advantages and disadvantages of each architecture in terms of power distribution, efficiency, and performance.	1. To measure the efficiency of individual components in the hybrid drivetrain, including electric motor through dynamometer.	**PRACTIC**	EV configuration with two EM, EV configuration with in wheel motor and mechanical gear, EV configuration with in wheel motor and no mechanical gear. EV alternatives based on power source configuration: EV configuration with battery source, EV configuration with two battery sources, EV configuration with battery and fuel cell source, EV configuration with multiple energy sources, EV configuration with battery and capacitors sources, EV	**Unit-V Basic Architecture of Electric Drive and Analysis of Parallel Hybrid Electric Drive Train,**	Introduction to Parallel Hybrid Electric Drive Train, Torque Coupling, Speed Coupling, Post-Transmission Parallel Hybrid Drive Train with Torque Coupling, Pre-Transmission Parallel Hybrid Drive Train with Torque Coupling, Parallel Hybrid Drive Train with Speed Coupling: Hybrid traction, Engine alone traction, Motor alone traction, Regenerative braking,	**Unit-VI Torque Coupling and Analysis of Parallel**	Control: Mode 1: During startup, Mode 2: During full throttle acceleration, Mode 3: During normal driving, Mode 4: During driving at light load, Mode 5: During braking or deceleration, Mode 6: Axial balancing.
				Total 45 Hou							**09 Hours**		**09 Hours**

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nd

7. https://nptel.ac.in/
8. https://www.courser

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Course Outcomes (COs)

1. Understand the various types of fuel cells.
2. Understand the thermodynamics background of fuel cells.
3. Analyze the Gain of the fundamental concepts of electro chemistry fuel cells.
4. Analyze the performance behavior of fuel cell.
5. Evaluate the various technology of hydrogen fueling.

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)*

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

Course Objectives

This course will expose students to

To Study about the various types of fuel cells.

To Understand the thermodynamics of fuel cells.

To Understand the electro chemistry concept of fuel cells.

To Study the performance characteristics of fuel cell.

To Understand

PEEE0405A Electro-Chemistry of

Semester-

B. Tech - Electrical & Electronics Engineering

Unit-IV Fuel Cell Components and Their Impact on Performance Fuel cell performance characteristics-Current/voltage, voltage efficiency and power density

09 Hours

Nernst equation, relation of the fuel consumption versus current output, stoichiometric coefficients and utilization percentages of the fuel and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serious connection, over-potential and polarizations, DMFC operation scheme, generous issues -water

Unit-III Electro Chemical Thermodynamics

09 Hours

Enthalpy change of a reacting system, systematic Gibbs free energy, Ideal efficiency of the energy conversion, energy balance in fuel cells.

Unit-II Thermodynamics

09 Hours

Introduction-working and types of fuel cell-Low, medium and high temperature fuel cell, Liquid and methanol types, Proton exchange fuel cell solid oxide, hydrogen fuel cells-Thermodynamics and electrochemical kinetics

Unit-I Introduction Fuel

09 Hours

High-3 Medium-2 Lo

L-2 T-1 P-2

Ma nd

List of e-Learning Resources:

9. https://nptel.ac.in/10.https

References

1. Francesco Babir, "PEM FUEL CELLS: Theory and Practice", Elsevier Academic Press, USA, 2005.
2. Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2006.Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007.
3. Fuel cells for automotive applications - professional engineering publishing UK, 2004.
4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modem Electric, Hybrid Electric and Fuel cell Vehicles", Fundamental, Theory and design", CRS Press, 2004.
5. Fuel cell Technology Handbook SAE International Gregor Hoogers CRC Press, 2003.

Total: 75 H

PRACTICA

1. To investigate the electrochemical properties of various electrode materials used in fuel cells.
2. To evaluate the properties and performance of membrane electrolytes used in fuel cells.
3. To test a fuel cell stack to evaluate its performance under different operating conditions.
4. To study the electrochemical kinetics and reaction mechanisms involved in fuel cell operation.
5. To assess the degradation mechanisms and durability of fuel cell components under operating conditions
6. To measurement the capacity of full cell.
7. To measure the electrochemical impedance spectroscopy form full cell.
8. To test the electrochemical impedance spectroscopy copy for half cell.
9. To test the electrochemical capacity of full cell.
10. To test the differential voltage analysis

Total 45 Hours

Unit-VFue

Hydrogen storage technology- pressure cylinders, liquid hydrogen, metal hydrides, methods of hydrogen production, carbon fibers-reformer technology- steam reforming, partial oxidation, auto thermal reforming CO removal resistance, Kinetic performance, mass transfer effects- membrane electrode assembly components, fuel cell stacks, bi-polar plate, humidifiers and cooling plates.

09 Hours

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Unit-III Lighting sy	CAN bus: Applications, Topology , Data transmission system, CAN protocol , data transfer sequence, standardization, characteristics. LIN bus: Overview, Applications, Data transfer, Bus access, LIN protocol, network management, example. MOST bus: Introduction, features, data transfer, administrative functions, application layer Bluetooth: Overview, applications, Bluetooth versions, transmission technology, power classes, topology, physical data channel, physical	**09 Hours**	**Unit-II Bussyst**	Overview, Motronic engine management system, Electronic diesel control, Lighting technology, Electronic stability program, Adaptive cruise control, Infotainment System. **Basic principles of networking:** Network topology, Network organization, OSI reference model, Control mechanisms. **Automotive networking:** Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, Examples of networked vehicles system.	**09 Hours**

Unit-I Electrical And Electronic Systems

Articulation Matrix

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

(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)

High-3 Medium-2 Lo

Course Outcomes (C

Evaluate the auxiliaries and chassis electric systems in automobiles.	Apply the basic principles of networking requirements in an automotive. Analyze requirements and types of bus systems. Analyze the lighting systems in vehicles.	Understand the various electrical & electronic systems in vehicles and understand their working.

Course Objectives

- Understand the electrical and electronic systems in vehicles.
- Understand the principles of networking.
- Explain requirements and types of bus systems.
- Comprehend the lighting systems in vehicles.
- Understand the auxiliaries and chassis electric systems in automobiles.

PEEE04 06AAutomotive Electr

Mandsaur

B.Tech - Electrical& Electronics Engineering (EVT) Semester-V

L-2 T-1 P-2

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Subject Expe

Academic Coordinator

HoD

Appointed Senior Faculty by DoA

List of e-Learning Resources:

1. https://nptel.ac.in/
2. [illegible]

Reference

7. Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics", 5th Edition. John Wiley & Sons Ltd, 2007.
8. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier, 2003.
9. Tom Denton: "Automobile Electrical and Electronic Systems", 3rd Edition, Elsevier Butterworth-Heinemann Publication, 2004.

Total: 75 H

16. To test and optimize the performance of the Anti-lock Braking System (ABS) in Electric Vehicles.
17. To integrate and evaluate a Traction Control System (TCS) for Electric Vehicles to improve traction and vehicle stability.

11. To optimize motor controller settings to maximize electric motor efficiency, torque control precision, and regenerative braking effectiveness, contributing to enhanced overall vehicle performance and energy efficiency in EVs.
12. To evaluate the performance of Ethernet-based networking protocols for in-vehicle communication.
13. To analyze the communication on the Controller Area Network (CAN) bus within an automotive system.
14. To evaluate the efficiency and performance of light emitting diode (LED) headlights in electric vehicles.
15. To integrate and evaluate an adaptive lighting system (ALS) for electric vehicles to enhance safety and visibility.

PRACTIC

Total 45 Hou

Anti-lock brakes, Active suspension, Traction control, Automatic transmission, other chassis electrical systems, Case studies, Diagnosing chassis electrical system faults, Advanced chassis systems technology, New developments in

Unit-V Chassis Electrical

09 Hours

Windscreen washers and wipers, signalling circuits, other auxiliary systems, Case studies, Diagnosing auxiliary system faults Advanced auxiliary systems technology, new developments in auxiliary systems.

Unit-V Auxiliaries in

09 Hours

Lighting fundamentals Lighting circuits, Gas discharge and LED lighting, Case studies, Diagnosing lighting system faults, Advanced lighting technology, new

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