RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV 601- Electric and Electronic Power Systems for Vehicles

Course Objectives

The course to aimed at;

1. Developing the skills to understand the circuit and electrical wiring diagram and interpret the same.

2. Providing students with a good understanding of automotive electrical systems with particular emphasize on batteries, charging, ignition, starters and lighting systems.

3. Imparting students the knowledge about the new developments and advancements of automotive electrical technologies.

Course Outcomes

At the end of the course, the student will be able to ;

1. Interpret the electrical wiring, circuit diagram for automotive applications

2. Understand the role of batteries in vehicles and develop a charging system for vehicles

3. Understand the starter and ignition systems in vehicles

4. Demonstrate knowledge on lighting systems for vehicles.

5. Design and implement various electrical outlet systems for vehicles

Unit :1 Electrical Systems and Circuits

System approach –electrical wiring, terminals and switching –multiplexed wiring systems – CAN – circuit diagrams and symbols, Requirements for two wheeler, three wheeler vehicles, Requirements for heavy vehicles- trucks and trailers.

Unit:2 Batteries and Charging systems

Vehicle Batteries –Lead-Acid batteries –maintenance and charging –diagnosing Lead acid battery faults –advanced battery technology.

Requirements of charging systems —generation of electrical energy in motor vehicle – physical principles – alternators –characteristic curves –charging circuits –diagnosing charging system faults.

Unit: 3 Starting System and Ignition system

Requirements –starter motors and circuits –types of starter motors –diagnosing starting system faults.
Ignition system ; Fundamentals –electronic ignition –programmed ignition –distributor less ignition –direct ignition spark plug ignition –diagnosing faults.

Unit : 4 Lighting system

Insulated and earth return systems, positive and negative earth systems, Concealed headlights Lighting circuit types, glare and preventive methods.

Unit : 5 Gauges, Accessories and Passive restraint systems

Electrical fuel pump, speedometer, oil and temperature gauges, Horns, Wipers, washers, Blower motors, Defoggers, Power windows, seats, door locks, Air bag systems, Seat belt pretensioners

References

1. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd Item 67/15 –
2. Annexure - 19 Proceedings of the 67th Academic Council (08.08.2022) 1038 Page 18 of 60 22MAE Edition, 2015
3. Judge, A.W., ―Modern Electrical Equipment of Automobiles‖, Chapman & Hall London, 1992
4. Young, A.P., &Griffiths.L., ―Automobile Electrical Equipment‖, English Languages Book Society & New Press, 1990
5. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004
6. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997
7. Jurgen, R., Automotive Electronics Hand Book, 2015

Mode of Evaluation:
Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV 602- Automotive Air Conditioning Systems

Course Outcomes

At the end of the course, the student will be able to ;

1. Compare the Vapour compression refrigeration system, vapour absorption refrigeration system
2. Know about the refrigerants used in automobile air conditioning.
3. Design Central Air conditioning system
4. Understand about the design principle of Air Distribution Systems
5. Perform Air Conditioning Service and maintenace

Syllabus

Unit 1: Introduction to Air conditioning & Refrigeration:
Methods of refrigeration. Vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, Refrigerated transport vehicles, applications related with very low temperatures.

Unit 2: Refrigerants and Psychrometry: Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants, applications of refrigerants, refrigerants used in automobile air conditioning.

Psychrometry: Psychrometric properties, psychrometric tables/charts, psychrometric processes, comfort charts, factors affecting comfort, effective temperature, ventilation requirements.

Unit 3:. **Air Conditioning Systems** : Classification, layouts, central / unitary air conditioning systems. System components like compressor, evaporator, condenser, expansion devices, Receiver dryer, fan blowers, heating system etc. Switch and electrical wiring circuit.

Load Calculations & Analysis: Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems. Cooling & heating load calculations. Load calculations for automobiles. Effect of air conditioning load on engine performance in terms of loss of available Peak Torque/Power and Fuel consumption.

Unit 4: Air Distribution Systems, Air Routing & Temperature Control: Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct

systems for automobiles and their impact on load calculations.

Air Routing & Temperature Control: Objectives of the dashboard re-circulating unit, automatic temperature control, controlling flow, control of air handling systems & air flow through – evaporator care

Unit 5: Air Conditioning Service and Control: Air conditioner maintenance & service - removing & replacing Components. Compressor service. Testing, Diagnosis & trouble shooting of air conditioning system. Refrigerant gas charging procedure &. Servicing of heater system.

Air Conditioning Control: Common controls such as thermostats, humidistat, control dampers, pressure cutouts, relays. 10. Heating Systems: Automotive heaters, manually controlled and automatically controlled air conditioner and heater system, automatic temperature control

References

1. "Automotive Air-Conditioning", by Crouse & Anglin – Mc Graw Hill Pub.
2. "Automotive Air-Conditioning", by Paul Weiser – Reston Publishing Co.
3. "Automatic Heating & Air Conditioning Systems" – Mitchell Information Services.
4. "Air Conditioning", by Paul Lang, C.B.S. Publisher & Distributor, Delhi.
5. Principles of Refrigeration by Roy J. Dossat – Pearson Publication.
6. "Modern Air Conditioning", by Harris.
7. "Automobile Engg", by Anil Chhikara - Satya Prakashan.
8. "American Society of Heating, Refrigeration & Air Conditioning – Fundamentals", ASHRAE Handbook – 1985.
9. Domkundwar ,Refrigeration and Air Conditioning , Dhanpat Rai
10.C P Arora , Refrigeration and Air Conditioning, TMH
11.R S Khurmi Refrigeration and Air Conditioning S Chand

Suggested List of Experiments:

1. Experiment based on air conditioning test rig and plot various processes.
2. Experiment based on air conditioning for automobile.
3. Performance and analysis of air conditioning system.
4. Experiment based on refrigerants used in automobile air conditioning.
5. Experiment based on air distribution system for automobile.
6. Design of air conditioning system and load calculation for automobile.
7. Experiment based on air conditioning system components.
8. Experiments based on air conditioning services for automobile.
9. Experiment based on air conditioning controls.
10. Experiments based on air routing and temperature control.
11. Tutorials.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV 603 (a) Energy Storage Systems for Electric Vehicle

Course Outcomes:

At the end of the course, the student will be able to;

CO 1 Understand the basic history of electric vehicles.
CO 2 Discuss the various energy storage systems
CO 3 Analyze the battery characteristics & parameters
CO 4 Enlighten the battery management system
CO 5 Apply the knowledge of battery testing, disposal & recycling to avoid environmental pollution for the betterment of society

Syllabus:

Unit-1 - Electric Vehicle Mechanism

Basics of vehicle mechanisms, history of electric vehicles (EV) and hybrid electric vehicles (HEV), need for and Importance of EV and HEV, Power/Energy supply requirements

Unit 2 –Betteries

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System

Unit 3 - Cells and Batteries

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design- Performance criteria for Electric vehicles batteriesVehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

Unit-4 Batteries for Electric Vehicle

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests

Unit -5- Chemical & Structure Material for Battery Design

Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries

References

1. AK Bandyopadhyay, Nanomaterials , New Age International (P) Ltd., 2 nd Edition, 2010.
2. Rao. C. N, Muller. A, Cheetham . A. K, Nanomaterials chemistry, Wiley-VCH, 2007.
3. N. Kumar, Concise concepts of nanoscience and nanomaterials, Scientific publishers, 2018
4. Pistoia, J.P. Wiaux, S.P. Wolsky, Used Battery Collection and Recycling, Elsevier, 2001.
5. Chris Mi, Abul Masrur& David Wenzhong Gao, Hybrid electric Vehicle- Principles & Applications with Practical Properties, Wiley, 2011.
6. Arno Kwade, Jan Diekmann, Recycling of Lithium-Ion Batteries: The LithoRec Way, Springer, 2018.
7. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, Thermal Management of Electric Vehicle Battery Systems, JohnWiley& Sons Ltd., 2016.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV603 (b) Emission Control and Diagnosis

Course Objectives

The course is aimed at:

1. Preparing the students to analyze automotive pollution control techniques

2. Introducing the concepts of formation and control techniques of pollutants like sulphur, CO, NOx and particulate matter

3. Preparing the students to analyze smoke for both SI and CI engines

Course Outcome

At the end of the course, the student will be able to ;

1. Get details of the emission from automobiles

2. Analyze emission from Spark Ignition Engine and Compression Ignition Engine

4. Explain about the exhaust emissions and comprehend the Emission Control Legislation – I, II

5. Understand about the Exhaust gas measuring techniques

Syllabus

Unit :1 Emission From Automobiles

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

Unit :2 Emission from Spark Ignition Engine and its Control

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, CCS, Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion

Unit :3 Emission From Compression Ignition Engine and its Control

Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

Unit :4 Exhaust Emissions

Combustion products, Properties of exhaust gas components Module:5 Emission control legislation - I

Overview, CARB legislation, EPA legislation, EU legislation, Japanese legislation , Emission control legislation - II US test cycles for passenger cars and light duty trucks, European test cycles for passenger cars and light duty trucks, Japanese test cycles for passenger cars and light duty trucks, test cycles for heavy commercial vehicles

Unit :5 Exhaust gas measuring techniques – I

Exhaust gas test on chassis dynamometers, Exhaust gas measuring devices, Diesel smoke emission test, Evaporative emission test

References

1. . G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.

2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication, 1985. Autmotive Handbook – 9th Edition – 2015, BOSCH

3. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.

4. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company.,Newyork 1993.

5. Charles K. Alexander, Matthew N. O. Sadiku, "Fundamentals of Electric Circuits," 2015, 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, India.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV603 (c) Vehicle Ergonomics & Safety Systems

Course Objectives

The course is aimed at:

1. Have a better understanding of good design practices which will enable product improvement that manifests significantly less risk to humans, machines and the environment

2. Gain the ability to design and demonstrate the vehicle safety critical systems to reduce the system errors and faults

3. Introducing the students to do design safety systems using MATLAB simulation

Course Outcome :

At the end of the course, the student will be able to ;

1. Understand the basic concept of vehicle ergonomics and safety

2. Understand the operation of braking system design and its operation

3. Understand the braking system for passenger vehicles

4. Know the working principle of ABS and traction control systems, concepts of braking systems for commercial vehicles

5. Understand the vehicle stabilization for commercial vehicles, about the airbag system for passenger safety

Unit 1: Vehicle Ergonomics and Human Computer interface

Ergonomics: Introduction, areas of study under ergonomics, man-machine system. Components of man-machine system and their functions –, study of development of stress in human body and their consequences. computer based ergonomics

Human Computer interface.

Design of man-machine system: Quantitative, qualitative representation and alphanumeric displays. types of control, layouts of panels and machines. Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light on human efficiency.

Unit 2 Basic Concepts of Vehicle Safety and Braking Systems

Underlying principles-cause and effect –safety factors-design for uncertainty-identifying component safety factor-Digital models and man testing -compliance

Braking systems; Definitions-principles-design and components of braking system-brake-circuit configurations-braking system design

Unit :3 Braking system for passenger cars and light utility vehicles

Brake booster-brake master cylinder-braking force limiters-disk brakes-drum brakes

Vehicle stabilization systems for passenger cars 4 hours Anti-Lock braking system(ABS)-traction control system(TCS)-Electronic stability program(ESP)- Electrohydraulic brakes

Unit : 4 Braking system for commercial vehicles

System and configuration-air supply and processing-Transmission device-wheel brakesparking brake system-retarder braking system

Unit: 5 Vehicle stabilization system for commercial vehicles

Electronic stability program(ESP) for commercial vehicles-Electronically controlled braking(ELB)-function-system design-components-electro pneumatic braking Occupant injury prevention and distracted driver ; Introduction-proper use of head restraints-Airbags-distractors and risk reduction-information processing

REFERENCES:

1. ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition,2008.

2. M S Sanders and E J McCormic -Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition,1992.

3. R.S.Bridger -Introduction to Ergonomics, ISBN:13:9780849373060, Publisher Taylor and Francis dated 20th Aug 2008, 3rdEdition.

4.O.P.Khanna, Work study and Ergonamics, Dhanpat Rai & Sons

5. George A. Peters, Barbara J. Peters, ”Automotive vehicle safety”, Taylor and Francis,3rd Item

6. Proceedings of the 67th Academic Council (08.08.2022) 1070 Page 50 of 60 22MAE edition, 2015

7. Robert Bosch, ”Automotive handbook”,9th edition,2015

8. Bimal K Bose, “Power Electronics and Motor Drive: Advances and Trends”, Elsevier, Inc., 2006

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV604 (a) Total Quality Management

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand TQM Framwork, Quality, customer focus , how to translate needs into requirements
2. Have overview of contributions of Renowned Philosophers of quality management
3. Understand concept of quality circle,statistical process control and process capability.
4. Compare TQM, BPR and Six sigma tools and apply them appropriately in industry.
5. Suggest / Implement guidelines of ISO 9004:2000 in a small industry.

Unit I: Introduction To Quality Management

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

Unit II :Principles and Philosophies of Quality Management

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit III : Statistical Process Control and Process Capability

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed.
Process capability, meaning, significance and measurement – Six sigma concepts of process capability.
Reliability concepts; definitions,reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit IV: Tools and Techniques for Quality Management

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA), requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.

Unit V: Quality Systems Organizing and Implementation

Introduction to IS/ISO 9004:2000, quality management systems, guidelines for performance improvements. Quality Audits. TQM culture, Leadership, quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

REFERENCES:

1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002
3. M.Mahajan, Total Quality Management, Dhanpat Rai & Co.

4. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
5. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV604 (b) Operation Research

Course Outcomes :

After studying this course, students will be able to;

1. Formulate mathematically and solve Linear programming problems
2. Perform sensitivity analysis, compare assignment and transportation problems
3. Apply Game theory and identify critical path.
4. Determine problems based on Queuing Theory
5. Apply Monte Carlo simulation in queuing system

Syllabus:

UNIT 1: Linear programming problems

Mathematical formulation, graphical method of solution, simplex method

UNIT II Duality in linear programming problems

Dual simplex method, sensitivity analysis, transportation and assignment problems, Traveling salesman Problem.

UNIT III Game theory and Project Management

Introduction, two-person zero-sum games, some basic terms, the maxmin minimax principle, games without saddle points-Mixed Strategies, graphic solution of 2 * n and m*2 games, dominance property. CPM & PERT- project scheduling, critical path calculations, Crashing.

UNIT IV Queuing theory

Basic structure of queuing systems, roles of the Poisson and exponential distributions, classification of queues basic results of M/M/1: FIFO systems, extension to multi-server queues.

UNIT V Simulation

Simulation concepts, simulation of a queuing system using event list ,pseudo random numbers, multiplication congruential algorithm, inverse transformation method, basic ideas of Monte-Carlo simulation.

References

• Taha.H.A ,operation Research : An Introduction, McMilan publishing Co., 1982. 7 th ed.

• Ravindran A, Philips D.T & Solbery.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.

• Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research for Management. All India Traveler Book seller, Delhi.

• Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw

Hill, 1987.

• Joseph.G.Ecker & Michael Kupper Schimd, Introduction to operations Research, John Wiley & Sons, 1988.

• Hillier.F.S & Liberman.G.J, operation Research, Second Edition, Holden Day Inc, 1974.

• Heera and Gupta,Operation Research

• Kanti Swarup, Gupta.P.K. & Man Mohan, operations Research, S.Chand & Sons.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV604 (c) Industry 4.0

Course Objectives:

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application.
- Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular applications.

COURSE OUTCOMES

On completion of the course, student will be able to;

CO1 - Understand the basic concepts of Industry 4.0 and the other related fields.
CO2 – Understand cyber physical system and the emerging applications.
CO3 - Analyze the different new business models
CO4 – Implement the industry 4.0 to solve engineering problems.
CO5 – Design of smart vehicle and analyze its performance..

Syllabus:

UNIT 1 Introduction to Industry 4.0

Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Comparison of Industry 4.0 Factory and today's Factory, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances

UNIT 2 Industry 4.0 and Cyber Physical System

Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.

UNIT 3 Smart Energy Sources

Energy Storage for Mitigating the Variability of Renewable Electricity Sources-Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation.

UNIT 4. New Business Models

How CPS can induce new Business Models, The Role of horizontal and vertical value streams .New Business Models for the Smart Factory. Characteristics of Business Models within the Smart Factory. Examples of new Business Models - Business Model: Service provider - Business Model: Data provider Business Model: Technology provider - Business Model: Platform provider

UNIT 5 Smart Applications

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google‘s Self-Driving Car, Intellectual Property Rights.

TEXT / REFERENCE BOOKS

1.Jean-Claude André, ―Industry 4.0‖, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.

2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020

3. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.

4. Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition , ISBN-13:978-0128100714

5.Hossam A. Gabbar, ―Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978- 0-12-805343-0.

6.Mini S. Thomas, John Douglas McDonald, ―Power System SCADA and Smart Grids‖, CRC Press, 2017.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV 605 - Hybrid and Electric Vehicles Technology Lab

Suggested List of Experiments

1 Performance study of AC Induction electric vehicle motor (Frame)

2 Performance study of BLDC electric vehicle motor (Hub)

3 Performance map development for SI engine to operate in hybrid mode

4 Development of Energy Management system for SI engine with electric vehicle motor

5 Performance study of Lithium-ion battery for Electric Vehicle

6 Performance study of Fuel Cells and Supercapacitors for Electric Vehicle

7 Performance study of battery and motor cooling system in Electric Vehicle

8 Battery Management System simulation and control

9 Performance study on regenerative braking for PMSM motor

10 Fault diagnosis of battery using BMS in electric and hybrid vehicle.

Text Books

1. Denton, T. (2020). Electric and hybrid vehicles. Routledge.

2. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). Modern electric, hybrid electric, and fuel cell vehicles. CRC press.

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV606 - Soft Computing Techniques Laboratory

OBJECTIVES: The Laboratory course should enable the students to:

1. Understand Fuzzy concepts
2. Learn neural networks with back propagation and without preparation
3. Learn the operators of genetic algorithms
4. Practice on crisp partitions

Suggested List of Experiments:

1. Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
2. Write a program to implement artificial neural network without back propagation. Write a program to implement artificial neural network with back propagation.
3. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations
4. Implement travelling sales person problem (tsp) using genetic algorithms.
5. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on soya bins data. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.
6. Implement linear regression and multi-regression for a set of data points
7. Implement crisp partitions for real-life iris dataset
8. Write a program to implement Hebb's rule Write a program to implement Delta rule
9. Write a program to implement logic gates.
10. Implement svm classification by fuzzy concepts.

REFERENCES:

1. D.K Prathikar, ―Soft Computing, Narosa Publishing House, New Delhi, 2008.

Web References:

1.https://ldrp.ac.in/images/syllabus/BEComputer/8023%20soft%20computing.pdfhttp://itmgoi.in/download/CSE%20&%20IT/Soft%20Computing%20IT%20(IT-802).pdf

2. http://mirlab.org/jang/book/

SOFTWARE AND HARDWARE REQUIREMENTS FOR 30 STUDENTS (One batch):

SOFTWARE: Python

HARDWARE: 30 numbers of Intel Desktop Computers with 4 GB RAM

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New Scheme Based On AICTE Flexible Curricula

Electric Vehicles, VI-Semester

EV- 608 Minor Project-II

Objectives of the course Minor Project II:

1. To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
2. To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
3. To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
4. To adapt students for latest development and to handle independently new situations.
5. To develop good expressions power and presentation abilities in students

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The focus of the Minor Project II is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule:

The faculty and students should work according to following schedule: Each student undertakes substantial and individual project in an approved area of the subject and supervised by a faculty of the department. In special case, if project is huge, then maximum 03 students may be permitted to work together as a team to do the same. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty and Head of department. Project guide should motivate students to develop some Innovative working models of Electric Vehicles systems , Hybrid systems based Working Models etc. through which students can learn practical aspects.

Evaluation: There will be an internal evaluation of project carried out by each student.
