Jan-May Semester

Functional and Conceptual Design - ED1011

Approved Details

Description

Introduce the concepts of new product design

Course Content

Overview of the Design Process – Philosophy of Engineering Design, Steps involved in the Design Process S curves, Communications during design process. Understanding the customer need – Steps involved in developing Engineering Design Specifications. The technique of Quality Function Deployment. Case studies in QFD. Functional Design – Functions in engineering Design. Basics of Function Structure – Functional Basis , Functional decomposition and flow. Product Concept – Various methods of concept

TextBooks

1. K Otto and K Wood, Product Design, Pearson Education, 2001.2. D G Ullman, The Mechanical Design Process, McGraw Hill 1997.3. G Pahl and W. Beitz, Engineering Design, Springer 1996.

Reference Books

1. K Otto and K Wood, Product Design, Pearson Education, 2001.2. D G Ullman, The Mechanical Design Process, McGraw Hill 1997.3. G Pahl and W. Beitz, Engineering Design, Springer 1996.

Prerequisite

NIL

Form and Aesthetics in Design I - ED1033

Approved Details

Description

The course focuses on observation, critical and visual thinking and process related to form and design. To Develop a design process with systematic and creative thinking through brain-storming, problem perception, clustering of ideas, exploratory concept development, refinement and detailing.

Course Content

Aesthetics in design to develop judgement and creative thinking• Design trends with focus on the rendering skills to result in ideational, hand and/or software-based rendering and analysis of one's work to develop work ethics and craftsmanship• Free Form Surface Design• Creative approach to form incorporating analysis of a problem statement and its solution creatively giving riseto multiple options• Graphic identity to learn to employ strong elements of design and build upon individual capacity.

TextBooks

Ching, Francis, D.K. Drawing: A Creative Process. New York: Van Nostrand Reinhold, 1990.

Reference Books

1. Edwards, Betty; New Drawing on the Right Side of the Brain, Publisher: Tarcher; 20022. Lidwell, William; Holden, Kritina; Butler, Jill; Universal Principles of Design, Rockport Publishers, 20033. Demers, Owen; Digital Texturing & Painting, Publisher: New Riders Press; Bk&CD-Rom edition, 20014. Gail Greet Hannah, Elements of Design, Publisher: Princeton Architectural Press, 2002Itten, Johannes; The Art of Color: The Subjective Experience and Objective Rationale of Color, Publisher:Wiley Publications,19975. Pogany, Willy ; The Art of Drawing, Publisher: Madison Books, 19966. Kepes, Gyorgy; Language of Vision, Publisher: Dover Publications, 19957. Elam, Kimberly; Geometry of Design: Studies in Proportion and Composition, Publisher: Princeton Architectural Press, 20018. Lawlor, Robert; Sacred Geometry: Philosophy and Practice (Art and Imagination), Publisher: Thames & Hudson, 19899. McKim, Robert; Experiences in Visual Thinking, Publisher: Brooks/Cole Publishing Company, 1980

Prerequisite

NIL

Japanese Language - ED1091

Approved Details

Description

This course is intended for beginners who are interested in Japanese language and culture. The objective of this course is to develop the listening and speaking skills along with the competence in non-verbal aspects as well as cultural understanding.

Course Content

The course focuses on the following • Introduction to the Japanese Scripts - Hiragana, Katakana. Practice reading and writing of the Hiragana and Katakana alphabets and introduction to few Kanji characters. • Introduction to basic grammar and structure of Japanese verbs, adjectives and adverbs. Various sentence patterns required to establish the basic conversation • Pronunciation & Intonation ? Hiragana & Katakana ? Vocabulary relating to the daily life, work and play etc. • Classroom activities for ? Exchange greetings in culturally appropriate manner with the pronunciation, intonation. ? To be able to introduce one self. ? Short composition.

TextBooks

The following text book will be followed during the course MARUGOTO,Nyûmon A1 Katsudô(introduction A1, Activity), Japan Foundation

Reference Books

? http://www.marugotoweb.jp/(a website where users can learn about Japanese language and culture) ? http://words.marugotoweb.jp/mylist_top.php?lv=A1&lang=en (List of vocabulary (along with audio)of various topics mentioned in Marugoto:Katsudo textbook) ? http://erin.ne.jp (This webside contains videos of the skits, various exercises to study Japanese, and many pictures, quizzes and games to understand Japanese culture.)

Prerequisite

NIL

Control Systems - ED2040

Approved Details

Description

Objectives: To provide a basic understanding of the concepts and techniques involved in designing control schemes for dynamic systems. Learning Outcomes: At the end of this course, one should: 1). possess in-depth knowledge of concepts from classical control theory, 2). have an exposure to state space representation of dynamic systems and analysis, 3). analyze dynamic systems for their stability and performance, and 4). design controllers (such as Proportional-Integral-Derivative) based on stability and performance requirements.

Course Content

Introduction and basic definitions; Mathematical preliminaries – complex variables, Laplace transform, ordinary differential equations; Mathematical modeling of dynamic systems; Introduction to transfer function; Introduction to state space representation; Analysis of transient response of first and second order linear time invariant systems; Typical feedback system, common control actions; Notion of Bounded-Input-Bounded-Output stability, Routh-Hurwitz stability criterion; Performance Specifications; Root locus analysis and control system design based on it; Analysis of steady state response, Non-minimum phase systems; Frequency response analysis – Introduction, Bode plots, Nyquist plots and Nichols plots, Nyquist stability criterion, Relative stability – gain and phase margins, Control system design via frequency response – lead, lag and lag-lead compensation techniques; Experimental determination of transfer function; Tuning of PID controllers; Case studies. Laboratory experiments: control of DC motor, magnetic levitation, multi-tank flow system, inverted pendulum, gyroscope, electro-pneumatic systems and sensors.

TextBooks

K. Ogata, Modern Control Engineering, Prentice Hall.

Reference Books

1). G. Franklin, J.D. Powell, and A. Emami-Naeini, Feedback Control of Dynamic Systems, Prentice Hall. 2). B. C. Kuo, Automatic Control Systems, Prentice Hall. 3). E. I. Umez-Eronini, System Dynamics and Control, Thomson Engineering.

Prerequisite

NIL

Aesthetics in Design - ED3040

Approved Details

Description

• Cultivate a critical eye toward contemporary art and design • Provide students with the practical knowledge and critical skills necessary to effectively consider visual design as an important and inevitable component of their work. • Identify user needs, develop scenarios, and build user experience frameworks around a given topic.• Students will walk away from this class informed about branding system and portfolio design. • This course is about understanding visual art and design concepts.

Course Content

UNIT- I– Art and Design History, Neuroesthetics – (Theory)UNIT- II–Drawing for design using Gestalt principles (Practical) UNIT- III– User-centered Empathic design, Interaction design (Practical)UNIT- IV-, Graphic identity and Branding, Design Narrative (Theory and Practical)UNIT –V- Contemporary art and design (Practical and Presentation)

TextBooks

• The Design of Everyday Things: Don Norman, Basic Books, New York, 2013• Universal Principles of Design: 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach through Design, William Lidwell, Kristina Holden, and Jill Butler Sketching, Rockport pub, 2010.

Reference Books

• Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design, Morgan Kaufman, 2007• Dan Roam, The Back of the Napkin: Solving Problems and Selling Ideas with Pictures, Portfolio Hardcover, 2008• Darlie Koshy, Indian Design Edge: Strategies for success in the creative economy, Lotus Collection, 2008• Graham Collier, Form, Space, and Vision: Discovering Design Through Drawing, Prentice hall• John Berger, Ways of Seeing, Penguin Books Ltd, 2008RELATED READING:• 21st Century Design: New Design Icons from Mass Market to Avant-Garde, by Marcus Fairs• Designing Interactions, by Bill Moggridge• Drawing for Designers, by Alan Pipes• Sketching: Drawing Techniques for Product Designers, by Koos Eissen• Super Normal: Sensations of the Ordinary, by Naoto Fukasawa• Thoughts on Interaction Design, by Jon Kolko

Prerequisite

NIL

Design of Thermal and Fluid Systems - ED4040

Approved Details

Description

To introduce fundamental aspects of thermal and fluids design and associated principles. Lectures will be augmented with laboratory sessions.

Course Content

Case studies in thermal and fluid analysis. Fundamentals of Thermodynamics - System & Control volume, Property, State & Process, Exact & Inexact differentials; Work - Thermodynamic definition of work; examples, Displacement work, Path dependence of displacement work and illustrations for simple processes, Fully resisted, partially resisted and unresisted process, Definition of thermal equilibrium, Zeroth law, Definition of temperature and temperature scales, Heat - Definition; examples of heat/work interaction in systems. First Law - Cyclic & Non-cyclic processes, Concept of total energy E, Enthalpy and internal energy; Second law - Definitions of direct and reverse heat engines - Definitions of thermal efficiency and COP, Kelvin-Planck and Clausius statements, Definition of reversible process, Internal and external irreversibilities, Carnot cycle, Absolute temperature scale; Entropy - Clausius inequality, Definition of entropy S Description of fluid motion – Kinematics. Conservation of mass, momentum and energy – Balance laws Constitutive equations; Navier -Stokes equations; Solutions in simple flows Hydrostatics Introduction and Classification of Fluid Machines – Analysis of Turbo machinery flows – Performance characteristics of turbo machines Introduction to CFD. Heat Transfer: Conduction – General Conduction Equation – One dimensional Steady state conduction- Fins and Extended Surfaces – Transient conduction of lumped and distributed systems. Convection: Boundary Layers – dimensionless group for convection – Forced Convection – Laminar flow in a pipe – flow over cylinders, spheres Elements of free convection Turbulent flow in pipes Introduction to the analysis of heat exchangers Elements of Radiative Heat Transfer Laboratory experiments to include aspects of flow control and measurement, material property measurement, pneumatics and hydraulics. CFD laboratory.

TextBooks

1. Fox and McDOnald, Introduction to Fluid Mechanics, Fifth Edition, John Wiley, 2003. 2. S.P. Venkatesan, A First Course in Heat Transfer, ANE Books, 2004.

Reference Books

1. P. Kundu, I Cohen and D. Dowling, Fluid Mechanics, Fifth edition, Associated Press, 2015 2. J.P. Holman, Heat Transfer, Tenth edition, McGraw Hill, 2016

Prerequisite

NIL

Design of Mechanical Systems 2 - ED4060

Approved Details

Description

To introduce fundamental aspects of kinematics and component design. Lectures will be augmented with laboratory sessions.

Course Content

Case studies in Rigid body analysis and deformable body analysis. Introduction to basic concepts and definitions: machines, linkages and mechanisms; types of links and joints; concept of degree-of-freedom of planar and spatial linkages. Kinematic analysis: position, velocity and acceleration analysis of planar mechanisms, with specificexamples such as the slider-crank mechanism, four-bar mechanisms, six-bar mechanisms, quick-return and dwell mechanisms, etc. Synthesis: synthesis of four-bar mechanisms for function generation, path generation, and rigid-body guidance; synthesis of six-bar mechanisms for dwell; specific examples in synthesis of mechanisms for solving practical problems; case studies. Statics: Principle of virtual work; concept of transmissibility and mechanical advantage in mechanisms; study of the IC engine, and toggle devices. Dynamics: Formulation of the equation of motion using the Lagrangian concept; dynamic simulation of simple mechanisms such as the slider-crank, four-bar; revisiting the IC engine: dynamic unbalance and shaking forces etc. Concepts of cams: Types of cams; analysis of the motion of the follower in a few cases; synthesis of cams, e.g., reciprocating roller-follower with offset etc. Design of Shafts, keys and couplings. Bearings in Engineering Design – Types and applications. Design of Belt and Chain drives. Concepts of gears: Principle of gearing; types of gears; computation of gear ratios of compound gear trains; epicyclic gears and the automotive differential. Gears Design. Design of Clutches and brakes. Laboratory includes kinematics experiments and Product Design for application of the relevant concepts.

TextBooks

1. Theory of Mechanisms and Machines, by Amitabha Ghosh, Asok Kumar Mallik, East-West Press 3rd Edition. 2. R.L. Norton, Machine Design – An Integrated Approach, Second Edition, Pearson, 2000.

Reference Books

1. R. L. Norton, Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, 3rd Edition, McGrawHill 2. J.R. Shigley and C.R. Mischke, Mechanical Engineering Design, Mc Graw – Hill, 1989.

Prerequisite

NIL

Introduction to Chinese Language - ED4571

Approved Details

Description

Introduction to Chinese language is an introductory course to introduce basic knowledge of Chinese language and Chinese culture to students with NO Chinese learning background.

Course Content

The course will address the problems of pronunciation, character writing and basic daily conversations. By the end of the course, the students should have mastered 200-300 characters, 500 words, which should allow them to carry basic conversations regarding aspects of their daily life. 1.Phonetics pronunciation (initials and finals) and the four tones. 2.Greetings and introducing oneself. 3.Numbers, counting, and money. 4.Forming basic sentences, questions, and phrases regarding aspects of their daily life. The students are expected to be punctual and follow the course guidelines.

TextBooks

Shou-hsin Teng, A Course in Contemporary Chinese (Indian edition), 2021

Reference Books

1.Modern Chinese, 2019 2.Practical Audio-Visual Chinese 3rd edition, 2017

Prerequisite

NIL

Chinese Language II - ED4572

Approved Details

Description

Chinese language ll is a course to introduce more knowledge of Chinese language and Chinese culture to students with SOME (after 50 hours learning) Chinese learning background.

Course Content

The course will address the problems of pronunciation, character writing and basic daily conversations. By the end of the course, the students should have mastered 400-500 characters, 800 words, which should allow them to carry some topics regarding aspects of their daily life. 1.Hobbies. 2.Directions. 3.Forming sentences, questions, and phrases regarding aspects of their daily life.4.TOCFL Examination skills. The students are expected to be punctual and follow the course guidelines.

TextBooks

1.Shou-hsin Teng, A Course in Contemporary Chinese (Indian edition), 2021

Reference Books

1.Modern Chinese, 2019 2.Practical Audio-Visual Chinese 3rd edition, 2017

Prerequisite

NIL

Undergraduate Research Project - ED4901

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Advanced Applications of Human Factors - ED5012

Approved Details

Description

OBJECTIVES: i. Understanding physical and cognitive ergonomics. ii. Developing and using various models to evaluate product and process usability by human. iii. Case studies on application of human factors.

Course Content

Fundamentals of Physical and Cognitive Ergonomics: Muscle and joint loads, and joint kinematics – Bone and soft tissue biomechanics, fundamentals of nerves system, sensation and perception, Engineering psychology, human capability and limits, other influences in human performance. ? Workplace/ Product Design: Force analysis during physical activities, occupational biomechanical models and workplace analysis techniques, demand-resource optimization. * Human Factors and Systems: Human computer Interface and human factors integration. * Case Studies: Cases on human factors applications in manufacturing, transportation (such as automobile, aviation), military and medical systems.

TextBooks

TEXTBOOKS: Occupational Biomechanics by D. B. Chaffin, G. B. L. Andersson, B. J. Martin, Wiley-Interscience, 1999

Reference Books

REFERENCES: * Related cases studies and other peer reviewed publications. * Biomechanics in the Musculoskeletal System by M. M. Panjabi and A. A. White, Churchill Livingstone, 2000. * Human Factors Engineering by C.A. Phillips, John Wiley & Sons, 1999. * Human Factors in Automotive Design, SAE International SP 1591, SAE, Warrendale, USA, 2001. * System safety engineering and risk assessment: A practical approach by Bahr, N., Washington DC, Taylor and Francis; 1997

Prerequisite

NIL

Analytical and Experimental Techniques in Vibration - ED5013

Approved Details

Description

To introduce structural dynamics and the theoretical underpinnings of experimental modal analysis.

Course Content

Mathematical Models of Multidegree of Freedom Systems: Introduction to Hamilton's Principle and Lagrange Equations with applications. Vibration of MDOF Systems – Undamped and Damped Systems, Mode Superposition. Numerical Evaluation of Modeshapes and Frequencies. Direct Integration Methods. Introduction to Experimental Modal Analysis – Procedures and Equipment Modal Parameter Estimation – Basic Modal model equations, SDOF methods – Curve fitting Multidegree of freedom time domain methods – Polyreference least square complex exponential (LSCE) and Eigen system realization (ERA) Multidegree of freedom frequency domain methods – Polyreference least-square complex frequency domain methods (Polymax) Model Validation – Modal scale factor and modal assurance criterion (MAC). Mode participation.

TextBooks

1. Ward Heylen, Stefan Lammens and Paul Sas, "Modal Analysis Theory and Tesing", Katholieke Universiteit, Lueven Publication, 1997. 2. R.R. CraigJr., A.J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley, 2006.

Reference Books

1 M. Geradin and D.J. Rixen "Mechanical Vibrations: Theory and Applications to Structural Dynamics", Third Edition, Wiley, 2015 2 Ewins DJ, "Modal Testing: Theory, Practice and Application, Research Studies Press, Baldock, 2000.

Prerequisite

NIL

Computational Methods in Design - ED5015

Approved Details

Description

To introduce linear and non-linear finite elements to students of design.

Course Content

• Introduction to finite element methods – One dimensional Element and Computational Procedures. Formulation techniques – Variational Methods, Galerkin . • Isoparametric Elements – Formulation. Introduction to non-linear finite elements . Introduction to structural elements. • Introduction to Continuum Mechanics – Measures of strain, stress in finite deformation, Constitutive models. • Variational Description of finite deformation, - Toal Lagrangian and updated Lagrangian methods. • Computational contact mechanics – An introduction. • Case studies in finite elements.

TextBooks

1. R.D. Cook, Concepts and Applications of Finite Element Analysis, Fourth Edition, John Wiley, 2002. 2. O.C. Ziekiewicz, R.L. Taylor and D.D. Fox,, The Finite Element Method, for solid and structural mechanics, Butterworth, 2005. 3. J.N. Reddy, An Introduction to the Finite Element Method, McGraw Hill, 1984.

Reference Books

1. T.J.R. Hughes, The Finite Element Method: Linear Static and Dynamic Analysis, Dover, New York, 2000. 2. G.A. Holzapfel, “Nonlinear Solid Mechanics: A Continuum Approach for Engineering”, Wiley, 2000.

Prerequisite

NIL

Biomedical Micro/Nano Devices and Applications - ED5016

Approved Details

Description

The objective of this course to teach students, how to design and fabricate of advanced Biomedical Micro/Nano Devices including lab on a Chip, Micro total analysis (μTAS) system, Bio-Micro/Nano-Electro-Mechanical Systems (Bio-MEMS/NEMS), Bio-Microfluidics/nanofluidics devices and their potential biomedical applications specially in molecular biology as well as in therapeutics and diagnostics. The current and future prospects of Biomedical Micro/Nano devices towards health benefit with their advantages and limitations will also elaborate.

Course Content

Introduction: Introduction to Bio-Micro/Nano device design, Bio-MEMS/NEMS, Implementation, Bio-Micro/Nano device materials, Applications Device Design and Fabrication: Design and fabrication pathways of Bio-Micro/Nano Devices: System design, : clean room, wafer cleaning, Lithography, Oxidation, wet/dry etching, Silicon wet etching, glass wet etching, Bulk micromachining, surface micromachining, Laser Machining, Laser-assisted etching (LAE), Focused Ion-Beam Milling, Electroplating, Diffusion, Evaporation, sputtering, Chemical Vapor Deposition (CVD), Physical vapor deposition (PVD), plasma enhance chemical vapor deposition (PECVD), low pressure chemical vapor deposition (LPCVD), Ion implantation and etc. Considerations of polymers in Bio-MEMS/NEMS, fabrication processes, micro/nano fluidic devices made by PDMS/PMMA, nanofabrication by replication, nanofabrication by self-assembly. Bio-Micro/Nano Devices in life science: Micro/nano biomedical and fluidic system, biomedical micro/nanofluidic process technology, biomedical sensor system, digital microfluidics, biomedical nanotechnology, microarray biochips, single-molecule manipulation and detection technology, single cell technologies, molecular biology on a chip: genomics, proteomics, nanomedicine and molecular nanotechnology, nanomedical perspective, pathway to nanomedicine. Drug screening (microarray), drug delivery (LOC, μ-TAS), sequencing of bio molecules, in vivo monitoring, biosensors, biological chemical sensors, penetrating neural probes, regeneration neural electrodes, cultured cell systems.

TextBooks

1. Manufacturing Techniques for Microfabrication and Nanotechnology, M.J.Madou, Taylor &Francis, July 2011. 2. From MEMS to Bio-MEMS and Bio-NEMS: Manufacturing Techniques and Applications, M.J. Madou, Taylor & Francis, July 2011. 3. Introduction to Bio-MEMS: Albert Folch, CRC Press, 2013

Reference Books

1. Nanofabrication: Principles, Capabilities and limit, Zheng Cui, Springer, 2008. 2. Handbook of Single Cell technologies, Springer-Nature, Tuhin Subhra Santra and Fan-Gang Tseng, 2022 3. Microsystem Design, Stephen D Senturia, Kluwer Academic Publishers, New York, 2002.

Prerequisite

NIL

Digital Signal Processing for Engineering Design - ED5017

Approved Details

Description

At the end of this course, the student should be able to: 1. Understand and apply the concepts of signals and systems 2. Understand and apply the concepts about linear time-invariant (LTI) systems and its analysis in the frequency domain 3. Understand and apply the Z-transforms and discrete-time Fourier transforms to analyze LTI systems 4. Understand and design the Infinite Impulse Response (IIR) filters and Finite Impulse Response (IIR) filters 5. Applications of digital signal processing (DSP) techniques in Engineering Design

Course Content

i. Signals and Systems: signal classification, continuous-time and discrete-time, standard signals, operation on signals, system classification, analog-to-digital and digital-to-analog conversion ii. Linear time-invariant (LTI) systems, analysis of discrete-time linear time-invariant systems, interconnection of LTI systems, impulse response of an LTI system, convolution integral, graphical convolution, system properties from impulse response, correlation of discrete signals, implementation of discrete-time systems iii. Frequency analysis of continuous-time and discrete-time signals. Fourier series and Fourier transforms. Frequency domain analysis of LTI systems, Z-transforms, Inverse Z-transforms, LTI systems as frequency-selective filters, inverse systems and deconvolution iv. The discrete Fourier transform properties and applications. DFT-FFT algorithms v. Digital filter design-Finite impulse response (FIR), and infinite impulse IIR filters. vi. Applications of DSP in engineering design; Biomedical, robotics and automotive applications.

TextBooks

1. Digital Signal Processing, John G. Proakis and Dimitris G. Manolakis, 4th edition. Pearson Prentice Hall, 2007.

Reference Books

1. Alan V. Oppenheim & Ronald W. Schafer, Discrete-Time Signal Processing, 3rd edition, Prentice Hall Signal Processing Series. 2. Signals and Systems: Oppenheim, Willsky and Nawab (2nd Edn).

Prerequisite

NIL

Business Excellence and Quality Management - ED5018

Approved Details

Description

i. Explain how automotive companies develop business excellence to cope with dynamic globally competitive environment. ii. Explain different models of business excellence in general and TQM in particular iii. Explain how the products are defined and developed to fulfill the stated and latent needs of customer iv. Explain how the Quality of products are ensured through the product life cycle

Course Content

• Highly dynamic and competitive business environment with global players in domestic and international markets. Need to build sustainable competitive advantage. Adopting and evolving business excellence model. Case study of industries adopting TQM as business model will be discussed. • Business excellence models, TQM philosophy, merits and challenges in implementing in Indian context. Evolving enterprise management system and developing culture of business excellence. • Innovation and New product development as the source of competitive advantage and driver of business growth. Defining new products – “Attractive Quality” and “Must be Quality” with deeper insights from target customers. Managing stage-gate process for new product development to deliver the target quality. • Managing Quality of products through life cycle of products, Managing Quality growth – achieving and improving Reliability and durability with active involvement of suppliers.

TextBooks

• Product Development Performance: Strategy, Organisation and Management in the World Auto Industry by Kim B. Clark and Takahiro Fujimoto, Harvard Business School Press, 1991

Reference Books

• Total Quality Essentials: Using Quality Tools and Systems to improve and Manage your business by Sarv Singh Soin, McGraw-Hill Publication, 1998 • Hoshin Kanri : Policy Development for Successful TQM by Yoji Akao, Productivity Press, Cambridge, 1991 • Quality Function Deployment: Integrating Customer Requirements into Product Design by Yoji Akao, Taylor & Francis, 2004 • Introduction to Quality Control by Kaoru Ishikawa, Taylor & Francis, 1990

Prerequisite

NIL

Battery Charging Technology - ED5021

Approved Details

Description

The course is aimed toi. impart knowledge on the fundamentals, the operation and design of battery storage systems ii. equip with the operation of different ways of supplying energy into the batteries iii. lay/develop a foundation for the battery pack and its charging infrastructure design. Learning opportunities will include lectures and industry case studies.

Course Content

Course Contents: i. Energy storage for modern e-mobility systems, an overview of energy storage systems, battery chemistries, characteristics, battery parameters, battery pack sizing and management ii. Battery charging infrastructure, battery charging requirements, charging techniques, electric vehicle supply equipment (EVSE), communication protocols, classification of battery chargers, standards, and battery swapping iii. Onboard and offboard grid interactive chargers, grid code requirements, power factor correction circuits, AC-DC converters, battery interface circuits, standard charger design and case studies of commercially available battery chargers iv. Renewable-based charging, opportunity charging, flash/pantograph charging, wireless power transfer (WPT)-based charging, static and dynamic WPT, operating principle, inductive, and capacitive WPT systems, power conversion systems, compensation circuits, couplers, energy management and solution design List of Experiments: 1. Design and study of a single-phase AC to DC conversion using an uncontrolled rectifier without and with filters 2. Design and study of a three-phase AC to DC conversion using an uncontrolled rectifier without and with filters 3. Design and study of a single-phase PFC rectifier for onboard charging systems 4. Design and study of a battery interface circuit (isolated dc-dc converter) for onboard charging systems 5. Design and study of a three-phase PFC rectifier for off-board charging systems 6. Understanding the communication protocol of Bharat AC or DC and CCS combo plugs 7. Design and performance (efficiency measurement) study of DC to high-frequency AC conversion using a full-bridge inverter with a phase-shifted pulse width modulation 8. Measurement of self and mutual inductance of circular charging pad for wireless charging 9. Study of various compensation circuit topologies for inductive power transfer systems 10. Design and simulation of inductive charging pad using FEA software 11. Design and simulation of a capacitive charging pad using FEA software 12. Design and study of wireless charging system

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN: 97811190636432. Fundamentals of Power Electronics, Robert W. Erickson, and Dragan Maksimovic, 3rd edition, Springer, 2020, ISBN 9783030438791.

Reference Books

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, CRC Press, 2004, ISBN: 9780429128192. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Chris Mi, and M. Abul

Masrur, John Wiley & Sons Ltd, 2nd Edition, 2017, ISBN: 97811189705603. Electric Vehicle Battery Systems, S. Dhameja, Newnes, 2002, ISBN: 0750699167.4. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 3rd Edition, CRC Press, 2021, ISBN: 97803676939305. Power Electronics – Converters, Applications and Design, Mohan N., Underland T.M. and Robbins W.P., 3rd Edition, Wiley publishers, 2007, ISBN 9788126510900

Prerequisite

NIL

Power Converter Design for Electrified Vehicles - ED5023

Approved Details

Description

The course is aimed to impart knowledge of the practical design aspects of power electronic converters in electrified vehicles along with detailed case studies on the traction power converters and battery chargers

Course Content

Course Contents: i. Introduction to electric vehicle architectures and configurations, power processing units and classification, traction power converters, battery management circuits (BMS) circuits and battery chargers ii. Introduction to Si-based power semiconductor devices, wide bandgap (WBG) devices, static and dynamic characteristics, comparison and selection of power semiconductor devices, understanding the datasheet of Si-based and WBG-based devices, commercially available power devices, WBG challenges, protection circuits and gate driver design iii. Power converter components, device selection, capacitor types, capacitor loss model, capacitor selection, snubber circuits, RC/RCD snubbers, device conduction and switching losses, device power loss calculation, thermal modeling, heat sink selection, cooling system design, parasitic management, low-inductance bus bar design, voltage/current sensors, signal conditioning boards, controller design, case studies on traction power converters and battery chargers iv. Magnetic circuit basics, skin effect, proximity effect, high-frequency inductance and transformer design, core and copper loss, selection of core, wireless inductive and capacitive coupler design, planar magnetics, case studies v. Introduction to electromagnetic interference (EMI) and electromagnetic compatibility (EMC), EMI measurements, sources of EMI in power electronics, common mode (CM) and differential mode (DM) noise, EMI filter design vi. PCB design, familiarity with power electronic components, different packages, schematics development steps, layout steps, layout guidelines, case studies

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN: 9781119063643 2. Fundamentals of Power Electronics, Robert W. Erickson, and Dragan Maksimovic, 3rd edition, Springer, 2020, ISBN 9783030438791.

Reference Books

1. Fei (Fred) Wang, Zheyu Zhang, and Edward A. Jones, “Characterization of Wide Bandgap Power Semiconductor Devices”, The Institution of Engineering and Technology, 2018. 2. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009 3. V. Ramanarayanan, course material on switched mode power conversion, ebook, 2007 4. Power Electronics – Converters, Applications and Design, Mohan N., Underland T.M. and Robbins W.P., 3rd Edition, Wiley publishers, 2007, ISBN 9788126510900. 5. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, 4th Ed. Pearson Education, 2017.

Prerequisite

NIL

Medical Equipment Dissection Lab - ED5060

Approved Details

Description

Study of various medical equipment by dissection of these equipments. Understanding the functions, concepts and features of the product in the product design taxonomy.

Course Content

TextBooks

NIL

Reference Books

NIL

Prerequisite

NIL

Design of Monitoring and Diagnostic System (L&P) - ED5070

Approved Details

Description

This course is structured to i) Understand various physiological parameters, biosignals and measurement techniques. ii) Understand advances in biomedical instrumentation: monitoring techniques and evaluation. iii) Present overview of conventional monitoring devices and biosensors. iv) Understand the current need for monitoring and diagnostic systems via interaction with the medical practitioners.

Course Content

i) Introduction – Types of diagnostic systems – Electric, optic, acoustic etc. ii) Monitoring systems – Deployment and requirements. Conventional monitoring devices. iii) Biomedical instrumentation – Acquisition and Processing with examples from ECG, EEG, EMG, Blood pressure, blood flow, oximetry, respiratory system etc. iv) Biosensors – Their application in monitoring and diagnostic equipment, Optics in diagnostic systems. v) Design considerations, concepts and details of equipment for minimally-invasive diagnostics and point-of-care monitoring. Hospital/clinic visits and interaction with the medical practitioners.

TextBooks

i) Joseph J. Carr and John M. Brown: Introduction to Biomedical Equipment Technology, Pearson Education, 2013 (ISBN 9788177588835) ii) Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer: Biomedical Instrumentation and Measurements, Pearson Education India, 2015 (ISBN 9789332556911) ii) R. S. Khandpur: Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 2004 (ISBN 9780071447843)

Reference Books

i) John G. Webster and Amit J. Nimunkar (Eds.): Medical Instrumentation – Applications and Design, Wiley, 2020 (ISBN 9781119457312) ii) James Moore and George Zouridakis: Biomedical Technology and Devices Handbook CRC Press, 2003 (ISBN 9780429061950) iii) Tatsuo Togawa, Toshiyo Tamura and P Ake Oberg: Biomedical Sensors and Instruments, CRC Press, 2011 (ISBN 9781420090789) iv) Joseph D. Bronzino and Donald R. Peterson, The Biomedical Engineering Handbook, CRC Press, 2015 (ISBN 9780429195679)

Prerequisite

NIL

Design of Medical Imaging Systems - ED5071

Approved Details

Description

This is an introductory course on medical imaging systems and is designed to cover the 1. basics of imaging principles and medical imaging signals and systems, and 2. underlying principles of important imaging modalities in radiology.

Course Content

Introduction to medical imaging principles: Linear systems, Fourier transform, transfer function, 1D and 2D signal analysis. Quantification of image quality – resolution, noise, contrast, signal to noise ratio, sampling, artifacts, accuracy. Radiography imaging: Physics of x ray generation and interaction with tissues, system design, signal acquisition and image formation in projection radiography and computed tomography systems, image quality. Nuclear medicine imaging: radioactive decay, system design, signal acquisition and image formation in nuclear medicine, planar scintigraphy and emission computed tomography, image quality. Ultrasound imaging: physics of ultrasound wave generation and propagation in tissue, imaging systems and modes, image formation, image quality. Magnetic resonance imaging: physics of magnetization and nuclear magnetic resonance, MR imaging system design, data acquisition and image formation, image quality.

TextBooks

i) Jonathan M. Links and Jerry L. Prince: Medical Imaging Signals and Systems, Pearson Education India, 2nd edition, 2014

Reference Books

i) Andrew Webb: Introduction to Biomedical Imaging, New Jersey, Wiley, 2nd edition, 2003.

Prerequisite

NIL

Introduction to Motion Planning - ED5215

Approved Details

Description

1. Impart knowledge about the motion planning algorithms for robotic systems2. Learning opportunities will include lectures, assignments, research paper presentations, and individual/group projects3. Gain experience in applications of motion planning algorithms through individual/group projects4. Learn about the current trends in motion planning from research paper presentations

Course Content

1. Planning in a known environment with Stationary obstacles: Potential fields, Dynamic programming, Graph search, Depth-first, Breadth-first, and Djikstra, A*2. Unknown environment and stationary obstacle: Weighted A*, Anytime A*, D* Lite3. Complex high dimensional environment: Sampling-based algorithms, Visibility road maps and randomized trees, graphs: RRT and RRT*4. Realistic robot models: Reed-Shepps Car, Dubins Car, Differential drive robot + kinematic constraints, articulated arms. 5. Planning in presence of uncertainty: MDP based approaches. 6. Planning in the absence of system model: RL based approaches

TextBooks

1. Steven M. LaValle, Planning Algorithms, Cambridge University Press, 2006 2. Principles of Robot Motion: Theory, Algorithms, and Implementations, H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki and S. Thrun, MIT Press, Boston, 2005

Reference Books

1. Research papers will be assigned to individual/groups for presentations throughout the course2. OMPL: Open Motions Planning Library3. Optional: ROS, MoveIt

Prerequisite

NIL

Vehicle Dynamics - ED5220

Approved Details

Description

To understand the dynamics of vehicle for handling and ride

Course Content

Introduction to longitudinal, lateral and vertical dynamics Aerodynamics - Design of vehicle profile for efficient aerodynamics design Tyre mechanics - tyre construction, mechanisms involved in load bearing, rolling resistance, longitudinal force development and lateral force development. Introduction to tyre models Lateral dynamics of road vehicles - Governing equations, bicycle model, concept of stability - understeer gradient, Objective metrics for vehicle handling, objective - subjective correlation, state space approach Vertical dynamics - Governing equations, Forces in vertical dynamics - road profiles and tyre non-uniformities, introduction to random vibration and Ride comfort. Introduction to two wheeler dynamics

TextBooks

1. Gillespie, T. D., 1992. Fundamentals of Vehicle Dynamics, SAE International, Pennsylvania. 2. Wong, J. Y., 1989. Terramechanics and Off road Vehicles", Elsevier Science, Amsterdam.

Reference Books

1. Cossalter Vittore, 2002, Motor Cycle Dynamics, Race Dynamics, Inc. Greendale. 2. Pacejka, H B, Tyre and Vehicle Dynamics, Butterworth – Heinemann, Woburn, MA, 2002.

Prerequisite

NIL

Power Electronics and Motor Drives for Electrified Vehicles - ED5235

Approved Details

Description

The course is aimed to (i) impart knowledge of operation of power electronic converters and electric machines used in automotive applications. (ii). equip with approaches to calculate the performance, efficiency and energy storage requirements for electromechanical propulsion in such applications. (iii). lay/develop a foundation for e-drive system design for electrified vehicles. Learning opportunities will include lectures and industry case studies.

Course Content

i. Introduction to power processing, elements of power electronics, operation of power electronic converters: DC-DC converters (Boost and buck-boost and isolated, interleaved converters), DC-AC converters (single- and three-phase inverters), pulse-width-modulation. (16) ii. Principles of electromechanical energy conversion, traction machines: DC, Induction and permanent magnet AC machines, equivalent circuits, machine specifications, rated and peak operation, characteristic curves, Power-split system operation: Speed and torque relationship lever diagram, operational scenarios (Motor/generator launch, Engine start, Engine ON, Braking) (18)iii: Energy storage, losses and efficiency: Batteries, ultracapacitors, cabling, e-drive component and system efficiency estimations, driving cycle implications (8)

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics andDrives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN:97811190636432. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, Modern Electric, Hybrid Electric, andFuel Cell Vehicles Fundamentals, Theory, and Design, CRC Press, 2004, ISBN 9780429128196

Reference Books

1. Kwang H. Nam, AC Motor Control and Electrical Vehicle Applications: CRC Press, 2018, ISBN97813152001492. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003, ISBN97802030093903. James Larminie, Electric Vehicle Technology Explained, John Wiley & Sons, 2003, ISBN97804708516304. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2005,ISBN 9780824723613

Prerequisite

NIL

Design, Analysis and Control of Robot Manipulators - ED5314

Approved Details

Description

To help the students develop an understanding of the objectives and the process of designing robot manipulators; to teach these concepts through case studies; to teach the application of different control strategies to robot manipulators, and their simulation on a computer.

Course Content

Kinematic and dynamic objectives in design: mobility, workspace, singularities, isotropy and dynamic manipulability; case studies in planar manipulators, e.g., 3-RRR and spatial parallel manipulators, e.g., Gough-Stewart platforms. Control and path-planning: trajectory-tracking control schemes using dynamic models; trajectory-tracking control in the presence of singularities; control schemes in the task-space and the joint space; case studies in planar and spatial parallel manipulators.

TextBooks

a. Ashitava Ghosal, “Robotics: Fundamental Concepts and Analysis”, Oxford University Press (2006)b. Richard M. Murray, Zexiang Li, S. Shankar Sastry, “A Mathematical Introduction to Robotic Manipulation” CRC Press, (1994) c. Jean-Jacques E. Slotine, Weiping Li, “Applied Nonlinear Control”, Prentice Hall (1991)d. Rafael Kelly, Victor Santibanez, Antonio Loria, “Control of Robot Manipulators in Joint Space”, Springer-Verlag (2005)

Reference Books

a. J. P. Merlet, “Parallel Robots”, Kluwer Academic Publishers (2006)b. Suggested publications from journals and conference proceedings

Prerequisite

NIL

Design of Biophotonics Devices - ED5320

Approved Details

Description

The course is structured to i. understand the principles of light-based diagnostics in biomedical areas and therapeutics techniques, ii. understand the design of macroscopic and microscopic optical sensing, imaging systems, laser tweezers and laser-based microtools, iii. provide a multidisciplinary basis for optical instrumentation towards biomedical applications. Learning opportunities will include lectures and design projects.

Course Content

i. Light-tissue interaction, Tissue optical properties, Light sources and detectors, Free-space and optical fiber-based biosensors ii. Spectroscopy-based devices involving ultraviolet, visible and infrared spectroscopy; Raman spectroscopy; Fluorescence spectroscopy; Hyperspectral imaging and bioimaging probes for clinical applications, design of spectroscopy-based clinical systems iii. Optical Coherence Tomography (OCT) systems: time-domain based, frequency-domain based OCT systems; Functional OCT systems: polarization-sensitive OCT device, swept source-based devices, Doppler OCT; Photoacoustic tomography system; design of OCT-based clinical application systems iv. Light-tissue interactions via photochemical, photothermal, and photomechanical techniques, photodynamic therapy devices and applications

TextBooks

1. Paras N. Prasad, Introduction to Biophotonics, Wiley Interscience, 2003 (ISBN: 0471287709) 2. Gerd Keiser, Biophotonics - Concepts to Applications, Springer, 2016 (ISBN: 9789811009433)

Reference Books

1. Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, John Wiley & Sons, 1991 (ISBN: 0471839655) 2. David A. Boas, Constantinos Pitris, Nimmi Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011 (ISBN: 9781420090376) 3. Tuan Vo-Dinh (Editor-in-Chief), Biomedical Photonics Handbook, CRC Press, 2003 (ISBN: 0849311160) 4. Matthew J Baker, Caryn S Hughes, Katherine A Hollywood, Biophotonics: Vibrational Spectroscopic Diagnostics, Morgan & Claypool Publishers, IOP Concise Physics, 2016 (ISBN: 9781681740713) 5. Mark E. Brezinski, Optical Coherence Tomography: Principles and Applications, Elsevier Science and Technology, 2013 (ISBN: 9780123969644) 6. Subhas Chandra Mukhopadhyay, Aime Lay-Ekuakille (Editors), Advances in Biomedical Sensing, Instrumentation and Systems, Springer, 2010 (ISBN: 9783642051661)

Prerequisite

NIL

Science of musical instruments - ED5321

Approved Details

Description

• Introduce the evolutional and scientific aspects of classical musical instruments • Study the acoustics, mechanics, materials and construction of a few selected instruments to understand the achievements of master craftsmen from a modern scientist's perspective

Course Content

• Physics of music – musical scales, Carnatic/Hindustani/Western music and their instruments • Musical instruments – evolution, classification, evaluation, conservation • Materials for musical instruments – tone wood, structure & properties, treatments, glues, varnish, brass, bronze, ceramics, skin, steel/gut strings, characterization techniques • Acoustics of musical instruments – musical sound generation, amplification, spectrum • Mechanics of musical instruments – air/body/string vibrations, analyses • String instruments – veena, sitar, guitar, violins • Percussion instruments – mridangam, tabla, ghatam, drums • Wind instruments – flute, brass • Other types of instruments – bells, unusual instruments

TextBooks

• Fletcher NH, Rossing TD; The physics of musical instruments; Springer, 1998. ISBN: 978-1-4419-3120-7

Reference Books

• Kasliwal S; Classical musical instruments; Rupa & Co, Delhi, 2009. ISBN-13: 978-8129104250 • Campbell DM, et al; Musical instruments: history, technology and performance of instruments of western music; Oxford University Press, 2006. ISBN-13: 978-0199211852 • Montague J; Origins and developments of musical instruments; Scarecrow Press, 2007. ISBN-13: 9780810877702 • Journal & Conference publications (to be presented in the class)

Prerequisite

NIL

Data Science: Theory and practice - ED5340

Approved Details

Description

To equip the students in both theory and practice (through lab sessions) of a few topics in data science.

Course Content

Python basics, Strings, Lists, Tuples, Sets, Dictionaries, Functions, Classes and objects, File input/output.Fundamentals of Optimisation: Single-variable and multi-variable optimisation - Optimality Criteria, Non-gradient and Gradient-based methods in single variable, Contour plots, Unidirectional search, Gradient-based approaches in multi-variable, Constrained Optimisation, Implementation of Optimisation.Machine Learning (ML): Brief introduction, Linear / Polynomial Regression, Logistic Regression (Classification), Regularization, Support vector machines, Clustering, Dimensionality reduction, Manifold learning, 2D/3D Convolution, Introduction to Neural Networks, Evaluation Metrics. Introduction to python libraries - Numpy (ndarray, indexing, slicing and other functions). Matplotlib, Pandas, Scikit-Learn, Implementation of ML.

TextBooks

1) Let us Python, Yashavant Kanetkar and Aditya Kanetkar, First Edition, 2019, BPB Publications 2) Optimization for Engineering Design, - Algorithms and Examples, Kalyanmoy Deb, Second Edition, 2016, PHI 3) Machine Learning Refined: Foundations, Algorithms, and Applications - Jeremy Watt, Reza Borhani, Aggelos K. Katsaggelos, Cambridge University Press, 2nd Edition, 2020

Reference Books

1) Learn Python 3 the Hard Way, Zed A. Shaw, First Edition, 2018, Pearson Education Inc. 2) https://www.w3schools.com/python/ 3) https://scikit-learn.org/stable/ 4) https://matplotlib.org/tutorials/introductory/pyplot.html 5) Data science from scratch - First principles with Python, Joel Grus, O'Reily, 2015 6) Machine Learning, Tom Mitchell, McGrawhill, 1997 7) Introduction to Optimum Design - Jasbir Arora, Academic Press, 2016

Prerequisite

NIL

Powertrain and Fuels - ED5345

Approved Details

Description

The course is aimed to I. Impart knowledge of various powertrains and energy source to power up the automobile. II. Equip with approaches to calculate the performance, efficiency and fuel/energy storage requirements for conventional and electric powertrain. III. Lay/develop a foundation for energy converstion, efficiency, emission and renewables in automobile. Learning opportunities will include lectures and industry case studies.

Course Content

1. Introduction to Powertrains: Internal Combution Engine (ICE), Electric, Hybrid, Linear, Rotatory, Reciprocating machines. 2. Conventional and Renewable Fuels (Energy Sources): Diesel, Petrol, Compressed Natural Gas(CNG), Liquefied Natural Gas (LNG), BioFuels, Compressed air, Electricity, Hydrogen, Electro-Chemical. 3. Electric Vehicle Powertrain and Energy Source: Types of Traction Motors, Types of Battery Energy Storage, Capacitors and the Grid, Energy and Power Management, Types of Fuel Cells. 4. Supply, Storage, Conversion and Management of fuel: Sources, availability, storage techniques, energy conversion, risk and safety. 5. Emerging options in Power Trains and their fuels: Emerging technology, Energy efficiency, Energy conversion, recyclability, availability, Emission and after treatment, Metal Air, Micro Turbines, Rotary Engines. 6. Social and Techno-Economics of Fuels: Each combination to be analysed for Efficiency, Emissions, Costs and Engineering Challenges.

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN: 9781119063643 2. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design, CRC Press, 2004, ISBN 9780429128196

Reference Books

1. David Crolla and Behrooz Mashadi, Vehicle Powertrain Systems:WILEY, 2012, ISBN 9780470666029 2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003, ISBN 9780203009390 3. James Larminie, Electric Vehicle Technology Explained, John Wiley & Sons, 2003, ISBN 9780470851630

Prerequisite

NIL

Electric Vehicle Engineering and Development - ED5350

Approved Details

Description

OBJECTIVES: To provide a basic understanding of Electric Vehicle Engineering and Development process as Practiced in Industry. Course Outcomes: At the end of this course, the student should be able to: 1. Acquire in-depth knowledge of Electric Vehicle Engineering and development process and systems for different types of Electric Vehicles such as 2Wheeler, 3Wheeler, Cars, LCVs, Buses and Trucks. 2. Associate the attributes, functions and translate to engineering specifications, targets. 3. Getting insights onto Product Development process as followed in Industry and understand how the targets are tracked and the Program is managed from the concept stage till Product Launch. 4. Depict the various concepts using simple schematics, and apply concepts learnt in core undergraduate courses to synthesize towards Application Engineering.

Course Content

1. System Engineering, introduction to Electric Vehicle as a system. (2Hrs) 2. Hard point Engineering, vehicle integration _Internal Combustion Engine Vehicle (ICEV)), Electric Vehicles, (EV) Fuel Cell Electric Vehicles (FCEV) (6Hrs) 3. Electric Vehicle architecture, basic packaging, and Introduction to Sensors, electronic control unit (ECU), Electromagnetic interference (EMI) and electromagnetic compatibility (EMC (6 Hrs) 4. Platforms, Modularity, Commonality (2Hrs) 5. Vehicle attributes Quality Function Deployment, Key Buying Factors, translating to Vehicle & aggregates, Variant Tree (4Hrs) 6. Product Development (PD) Process Advanced Product Quality Planning (APQP), Lean Development Process (4Hrs) 7. Design failure mode and effect analysis (DFMEA), Process Failure Mode Effects Analysis (PFMEA) Design Verification and validation Plan (DVVP), Design for Quality, Cost, Manufacturing, assembly, maintenance, service. (4Hrs) 8. Verification, Validation, Testing, Regulatory Requirements, Homologation Process (4Hrs) 9. Supply chain, system partners, concurrent Engineering (2Hrs) 10. Case Studies and Mini Project (4-6Hrs)

TextBooks

1. M. Ehsani, Y. Gao and A. Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 2nd Edition, CRC Press, 2009. 2. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Second Edition, 2018, Wiley India. 3. J. Jiang and C. Zhang, FUNDAMENTALS AND APPLICATIONS OF LITHIUM-ION BATTERIES IN ELECTRIC DRIVEVEHICLES, 2015, John Wiley & Sons Singapore Pte. Ltd

Reference Books

1. AUTOMOTIVE TECHNOLOGY: A Systems Approach, 5th Edition Jack Erjavec, Delmar USA 2. The Automotive Chassis Vol. 2: System Design, Giancarlo Genta • Lorenzo Morello , Springer 2009 3. H-point: The Fundamentals of Car Design and Packaging-Stacey Macey , Stuart Macey Ralph Gilles , Freeman Thomas , Gordon Murray ,- Design Studio Press, 2009. 4. ERGONOMICS in the Automotive Design Process, Vivek D. Bhise. CRC Press USA , 2012 5. HYBRID ELECTRIC VEHICLES Edited by Teresa Donateo – InTech Croatia- 2017 6. Bosch - “Automotive Handbook” - 9th edition - SAE publication 2014.

Prerequisite

NIL

Project I (Industry) - ED5601

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Project II - ED5602

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Project III - ED5603

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Project II - ED5900

Approved Details

Description

Project II

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Introduction to Research - ED6021

Approved Details

Description

Research methodology -Department module

Course Content

NIL

TextBooks

NIL

Reference Books

NIL

Prerequisite

NIL

ID4100 - Creative Engineering Project

Approved Details

Description

NIL

Course Content

NIL

TextBooks

NIL

Reference Books

NIL

Prerequisite

NIL

ID4200 - Creative Engineering Project II

Approved Details

Description

NIL

Course Content

NIL

TextBooks

NIL

Reference Books

NIL

Prerequisite

NIL

Machine Learning for Engineering and Science Applications - ID5030

Approved Details

Description

Recent applications of machine learning have exploded due to cheaply available computational resources as well as wide availability of data. Machine Learning (ML) techniques provides a set of tools that can automatically detect patterns in data which can then be utilized for predictions and for developing models. Developments in ML algorithms and computational capabilities have now made it possible to scale engineering analysis, decision making and design rapidly. This, however, requires an engineer to understand the limits and applicability of the appropriate ML algorithms. This course aims to provide a broad overview of modern algorithms in ML, so that engineers may apply these judiciously. Towards this end, the course will focus on broad heuristics governing basic ML algorithms in the context of specific engineering applications. Students will also be trained to implement these methods utilizing open source packages such as TensorFlow.

Course Content

2. COURSE CONTENTS: Machine learning overview: Qualitative introduction to themes in machine learning – supervised & unsupervised learning, regression, classification, overfitting, regularization, data clustering, dimensionality reduction, decision trees, novelty detection, Bayesian inference. Mathematical and computational preliminaries: Review of probability, statistics and linear algebra, fundamentals of optimization, (Tutorial) popular Machine Learning software and tools Algorithms – Motivations behind various machine learning algorithms. Broad overview of various classes of algorithms – (a) Decision Tree Learning, Random Forests, (b) Support Vector Machines, Multi-category generalization (c) Artificial Neural Networks, Multilayer Perceptron, Back propagation, Deep learning. (d) Bayesian Learning – Maximum Likelihood Estimator, Maximum a-posteriori probability (MAP) estimator, Expectation Maximization, Probabilistic Graphical Models – Hidden Markov Models (e) Genetic algorithms and Evolutionary Strategies (f) Introduction to Reinforcement Learning Applications –Variety of applications would be introduced in the context of the specific algorithms. Applications include aerodynamic shape optimization, inverse problems in engineering and science, data driven discovery of governing equations, turbulence modeling, control of mobile robots, Applied image analysis – medical image reconstruction- X-ray computed tomography, image segmentation, computer vision- image registration.

TextBooks

1. Mitchell, Tom M. Machine learning, McGraw Hill (India) Edition, 2013 2. Goodfellow Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT Press, 2016 3. Bishop, Christopher M, Pattern recognition and Machine Learning, Springer, 2006

Reference Books

BOOKS: 1. Murphy, Kevin, Machine Learning – a Probabilistic Perspective, MIT Press, 2012 2. Duda, Richard O., Peter E. Hart, and David G. Stork. Pattern classification. John Wiley & Sons, 2012. 3. MacKay, David, Information Theory, Inference, and Learning Algorithms, Cambridge University Press, 2003 PAPERS: 1. Parish, Eric J., and Karthik Duraisamy. "A paradigm for data-driven predictive modeling using field inversion and machine learning." Journal of Computational Physics 305 (2016): 758-774. 2. Havaei, Mohammad, et al. "Brain tumor segmentation with deep neural

networks." Medical image analysis 35 (2017): 18-31. 3. Rabiner, Lawrence R. "A tutorial on hidden Markov models and selected applications in speech recognition." Proceedings of the IEEE 77.2 (1989): 257-286. 4. Kutz, J. Nathan. "Deep learning in fluid dynamics." Journal of Fluid Mechanics 814 (2017): 1-4. 5. Kay, Will, et al. "The Kinetics Human Action Video Dataset." arXiv preprint arXiv:1705.06950 (2017). 6. Salimans, Tim, et al. "Evolution strategies as a scalable alternative to reinforcement learning." arXiv preprint arXiv:1703.03864 (2017). 7. Brunton, Steven L., Joshua L. Proctor, and J. Nathan Kutz. "Discovering governing equations from data by sparse identification of nonlinear dynamical systems." Proceedings of the National Academy of Sciences 113.15 (2016): 3932-3937.

Prerequisite

NIL

Project III - ID5692

Approved Details

Description

IDDD-Robotics-Project Phase III

Course Content

TextBooks

Reference Books

Prerequisite

NIL

IDDD EV Project III - ID5992

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Introduction to Robotics - ID6040

Approved Details

Description

This course introduces the electrical, mechanical and computer science concepts as applicable to robotics. This will be a bridge course for the interdisciplinary dual degree program in Robotics.

Course Content

TextBooks

1. Introduction to Robotics: Mechanics and Control, John J Craig, Pearson Education, 20052. Fundamentals of Robotics, Robert J Schilling, Prentice Hall, 19903. Modern Power Electronics and AC Drives, Bimal K Bose, Pearson Education, 20024. Probabilistic Robotics, Sebastian THRUN, Wolfram BURGARD, Dieter FOX, MIT Press, Cambridge, 2006

Reference Books

1. Practical Robot Design, JgannathanKanniah, FlijkertErcan, Carlos A , CRC press, 2013

Prerequisite

NIL

ID6108

July-Nov Semester

Introduction to Computation and Visualization - ED1021

Approved Details

Description

Basic computational techniques are a must as they form very important ingredient for implementation that complement the theory courses. In this course, computational along with visualization techniques are introduced.

Course Content

C environment/Structured programming - C Standard Library, C data types, Operators, Expressions, Control statements (loops, break, exit, goto and continue statements), functions, arrays and pointers, dynamic memory allocation, structures, strings, file processing, basics of linked list and tree data structures. Introduction to OpenGL – OpenGL architecture, OpenGL geometric primitives, Transformations in OpenGL, GLUT programming. Numerical Methods - Round off and truncation errors, order of convergence, bisection, Newton - Raphson methods.

Textbooks

1. V. Rajaraman, Computer Programming in C, Prentice-Hall of India Pvt. Ltd, 2004.2. Yashwant Kanetkar, Understanding pointers in C, BPB Publications, 1997.3. Mason Woo, Jackie Neider, Tom Davis, and Dave Shreiner. 1999. OpenGL Programming Guide: The Official Guide to Learning Opengl, Version 1.2 (3rd ed.). Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA. 4. William Press, Saul Teukolsky, William Vetterling, and Brian Flannery. Numerical Recipes in C (2nd Ed.): The Art of Scientific Computing. Cambridge University Press, New York, NY, USA., 1992.

Reference Books

1. Alfred Aho, John Hopcroft, Jeffrey Ullman, Ritchie, Data Structures and Algorithms, Addison-Wesley,1983.2. Donald Hearn and M. Pauline Baker. Computer Graphics (2nd Ed.): C Version. Prentice-Hall, Inc., Upper Saddle River, NJ, USA., 1996.3. Samuel Conte and Carl De Boor. Elementary Numerical Analysis: An Algorithmic Approach (3rd ed.). McGraw-Hill Higher Education., 1980.4. Brian Kernighan, Dennis Ritchie, The C Programming Language (2nd ed.), Prentice Hall, 1988.5. K. N. King, C Programming: A Modern Approach, W. W. Norton & Company, February 1996.

Prerequisite

NIL

Creative Design - ED1031

Approved Details

Description

Skilled base course which focuses on sketching, drawing, rendering and modelling as a medium for expression and communication. **OBJECTIVES:** • To understand visual form representation in terms of size, scale and overall proportion• Introduction to different media Including computer-based illustration software, tools and instruments to express various materials • To develop the ability to represent images, ideas and concepts based on observations and thinking process• To form a bridge between cr

Course Content

UNIT- I – Basic shapes and forms and their perspective views UNIT- II – Design approach to building up shapes and form UNIT- III – Rendering UNIT- IV - Layouts in design UNIT –V - Three dimensionality of form.

Textbooks

Sketching : Drawing Techniques for Product designers: Koos Eissen Exploring the Basics of Drawing, Vebell, Victoria, (2005), Thomson Delmar Learning, New York. Ching, Francis, D.K., (1990), Drawing: A Creative Process, Van Nostrand Reinhold, New York.Design Graphics, David Fair and Marilyn Kenny, (1987), Hodder and Stougton Ltd., London Graham Collier, Form, Space, and vision: discovering design through drawing, Prentice hall, 1967

Reference Books

3DTotal Publishing, Sketching from the Imagination: An Insight into Creative Drawing, Paperback – Import, 2013 Barber, Barrington and Peter Gray. The Ultimate Drawing Workbook. London: Artcurus Publishing Ltd, 2009.Mulick, Milind. Sketckbook. Pune, India: Jyotsna Prakshan, 2007.Edwards, Betty, Drawing on the right side of the brain, How to unlock your hidden talent, Harper Collins, London, 1992Dawson,Robert and Joan, Ed.,Sculpture with simple materials, Lane books, California, 1972

Prerequisite

NIL

Creative Design - ED1031*

Approved Details

Description

Skilled base course which focuses on sketching, drawing, rendering and modeling as a medium for expression and communication.OBJECTIVES: • To understand visual form representation in terms of size, scale and overall proportion• Introduction to different media Including computer based illustration software, tools and instruments to express various materials • To develop the ability to represent images, ideas and concepts based on observations and thinking process• To form a bridge between cr

Course Content

UNIT- I – Basic shapes and forms and their perspective viewsUNIT- II – Design approach to building up shapes and form UNIT- III – Rendering UNIT- IV - Layouts in designUNIT –V - Three dimensionality of form.

TextBooks

Sketching : Drawing Techniques for Product designers: Koos EissenExploring the Basics of Drawing, Vebell, Victoria, (2005), Thomson Delmar Learning, New York.Ching, Francis, D.K., (1990), Drawing: A Creative Process, Van Nostrand Reinhold, New York.Design Graphics, David Fair and Marilyn Kenny, (1987), Hodder and Stougton Ltd., London Graham Collier, Form, Space, and vision: discovering design through drawing, Prentice hall, 1967

Reference Books

3DTotal Publishing, Sketching from the Imagination: An Insight into Creative Drawing, Paperback – Import, 2013 Barber, Barrington and Peter Gray. The Ultimate Drawing Workbook. London: Artcurus Publishing Ltd, 2009.Mulick, Milind. Sketckbook. Pune, India: JyotsnaPrakshan, 2007.Edwards, Betty, Drawing on the right side of the brain, How to unlock your hidden talent, Harper Collins, London, 1992Dawson,Robert and Joan, Ed.,Sculpture with simple materials, Lane books, California, 1972

Prerequisite

NIL

Form and Aesthetics in Design II - ED1034

Approved Details

Description

• The course focuses on observation, critical and visual thinking and processes related to form and aesthetics in design • To develop a design process with systematic and creative thinking through brain-storming, problem perception, clustering of ideas, exploratory concept development and refinement

Course Content

• Contemporary Design processes using analogous models, sketches, CAD iterations, Systems thinking and simple algorithms • Critical thinking and analysis of one's work ethics and craftsmanship • Introduction to non-western aesthetics • Free Form Surface Design • Creative approach to form incorporating analysis of a problem statement and its solution, creatively giving rise to multiple options

TextBooks

Ching, Francis, D.K. Drawing: A Creative Process. New York: Van Nostrand Reinhold, 1990. Johnson.s. Jason and Vermillion. Joshua, ed, Digital Design Exercises for Architecture students, New York: Routledge, 2016

Reference Books

1. Edwards, Betty; New Drawing on the Right Side of the Brain, Publisher: Tarcher; 2002 2. Lidwell, William; Holden, Kritina; Butler, Jill; Universal Principles of Design, Rockport Publishers, 2003 3. Demers, Owen; Digital Texturing & Painting, Publisher: New Riders Press; Bk & CD-Rom edition, 2001 4. Gail Greet Hannah, Elements of Design, Publisher: Princeton Architectural Press, 2002 5. Itten, Johannes; The Art of Color: The Subjective Experience and Objective Rationale of Color, Publisher: Wiley Publications,1997 6. Pogany, Willy; The Art of Drawing, Publisher: Madison Books, 1996 7. Kepes, Gyorgy; Language of Vision, Publisher: Dover Publications, 1995 8. Elam, Kimberly; Geometry of Design: Studies in Proportion and Composition, Publisher: Princeton Architectural Press, 2001 9. Lawlor, Robert; Sacred Geometry: Philosophy and Practice (Art and Imagination), Publisher: Thames & Hudson, 1989 10. McKim, Robert; Experiences in Visual Thinking, Publisher: Brooks/Cole Publishing Company, 1980

Prerequisite

NIL

Japanese Language - ED1091

Approved Details

Description

This course is intended for beginners who are interested in Japanese language and culture. The objective of this course is to develop the listening and speaking skills along with the competence in non-verbal aspects as well as cultural understanding.

Course Content

The course focuses on the following • Introduction to the Japanese Scripts - Hiragana, Katakana. Practice reading and writing of the Hiragana and Katakana alphabets and introduction to few Kanji characters. • Introduction to basic grammar and structure of Japanese verbs, adjectives and adverbs. Various sentence patterns required to establish the basic conversation • Pronunciation & Intonation ? Hiragana & Katakana ? Vocabulary relating to the daily life, work and play etc. • Classroom activities for ? Exchange greetings in culturally appropriate manner with the pronunciation, intonation. ? To be able to introduce one self. ? Short composition.

TextBooks

The following text book will be followed during the course MARUGOTO,Nyûmon A1 Katsudô(introduction A1, Activity), Japan Foundation

Reference Books

? http://www.marugotoweb.jp/(a website where users can learn about Japanese language and culture) ? http://words.marugotoweb.jp/mylist_top.php?lv=A1&lang=en (List of vocabulary (along with audio)of various topics mentioned in Marugoto:Katsudo textbook) ? http://erin.ne.jp (This webside contains videos of the skits, various exercises to study Japanese, and many pictures, quizzes and games to understand Japanese culture.)

Prerequisite

NIL

Japanese Language II - ED1092

Approved Details

Description

This course aims at enabling the students to acquire basic four skills, i.e., listening, speaking, reading and writing in the Japanese language. This course will also help in improving knowledge about Japanese culture. Students will be able to learn Kanji characters (100-180 numbers).

Course Content

i) Understanding of sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). ii) Communication in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. iii) Description in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need. iv) Recognition and use of 100 - 180 kanji characters. This includes writing and reading practice.

TextBooks

“Marugoto: Japanese Language and Culture” Elementary 1 A2 (by Japan Foundation) 1) Part I: Course Book for Communicative Language Activities, ISBN978-4-384-05755-3 C0081 (published in India by GOYAL Publishers & Distributers Pvt. Ltd.) 2) Part II: Course Book for Communicative Language Competences, ISBN978-4-384-05754-6 C0081 (published in India by GOYAL Publishers & Distributers Pvt. Ltd.)

Reference Books

Digital Audio Files: Elementary 1 (A2) Activities: https://www.marugoto.org/en/download/elementary1_a/ Elementary 1 (A2) Competences: https://www.marugoto.org/en/download/elementary1_c/ Marugoto Plus: http://www.marugotoweb.jp/ Drama: http://a2.marugotoweb.jp/en/challenge_drama/ Vocabulary: http://words.marugotoweb.jp/mylist_top.php?lv=A2-1&lang=en Listening: http://a2.marugotoweb.jp/en/listening/ Grammar: http://a2.marugotoweb.jp/en/grammar/ Kanji: http://a2.marugotoweb.jp/en/kanji/ JLPT Website: http://www.jlpt.jp/e/index.html

Prerequisite

NIL

Design of Mechanical Systems 1 - ED2011

Approved Details

Description

To introduce fundamental aspects of mechanics and failure analysis. Lectures will be augmented with laboratory sessions

Course Content

Case studies in failure analysis of mechanical components. Basic concepts of stress and strain; Mohr's circle, principal stresses and strains, Elasticity (elastic deformation, generalized Hooke's law, basic equations of elasticity for plane elasticity problems; elastic constants and their relations; strain energy, membrane stresses in thin and thick cylinders and simple shells, thin walled pressure vessels), torsion (torsion of circular shaft, close coiled helical springs; torsion of thin walled open and closed sections and non-circular sections)Bending Moment and Shearing Force (definitions and conventions, shear and moment equations, bending moment and shearing force diagrams), classical beam theory (bending stresses in beams; various cross-sectional shapes of beams; shear stresses in beams; unsymmetrical bending and shear center; deflection of beams; double integration of governing differential equation), strain energy methods (Castigliano's theorem, applications).Introduction to failure in mechanical design and basic concepts of reliability; Structure of common engineering materials, their classification based on bonding, influence of structure on mechanical properties.Classes of failure: plasticity (stress-strain curve, mathematical descriptions of elasticity and plasticity, yield criteria, constitutive properties), visco-elasticity (stress-strain response of polymers, frequency and temperature dependence, Maxwell and Voigt models, storage and loss moduli, time-temperature superposition), fracture (Griffith analysis, stress intensity factor, energy release rate, leak-before-break, cyclic crack growth), Fatigue, creep, design for surface integrity (Engineering models for wear, design guidelines for wear)Laboratory consisting of experiments on solid mechanics and materials failure in ductile and brittle materials; impact; fracture and creep testing.

TextBooks

1. J. M. Gere, D. E. Goetsch, and B. Goodno, Strength of Materials, Cengage Engineering, 20102. R. Balasubramaniam, Callister's Materials Science And Engineering Wiley-India, 2007

Reference Books

1. W. A. Nash and N. Mallik, Strength of Materials (Schaum's Outline Series, special Indian edition), Tata McGraw-Hill, 20052. B. C. Punmia, A. K. Jain and A. K. Jain, Mechanics of Materials, Laxmi Publications, 20013. M. F. Ashby and D. R. H. Jones, Engineering Materials 1: An introduction to properties, applications and design, 3rd edition, Butterworth-Heinemann, 2005

Prerequisite

NIL

Manufacturing Processes - ED2012

Approved Details

Description

This course will be an introduction to the principles of various manufacturing processes. It will present both primary and secondary operations with emphasis on casting, bulk deformation, sheet metal, cutting and additive processes.

Course Content

Manufacturing Process Overview – primary and secondary processes, basis for selecting manufacturing processes. Fundamentals of Metals Casting – solidification, structure and an overview of different metal casting processes and applications. Fundamentals of Bulk Deformation Process – forging, extrusion and rolling. Sheet Metal Forming – formability of sheet metals and processes such as shearing, deep drawing and stretch forming. Metal Cutting Operations for producing various shapes and surface integrity – turning, milling, drilling, reaming, tapping etc. Additive Manufacturing Processes – Introduction to 3D printing technologies such as Direct Metal Deposition (DMD) and Selective Laser Sintering (SLS). Engineering Metrology – measurement of roughness, profile, and other attributes of finished parts for achieving good integrity.

TextBooks

Roy A. Lindberg, “Processes and Materials of Manufacture,” Prentice-Hall of India, 1990. 2. SeropeKalpakjian and Steven Schmid, “Manufacturing, Engineering and Technology,” Prentice Hall, 2006. 3. SeropeKalpakjian and Steven Schmid, “Manufacturing Processes for Engineering Materials,” Prentice Hall, 2003.

Reference Books

• Milton Shaw, “Metal Cutting Principles”, MIT Press, 1960

Prerequisite

NIL

Manufacturing Processes - ED2012*

Approved Details

Description

This course will be an introduction to the principles of various manufacturing processes. It will present both primary and secondary operations with emphasis on casting, bulk deformation, sheet metal, cutting and additive processes.

Course Content

Manufacturing Process Overview – primary and secondary processes, basis for selecting manufacturing processes. Fundamentals of Metals Casting – solidification, structure and an overview of different metal casting processes and applications. Fundamentals of Bulk Deformation Process – forging, extrusion and rolling. Sheet Metal Forming – formability of sheet metals and processes such as shearing, deep drawing and stretch forming. Metal Cutting Operations for producing various shapes and surface integrity – turning, milling, drilling, reaming, tapping etc. Additive Manufacturing Processes – Introduction to 3D printing technologies such as Direct Metal Deposition (DMD) and Selective Laser Sintering (SLS).Engineering Metrology – measurement of roughness, profile, and other attributes of finished parts for achieving good integrity.

TextBooks

Roy A. Lindberg, “Processes and Materials of Manufacture,” Prentice-Hall of India, 1990.2. SeropeKalpakjian and Steven Schmid, “Manufacturing, Engineering and Technology,” Prentice Hall, 2006.3. SeropeKalpakjian and Steven Schmid, “Manufacturing Processes for Engineering Materials,” Prentice Hall, 2003.

Reference Books

• Milton Shaw, “Metal Cutting Principles”, MIT Press, 1960

Prerequisite

NIL

Geometric Modelling and CAD - ED2090

Approved Details

Description

This course is aimed at introduce the mathematical foundation and the software skills of the students in the domain of geometric modelling and CAD.

Course Content

Introduction – CAD/CAM process, tools and applications Computer Hardware – System, Standards for system evaluation, input and output devices. CAD/CAM software: Overview- Solid modeler, surface modeling and drafting. Geometric Modelling: Space curves – Bezier and B-Spline curves, Surfaces – Description and Generation. Mathematical Representation of Solids – B-rep, CSG, solid manipulations. Data Exchange in CAD/CAM systems.

TextBooks

I. Zeid, CAD/CAM Theory and Practice, Tata McGraw hill, 2001. 2. D.F. Rogers and J.A. Adams, Mathematical Elements for Computer Graphics, McGraw-Hill, 1990.

Reference Books

1. J.Hoschek and D. Lasser, Computer Aided Geometric Design, AK Peters, 1993.

Prerequisite

NIL

Analog and Digital Electronics - ED2130

Approved Details

Description

To introduce fundamental aspects of analog and digital circuit design for electronic system design and instrumentation. Lectures will be augmented with laboratory sessions.

Course Content

Linear circuit theory. Network theorems and analysis. Frequency and transient analysis of first and second order systems. Diode operation and application circuits. Bipolar junction transistor (BJT) operation, design of logic gates, amplifiers and oscillators. Operational amplifier and application circuits. Active filter design. Binary Systems. Boolean Algebra and Logic Gates. Simplification of Boolean Functions. Combinational Logic. Combinational Logic with MSI and LSI. Sequential Logic. Registers, Counters, Memory Unit. Register Transfer Logic. Processor Logic Design. Control Logic Design. Laboratory sessions: Transient and frequency domain analysis of passive circuits, design of wave shaping circuits using diodes, design of logic gates, amplifiers and oscillators using BJT, opamp application circuits. Analog filter design. Verification of Boolean logic gates, combinational and sequential logic design, counter design using flip flops, registers.

TextBooks

1. Anant Agarwal, Jeffrey H. Lang, "Foundations of Analog and Digital Electronics", Morgan Kaufmann, ISBN-10: 1558607358. 2. Albert Malvino and David Bates, “Electronic Principles”, Tata McGraw Hill, ISBN-10: 0070634246. 3. Morris M. Mano, “Digital Logic and Computer Design”, Pearson, ISBN-10 817758409X:.

Reference Books

1. Jacob Millman, Christos Halkias, Chetan D. Parikh, "Millman’s Integrated Electronics - Analog and Digital Circuits and Systems", Tata McGrawHill, ISBN-10: 0070151423. 2. Albert Malvino, Jerald Brown, “Digital Computer Electronics”, Tata McGraw Hill, ISBN-10: 0074622358.

Prerequisite

NIL

Sculpting for Design - ED2142

Approved Details

Description

This course offers a unique opportunity for engineering students to develop their creativity, problem-solving, and communication skills while exploring the fascinating world of sculpture. By integrating artistic practices with engineering principles, this course can foster innovative thinking and inspire new approaches to design and problem-solving across various engineering disciplines. To introduce students from diverse engineering disciplines to the fundamental principles and practices of sculpting as a creative design tool. To foster critical thinking, problem-solving, and spatial reasoning skills through hands-on sculpting experiences. To enhance creativity, innovation, and aesthetic appreciation across engineering domains. To develop communication and teamwork skills through collaborative sculpting projects. To provide a unique and engaging learning experience that bridges the gap between technical and artistic disciplines.

Course Content

Module 1: Introduction to Sculpture for Design Understanding sculpture for design Definition, history, and evolution of sculpture. Different types of sculpture: Additive (modeling, assembling), Subtractive (carving), Casting. Sculpture and Design Thinking: The role of sculpture in the design process. Generating ideas, exploring forms, and developing concepts through sculpting. Applying sculptural principles to problem-solving in engineering. Safety in the Sculpture Studio: Tool safety, material handling, and studio etiquette. Module 2: Basic Sculpting Techniques Modeling: Introduction to basic modeling materials: Clay (oil-based, water-based), wax, plaster. Hand-building techniques: Pinch pots, coil building, slab building. Armatures and supports: Constructing internal structures for stability. Carving: Introduction to basic carving materials: Soap, wood, foam. Basic carving tools and techniques: Chisels, gouges, rasps. Assemblage: Creating sculptures using found objects and recycled materials. Exploring different assemblage techniques: Gluing, welding, wiring. Module 3: Exploring Form and Function Abstraction and Representation: Exploring abstract and representational forms. Simplifying complex forms and identifying essential elements. Form and Function in Design: Analyzing the relationship between form and function in everyday objects. Designing sculptures that incorporate functional elements. Applying sculptural principles to the design of engineering systems. Biomimicry and Nature: Exploring natural forms and structures for inspiration. Applying biomimicry principles to design solutions. Module 4: Collaborative Projects Team-based projects: Collaborative sculpting projects that integrate diverse perspectives and skills. Developing and presenting project proposals. Project planning, execution, and evaluation. Communication and Teamwork: Effective communication within a team. Conflict resolution and decision-making. Project management and time management skills. Module 5: Sculpture and Technology Digital Sculpture: Introduction to 3D modeling software (e.g., Blender, Tinkercad). Creating digital sculptures and translating them into physical forms. Rapid prototyping and 3D printing. Sculpture and Engineering Applications: Case studies of how sculpture has been used in engineering and design (e.g., industrial design, architecture, aerospace). Exploring the use of sculpting techniques in prototyping and rapid prototyping.

TextBooks

1. Slobodkin, Louis, Sculpture: Principles and Practice (1973), Dover Publications, New York

Reference Books

1. Lanteri, Edouard (1985), Modeling and Sculpting the Human Figure, Dover Publication Inc, New York 2. Liebson, Milt (2001), Direct Stone Sculpture: A Guide to technique and creativity, Dover Publications, New York 3. Cobb, Sunshine (2018), Mastering Hand Building: Techniques, Tips and Tricks for Slabs, Coils, and More (Mastering Ceramics), Voyageur Press, Minnesota, US 4. Farag, Mahmoud M (2020), Materials and Processes of Contemporary Sculpture, Cambridge Scholars Publishing, Newcastle upon Tyne, UK

Prerequisite

NIL

Human Factors in Design (L&P) - ED3010

Approved Details

Description

The course objectives are to understand Fundamentals of human body (physical and cognitive) limits and performance Influence of human factors in product and system design Tools to evaluate usability and human performance

Course Content

History: Cultural perspectives on human productivity, evolution of Human performance evaluation and enhancements. Human Body: Anthropometry, Fundamentals of Musculo-skeletal system biomechanics, force analysis during bending, lifting, carrying, Cognitive psychology, sensation and perception, human limits and differences. Workplace/ Product Design: Engineering psychology, demand-resource optimization, environmental influence on human performance, manufacturing process design, Human computer Interface and human factors integration. Human Factors and Systems: Human factors in transportation systems (such as automobile, aviation) and medical systems. Laboratory: Physiological and psychophysical tools for human performance evaluation, case studies and design projects on human factors.

TextBooks

Biomechanics in the Musculoskeletal System by M. M. Panjabi and A. A. White, Churchill Livingstone, 2000. Human Factors Engineering by C.A. Phillips, John Wiley & Sons, 1999. Occupational Biomechanics by D. B. Chaffin, G. B. L. Andersson, B. J. Martin, Wiley-Interscience, 1999.

Reference Books

Textbook of Medical Physiology by A. C. Guyton and J. E. Hall, Saunders, 10E, 2000 Clinical Biomechanics of the Spine by A. A. White and M. M. Panjabi, JB Lippincott Company, 1990. Biomechanics – Motion, Flow, Stress, and Growth by Fung Y.C., Springer-Verlag, 1990 Human Factors in Engineering and Design by Mark S. Sanders and Ernest J. McCormick, McGraw-Hill, 1992 Human Performance Engineering – A Guide for System Designers by Robert W. Bailey, Prentice-Hall, 1982 Human Factors in Automotive Design, SAE International SP 1591, SAE, Warrendale, USA, 2001. Human Engineering, Design Criteria Standard, MIL-STD-1472F, Department of Defense, USA, 1999 System safety engineering and risk assessment: A practical approach by Bahr, N., Washington DC, Taylor and Francis; 1997

Prerequisite

NIL

Introduction to Chinese Language - ED4571

Approved Details

Description

Introduction to Chinese language is an introductory course to introduce basic knowledge of Chinese language and Chinese culture to students with NO Chinese learning background.

Course Content

The course will address the problems of pronunciation, character writing and basic daily conversations. By the end of the course, the students should have mastered 200-300 characters, 500 words, which should allow them to carry basic conversations regarding aspects of their daily life. 1.Phonetics pronunciation (initials and finals) and the four tones. 2.Greetings and introducing oneself. 3.Numbers, counting, and money. 4.Forming basic sentences, questions, and phrases regarding aspects of their daily life. The students are expected to be punctual and follow the course guidelines.

TextBooks

Shou-hsin Teng, A Course in Contemporary Chinese (Indian edition), 2021

Reference Books

1.Modern Chinese, 2019 2.Practical Audio-Visual Chinese 3rd edition, 2017

Prerequisite

NIL

Chinese Language II - ED4572

Approved Details

Description

Chinese language ll is a course to introduce more knowledge of Chinese language and Chinese culture to students with SOME (after 50 hours learning) Chinese learning background.

Course Content

The course will address the problems of pronunciation, character writing and basic daily conversations. By the end of the course, the students should have mastered 400-500 characters, 800 words, which should allow them to carry some topics regarding aspects of their daily life. 1.Hobbies. 2.Directions. 3.Forming sentences, questions, and phrases regarding aspects of their daily life.4.TOCFL Examination skills. The students are expected to be punctual and follow the course guidelines.

TextBooks

1.Shou-hsin Teng, A Course in Contemporary Chinese (Indian edition), 2021

Reference Books

1.Modern Chinese, 2019 2.Practical Audio-Visual Chinese 3rd edition, 2017

Prerequisite

Nil

Undergraduate Research Project - ED4901

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Energy Storage Devices and Systems - ED5011

Approved Details

Description

To be upload

Course Content

To be upload

TextBooks

To be upload

Reference Books

To be upload

Prerequisite

NIL

Design Thinking Strategies for Road Safety - ED5022

Approved Details

Description

This course is designed to provide a design thinking approach to understand and solve various issues related to road safety for vehicle and road engineering. This course gives an overview of policy planning and systems approach to road safety. A user centric approach to adopt various technologies and engineering aspects for road safety is presented to give a broad-spectrum view, and details of implementing interventions in a multi-sector/ multi-stakeholder environment. This course will aim to achieve the following goals: 1. Provide tools for creative problem solving in various environments using a design thinking approach. 2. Understand various issues that affect safety of all users on roads. 3. Learn from case studies various approaches for implementing and utilizing road safety stack active and passive road safety initiatives.

Course Content

1. Methods and Tools: Understanding Design Thinking; Developing a systems approach to problem solving using RBG Innovation Paradigm (RIP) for problem solving. 2. Introduction to Road Safety: Understanding Transportation Safety Framework (TSF) and 5E model for road safety; Data-driven multi-sectoral approach to road safety – Establishing and using an integrated Road Accident Database (iRAD/ eDAR); Global & National Road Safety scenario; Economic loss on account of Road Crashes and their implications; Road Safety Policy: Developing a Road Safety Policy; Road safety education; Road safety for vulnerable road users; Road safety management strategies. 3. Road Safety Measures: Road safety in an urban and rural environment; Traffic safety and human behaviour; Active and passive measures to prevent road crashes; Standardization of vehicle and Road Engineering 4. Road safety planning and Traffic Control: Systems approach to road safety; Establishing and Integrating Trauma care with Road Safety Planning; Integration of safety into traffic management schemes; Traffic Signages; Traffic calming and local speed intervention. 5. Case Studies: Case Studies on road safety.

TextBooks

1. Road Safety Fundamentals: Concepts, Strategies, and Practices that Reduce Fatalities and Injuries on the Road, Carter, Daniel; Gelinne, Dan; Kirley, Bevan; Sundstrom, Carl; Srinivasan, Raghavan; Palcher-Silliman, Jennifer; 2017. US DOT 2. Lecture Notes and Handouts.

Reference Books

1. Handbook of Transportation Engineering, Volume II: Applications and Technologies, Myer Kutz. Second Edition (McGraw-Hill Education: New York, Chicago, San Francisco, Lisbon, London, Madrid, Mexico City, Milan, New Delhi, San Juan, Seoul, Singapore, Sydney, Toronto, 2011). 2. Traffic Safety and Human Behaviour, David Shinar, Emerald Publishing, 2017 3. Catalogue of IRC Publications. https://www.irc.nic.in/WriteReadData/LINKS/Catalagoue%20July227c819d46-11d4-479d-b6f7-2e92bb3526c5.pdf 4. Road Safety Audits, Wilson, Eugene M., and Martin E. Lipinski. E´tats-Unis: National Cooperative Highway Research Program, 2004. 5. State practices for local road safety: A synthesis of highway practice, Seri Park, Patrick McTish, et. al, Transportation Research Board, 2016 6. Integrated Automotive Safety Handbook, Ulrich W. Seiffert, Mark Gonter. SAE International, R-407, ISBN 978-0-7680-6437-7, 2014. 7. Human factors guidelines for road systems, Campbell, J. L., Richard, C.

M., & Graham J. Transportation Research Board, 2008 8. Trauma Biomechanics – Accident Injury in Traffic and Sports; Kai-Uwe Scmitt, Peter F. Niederer, Markus H. Muser, Felix Walz, ISBN 978-3-540-73872-5 9. Road Safety Audits, Wilson, Eugene M., and Martin E. Lipinski. E´tats-Unis: National Cooperative Highway Research Program, 2004. 10. Human Factors in Transportation: Social and Technological Evolution Across Maritime, Road, Rail, and Aviation Domains (1st ed.). Di Bucchianico, G., Vallicelli, A., Stanton, N.A., & Landry, S.J. (Eds.), 2016. 11. Transport Planning and Traffic Engineering, Coleman A. O'Flaherty, Butterworth-Heinemann, 1997 12. Highway Capacity Manual, Transportation Research Board, 2000. 13. Indian Highway Capacity Manual (Indo - HCM), CSIR - Central Road Research Institute, New Delhi, 2017 14. Biomechanics in the musculoskeletal system. New York: Churchill Livingstone. Panjabi, M.M. and White, A.A., 2001. 15. Traffic & Highway Engineering, Nicholas J. Garber, Lester A. Hoel, Cengage Learning, 2008.

Prerequisite

NIL

Power Converter Design for Electrified Vehicles - ED5023

Approved Details

Description

The course is aimed to impart knowledge of the practical design aspects of power electronic converters in electrified vehicles along with detailed case studies on the traction power converters and battery chargers

Course Content

Course Contents: i. Introduction to electric vehicle architectures and configurations, power processing units and classification, traction power converters, battery management circuits (BMS) circuits and battery chargers ii. Introduction to Si-based power semiconductor devices, wide bandgap (WBG) devices, static and dynamic characteristics, comparison and selection of power semiconductor devices, understanding the datasheet of Si-based and WBG-based devices, commercially available power devices, WBG challenges, protection circuits and gate driver design iii. Power converter components, device selection, capacitor types, capacitor loss model, capacitor selection, snubber circuits, RC/RCD snubbers, device conduction and switching losses, device power loss calculation, thermal modeling, heat sink selection, cooling system design, parasitic management, low-inductance bus bar design, voltage/current sensors, signal conditioning boards, controller design, case studies on traction power converters and battery chargers iv. Magnetic circuit basics, skin effect, proximity effect, high-frequency inductance and transformer design, core and copper loss, selection of core, wireless inductive and capacitive coupler design, planar magnetics, case studies v. Introduction to electromagnetic interference (EMI) and electromagnetic compatibility (EMC), EMI measurements, sources of EMI in power electronics, common mode (CM) and differential mode (DM) noise, EMI filter design vi. PCB design, familiarity with power electronic components, different packages, schematics development steps, layout steps, layout guidelines, case studies

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN: 9781119063643 2. Fundamentals of Power Electronics, Robert W. Erickson, and Dragan Maksimovic, 3rd edition, Springer, 2020, ISBN 9783030438791.

Reference Books

1. Fei (Fred) Wang, Zheyu Zhang, and Edward A. Jones, “Characterization of Wide Bandgap Power Semiconductor Devices”, The Institution of Engineering and Technology, 2018. 2. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009 3. V. Ramanarayanan, course material on switched mode power conversion, ebook, 2007 4. Power Electronics – Converters, Applications and Design, Mohan N., Underland T.M. and Robbins W.P., 3rd Edition, Wiley publishers, 2007, ISBN 9788126510900. 5. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, 4th Ed. Pearson Education, 2017.

Prerequisite

NIL

Human Anatomy, Physiology & Biomechanics - ED5040

Approved Details

Description

TO introduce the basics of human anatomy, physiology and biomechanics to engineering students

Course Content

Introduction to systemic Anatomy, anatomicomedical terminology.The Skeletal System – classification of bones, structure, joints. Muscular system.Anatomy of thorax, abdomen, pelvis and perineum, back, lower and upper limb, head andneck. Physiology of Cardiovascular, respiratory, gastrointestinal etc.Introduction to biomechanics – Bio solid mechanics, fluid mechanics.

TextBooks

1. A.C. Guyton and J.E. Hall, Textbook of Medical Physiology, Elsevier, 20052. K.L. Moore and A.F. Dalley, Clinically Oriented Anatomy, Lippincott 19993. J.D. Humphrey and S.L. Delange, An Introduction to Biomechanics, Springer 2004

Reference Books

J. D. Bronzino Biomedical Engineering Handbook, CRC and IEEE Press, Boca Raton,FL, 2000

Prerequisite

NIL

Structural & Component Design of Vehicles - ED5050

Approved Details

Description

To introduce concepts of Mechanism of Methods for vehicle design

Course Content

History of development of automotive structures Architecture of automotive structure, force flow diagrams, concept of Simple Structural Surfaces, unsymmetric bending, open section under torsion, buckling of shell structure and beams, post yield behaviour and its application to automotive structure Bending and torsional stiffness of automotive structure Finite element modelling of auto components and structures including introduction to commercial software ABAQUS and case studies. Design for crashworthiness. Application of explicit FEM to crash Design of body structure for noise and vibration

TextBooks

1. J.C. Brown, A.J. Robertson, S.T. Serpento, Motor vehicle structures, Butterworth Heinemann Publishers, Oxford, England, 2002. 2. H. Heisler, Vehicle and Engine Technology, 2nd Edition, Arnold, 1999 3. D.E. Malen, Fundamentals of automobile structure design, SAE, 2020

Reference Books

1. J. Fenton, Handbook of vehicle Design Analysis, SAE International, 19962. J. Pawlowski, Vehicle body Engineering, Business Books, 19693. J. Happian-Smith, An introduction to modern vehicle, 2nd Edition, Butterworth - Heinemann, 2000

Prerequisite

NIL

Electromagnetic Compatibility for Product Design - ED5052

Approved Details

Description

To introduce fundamental behavior of analog circuit components and their non-ideal behavior in a system with emphasis on product design, and EMC directives for compliance aspects of electronic products

Course Content

Non ideal behavior of electronic components: Fundamental behavior of electrical systems. General formulation of electric circuit theory. Limitations of Kirchoff's law. Signals and spectra. Internal impedance of circuit elements. External impedance of circuit elements. Low and high frequency behavior. Equivalent circuits of resistor, inductor and capacitor.Radiated emissions: Common and differential mode currents. Radiated electric fields due to common and differential mode currents. Emission models for differential mode currents. Current probes. Two wire transmission lines and radiated immunity.Conducted emissions: Line impedance stabilization network. Common and differential mode currents. Power supply filters. Power supplies. Conducted immunity.Electronics system design principles: Capacitive and inductive coupling. Techniques for electric and magnetic coupling reduction. Shield terminations. Shielding effectiveness. Introduction to electrostatic discharge (ESD). ESD protection.Hands on laboratory sessions on understanding EMC concepts and test methods taught in the lectures.

TextBooks

1. Introduction to Electromagnetic Compatibility, P. R. Clayton, Wiley India Pvt. Ltd., ISBN13: 9788126528752, ISBN 10:8126528753, 2006.2. EMC for Product Designers, T. Williams, Elsevier Science, ISBN-10: 0750681705, ISBN-13: 9780750681704, 2007.

Reference Books

1. Lecture notes.

Prerequisite

NIL

Mechatronics System Design - ED5080

Approved Details

Description

To provide an overview of the amalgamation of mechanical and electrical sciences that constitutes mechatronics. Outcomes: At the end of this course, one should – have understanding of various electro-mechanical systems, – have an exposure to design and analysis of mechatronics system

Course Content

Introduction to the field of mechatronics; Mechatronics systems; Mechatronics design approach; Modeling electromechanical system; Introduction to sensors, actuators and their characteristics; Introduction to micro-electromechanical-system, Physical system modeling and simulation ; Micro-fabrication techniques ; Smart instrumentation system; Mechatronics-based embedded system design; smart product design. Case studies relevant to the field of Mechatronic systems and applications, case studies. Laboratory experiments include exercises in interfacing sensors, actuators, drive control system to microcontrollers; Opto-mechatronics; Mechatronics design project.

TextBooks

W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education, New Delhi, 2003, ISBN: 81-7758-284-4.

Reference Books

1) C. W. De Silva, Mechatronics: An Integrated Approach, CRC Press, New York, 2005, ISBN: 0-8493-1274-4. 2) H. Hosaka, Y. Katagiri, T. Hirota, and K. Itao, Micro-Optomechatronics, Marcel Dekker, New York, 2005, ISBN: 0-8247-5983-4. 3) G. Gerlach, W. Dötzel, and D. Müller, Introduction to Microsystem Technology, John Wiley & Sons. Ltd., West Sussex, 2008, ISBN: 978-0-470-05861-9. 4) R. H. Bishop (Ed.), The Mechatronics Handbook: Mechatronic Systems, Sensors, and Actuators: Fundamentals and Modeling, CRC Press, New York, 2008, ISBN: 978-0-8493-9258-0.

Prerequisite

NIL

Fundamentals of Automotive Systems - ED5160

Approved Details

Description

OBJECTIVE: To provide a basic understanding of the various systems of a typical automobile. Course Outcomes: At the end of this course, the student should be able to: 1. acquire in-depth knowledge of the various systems of an automobile, 2. associate the functions of each system with its design and layout, 3. depict the various systems using simple schematics, and 4. apply concepts learnt in core undergraduate courses to synthesize mathematical models of the various systems.

Course Content

1. Introduction and Overview – History of automobiles and an overview of a modern car. 2. Engines – Components of Internal Combustion (IC) engines, Types of engines and their operation, Engine cycles, Air standard cycle analysis, Combustion process and mixture requirements in Spark Ignition (SI) and Compression Ignition (CI) engines, Engine knocking, Engine testing and performance characterization, Emissions. 3. Drivelines – Clutches, Manual Transmission, Transmission matching. 4. Steering System – Classification, Mechanism, Steering geometry, Wheel alignment. 5. Suspensions – Components and types of suspension, Suspension analysis. 6. Brake Systems – Principles, Components and Dynamics, Antilock Brake System (ABS). 7. Electric and Hybrid Electric Vehicles – Overview, Topologies, Component sizing. 8. Introduction to Tyres. 9. Laboratory – Engine testing and analysis, modules on suspension, steering, brake, ABS, air conditioning, fuel injection and ignition, and automatic transmission.

TextBooks

1. R. Stone and J.K. Ball, Automotive Engineering Fundamentals, SAE International, 2004.

Reference Books

1. K. Newton, W. Steeds and K. Garrett, The Motor Vehicle, Butterworths, 1989. 2. D. B Astow, G. Howard and J. P. Whitehead, Car Suspension and Handling, SAE International, 2004. 3. R. Limpert, Brake Design and Safety, SAE International, 1992. 4. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill, 2007. 5. M. Ehsani, Y. Gao and A. Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 2nd Edition, CRC Press, 2009.

Prerequisite

NIL

E-Mobility Lab – 1 - ED5211

Approved Details

Description

The objectives of this course are: 1. To enable hands-on knowledge of important aspects of electric vehicles and their sub-systems such as power electronics and energy storage systems 2. To develop a correlation between theory and practice of electric vehicle subsystems through simulations and physical experiments. At the end of the course, the student will be able to 1. Analyze the operation and design of various EV subsystems in power electronics and energy storage systems. 2. Acquire simulation, testing and debugging skills of these subsystems.

Course Content

Module I: Power Electronics Lab 1. Design and performance analysis of non-isolated DC-DC converters: Buck converter, Boost converter, and Buck-boost converter. 2. Design and performance analysis of isolated DC-DC converters: Forward converter and Flyback converter. 3. Design and performance analysis of Two-phase interleaved boost converter. 4. Design and performance analysis of DC-AC three-phase voltage source inverter. 5. Comparative study of Pulse-width modulation (PWM) techniques: 120- and 180-degree conduction modes, Sinusoidal PWM, and Space Vector PWM. 6. Models for real inductors and capacitors: Measurement of parasitics and resonant frequency. 7. Study of switching characteristics of various power devices and gate drive circuit functionalities. Module II: Battery Engineering Lab 1. Charge-discharge test of Li-ion cell for the capacity analysis (SOC estimation). 2. Hybrid pulse power characterization tests of the battery module 3. Protection tests of the battery module 4. Study on battery management systems and cell balancing circuits 5. SoC estimation of the battery pack using a battery cycler. 6. Mechanical characterization (static and dynamic Analysis) of bus-bars in battery packs. 7. Electrochemical impedance spectroscopy (EIS) tests of a Li-ion cell.

TextBooks

Reference Books

Prerequisite

NIL

Power Electronics and Motor Drives for Electrified Vehicles - ED5235

Approved Details

Description

The course is aimed to (i) impart knowledge of operation of power electronic converters and electric machines used in automotive applications. (ii). equip with approaches to calculate the performance, efficiency and energy storage requirements for electromechanical propulsion in such applications. (iii). lay/develop a foundation for e-drive system design for electrified vehicles. Learning opportunities will include lectures and industry case studies.

Course Content

i. Introduction to power processing, elements of power electronics, operation of power electronic converters: DC-DC converters (Boost and buck-boost and isolated, interleaved converters), DC-AC converters (single- and three-phase inverters), pulse-width-modulation. (16) ii. Principles of electromechanical energy conversion, traction machines: DC, Induction and permanent magnet AC machines, equivalent circuits, machine specifications, rated and peak operation, characteristic curves, Power-split system operation: Speed and torque relationship lever diagram, operational scenarios (Motor/generator launch, Engine start, Engine ON, Braking) (18)iii: Energy storage, losses and efficiency: Batteries, ultracapacitors, cabling, e-drive component and system efficiency estimations, driving cycle implications (8)

TextBooks

1. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics andDrives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons, 2017, ISBN:97811190636432. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, Modern Electric, Hybrid Electric, andFuel Cell Vehicles Fundamentals, Theory, and Design, CRC Press, 2004, ISBN 9780429128196

Reference Books

1. Kwang H. Nam, AC Motor Control and Electrical Vehicle Applications: CRC Press, 2018, ISBN97813152001492. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003, ISBN97802030093903. James Larminie, Electric Vehicle Technology Explained, John Wiley & Sons, 2003, ISBN97804708516304. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2005,ISBN 9780824723613

Prerequisite

NIL

Algorithms in Computational Geometry - ED5310

Approved Details

Description

This course aims in introducing fundamental and extremely useful concepts in computational geometry. It also aims to showcase relation between a few machine learning concepts to computational geometry.

Course Content

Brief introduction to data structures and algorithms: Complexity, trees, graphs, divide and conquer, incremental and greedy algorithms. Classical art gallery problem in a polygon - Max over min formulation, triangulation, three-colouring, art-gallery variants. Extension to Polyhedra as well as Curved domains, partitioning of a polygon and their algorithms Convex hull (CH) in two and three dimensions - Concepts of convexity, Algorithms - gift-wrapping, Graham scan, quick hull, incremental, divide and conquer. Extension to curved domains. Voronoi diagram (VD) - Closest point VD and Delaunay triangulation (DT). Algorithms - Incremental, Divide and conquer and Fortune's, Farthest point VD, higher order VD, Medial axis, Alpha hull and shape, Extension to lines, circles and higher order curved domains. Minimum spanning tree, Kruskal's algorithm, Traveling salesman problem, Dijkstra Shortest path algorithm and Visibility graphs, minimal enclosures (ME) - circle, sphere, ellipse, ellipsoids. Geometry and machine learning - Relationship of CH, VD, ME to Support vector machines (SVM), Principal component analysis (PCA), Brief theory on Manifolds, manifold learning algorithms.

TextBooks

1. Computational Geometry in C, Joseph O'Rourke, Cambridge University Press, 19982. Differential geometry of curves and surfaces, Monfredo P. do Carmo, Prentice Hall,1976

Reference Books

1. Computational Geometry: Algorithms and Applications, Mark de Berg, Otfried Cheong, Marc van Kreveld, and Mark Overmars, Springer-Verlag, 2008. 2. Curves and surfaces for CAGD, Gerald Farin, Morgan Kaufmann Publishers Inc., 20023. Computational Geometry: An Introduction, Franco P. Preparata and Michael Ian Shamos, Springer, 1985 4. Art gallery theorems and algorithms, Joseph O'Rourke, Oxford University Press, 1987 5. Differential geometry of curves and surfaces, Monfredo P. do Carmo, Prentice Hall,1976 6. Machine Learning Refined - Foundations, Algorithms, and Applications, Jeremy Watt, Reza Borhani and Aggelos Konstantinos Katsaggelos, Cambridge University Press, 2020

Prerequisite

NIL

Introduction to Field and Service Robotics - ED5315

Approved Details

Description

Objectives: Introduce the theory and applications of field and service robots Outcomes: Basic understanding of the kinematics and dynamics of field and service robots. Appreciate the role of sensing and perception in the design of autonomous robots.

Course Content

Field and service robots: Classification, applications, sensing and perception, social and ethical implications of robotics. Autonomous Mobile robots: Kinematics, locomotion, perception, motion planning and control, localization and mapping; Intelligent unmanned vehicles. Underwater robots: Kinematics and dynamics, modeling and simulation, navigation, guidance and control. Aerial robots: Basics of aerial robots, sensors and actuators, modelling and control of small Unmanned Aerial vehicles, guidance and navigation of small range aerial robots, Autonomous indoor flight control. Medical Robots: Tele-operated surgical robots, haptics for tele-operation, design and control.

TextBooks

1. R Siegwart, I. R. Nourobakhsh, Introduction to Mobile robotics, MIT Press, Cambridge, 2004. TJ211.415.S54 2004 2. Jacob Rosen, Blake Hannaford, Richard M. Satava (Eds), Surgical Robotics: Systems, Applications and Vision, Springer, 2011. ISBN 978-1-4419-1125-4 3. G. Antonelli: Underwater Robots, 2nd Edition, Springer-Verlag, BerlinHeidelberg, 2006 4. KenzoNonami, FaridKendoul, Satoshi Suzuki, Wei Wang, Daisuke Nakazawa, Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles, Springer, 2010, ISBN 978-4-431-53855-4

Reference Books

1. Ollero, Aníbal; Maza, Iván (Eds.) Multiple Heterogeneous Unmanned Aerial Vehicles,: Springer Tracts in Advanced Robotics, Vol. 37 2007, ISBN: 978-3-540-73957-9 2. B Scicilliano, O Khatib (Eds), Handbook of Robotics, Springer, 2008

Prerequisite

NIL

Control of Automotive Systems - ED5330

Approved Details

Description

Objectives: 1. To provide a basic understanding of the concepts and techniques involved in designing control schemes for automotive systems. 2. To provide an experience on designing such schemes through case studies. Learning Outcomes: At the end of this course, one should 1. possess in-depth knowledge of concepts from modern control theory, 2. have an exposure to nonlinear control, 3. analyze automotive systems for their stability and performance, and 4. design controllers for automotive traction, braking, steering and suspension.

Course Content

Mathematical Preliminaries – Review of complex variables, Laplace transforms, linear algebra and ordinary differential equations. Brief review of classical control theory – Transient response and frequency response of linear time invariant systems, Root locus, Bode and Nyquist plots, Stability criterion. Introduction to state space approach – Motivation, Canonical representations and solutions, Stability analysis, Controllability and Observability, Control design based on state space approach, Observers, Introduction to Lyapunov function based analysis. Case Studies: Control of brake, steering, suspension and other vehicular systems.

TextBooks

1. U. Kiencke and L. Nielsen, Automotive Control Systems: For Engine, Driveline, and Vehicle, 2nd Edition, Springer, 2005. 2. Rajesh Rajamani, Vehicle Dynamics and Control, Springer, 2006.

Reference Books

1. J. Y. Wong, Theory of Ground Vehicles, 4th Edition, John Wiley & Sons, Inc., 2008. 2. J. J. E. Slotine and W. Li, Applied Nonlinear Control, Prentice Hall, Inc., 1991. 3. T. Kailath, Linear Systems, Prentice Hall, Inc., 1980. 4. R. F. Stengel, Optimal Control and Estimation, Dover Publications, Inc., 1994. 5. K. Ogata, Modern Control Engineering, 3rd Edition, Prentice Hall, Inc., 1997.

Prerequisite

NIL

Energy Storage and Conversion Systems - ED5361

Approved Details

Description

This course is structured to equip students with both theoretical knowledge and practical skills necessary for energy storage system development and management. The primary objectives of the course: i) To provide a deep understanding of the thermodynamics, electrochemical reaction kinetics, and material properties underlying various energy storage systems, such as batteries and fuel cells alongside the electrostatics of super capacitors and ultra super capacitors. ii) To enable students to design, model, and analyze energy storage systems for E-mobility applications. iii) To enable students to develop and implement energy management strategies for onboard energy storage systems, optimizing efficiency, performance, and longevity in real-world applications.

Course Content

1. Thermodynamics – Application of first law energy conservation in battery and chemical to electrical energy conversion, application of second law and entropy in energy loss due to irreversibility, and thermodynamic efficiency. 2. Electrochemistry – Key electrochemical principles, such as redox reaction, electrode potentials, and Nerst equation. Ion transport and reaction kinetics-Butler Volmer equation. Electrochemical impedance spectroscopy for battery analysis. 3. Li-ion battery cells – a) Anode materials, such as traditional graphite and emerging materials like silicon b) Cathode materials, such as NMC, LFP, etc., and their impact on energy density, cycle life, and thermal stability. Cell degradation mechanism and material improvements. 4. Battery pack design – Mechanical design, stress structural integrity, packaging, safety features (cooling channel design and vibration tests). Electrical design (state of charge, state of health estimation techniques, battery management systems, and battery modeling). Thermal management strategies including liquid cooling, phase change materials, and passive cooling. 5. Ultracapacitor – Principles of energy storage in ultracapacitor (double-layer capacitance and pseudo-capacitance), energy and power densities compared with batteries. Application of ultracapacitor in electrified vehicles. 6. Fuel cells – Proton exchange membrane fuel cells, Solid oxide fuel cells, and Direct methanol fuel cell and their basic principle of energy conversion. Fuel sources (Hydrogen, methanol) and electrochemical reactions. Efficiency, power output, and fuel cell modeling. Challenges of fuel cell implementation. 7. Hybrid energy storage system – Combination of batteries, ultracapacitors, and fuel cells to fulfill different energy and power demands. Energy management control algorithms and sizing for such hybrid storage system. 8. Case Studies on Li ion Battery Pack- Performance Analysis & Safety, SoC Prediction through Data Driven AI/ML techniques.

TextBooks

i) Rahn, Christopher D., and Chao-Yang Wang. Battery systems engineering. John Wiley & Sons, 2013 (ISBN: 9781119979500). ii) Newman, John, and Nitash P. Balsara. Electrochemical systems. John Wiley & Sons, 2021 (ISBN: 9780471477563) iii) Larminie, James, Andrew Dicks, and Maurice S. McDonald. Fuel cell systems explained. Vol. 2. Chichester, UK: J. Wiley, 2003 (ISBN: 9780768012590) iv) Robert, A. Huggins. Energy Storage: Fundamentals, Materials and Applications. Spinger, 2016 (ISBN: 9783319331089) v) Huggins, Robert. Advanced batteries: materials science aspects. Springer Science & Business Media, 2008 (ISBN: 9780387764238) vi) Hand book of Li ion Battery Pack Design, John T. Warmer, Elsevier, Second Edition, 2024, (ISBN-13 ? : ? 978-0443138072).

Reference Books

i) Daniel, Claus, and Jürgen O. Besenhard, eds. Handbook of battery materials. John Wiley & Sons, 2012 (ISBN: 9783527326952) ii) O'hayre, Ryan, et al. Fuel cell fundamentals. John Wiley & Sons, 2016 (ISBN: 9781119113805) iii) Osaka, Tetsuya, and Madhav Datta. Energy storage systems in electronics. CRC Press, 2000 (ISBN: 9789056991760) iv) Oldham, Keith, and Jan Myland. Fundamentals of electrochemical science. Elsevier, 2012 (ISBN: 9780125255455) v) Din, Ibrahim, Halil S. Hamut, and Nader Javani. Thermal management of electric vehicle battery systems. John Wiley & Sons, 2016 (ISBN: 9781118900246)

Prerequisite

NIL

Foundations to Electric Vehicle Technology - ED5370

Approved Details

Description

This course is structured to provide input on the foundation of electric vehicle technology. The course is structured i) To provide a basis for understanding topics concerning mechanics, thermodynamics, fluid mechanics, electrical and electronics, and mechatronics topics. ii) To understand hybrid and electric vehicle architectures, transmission systems, and energy management. iii) To present an overview of interdisciplinary topics concerning electric vehicle technology.

Course Content

Hybrid and Electric Vehicle: internal combustion vehicle (ICV) versus hybrid electric vehicle (HEV) versus electric vehicle, electric vehicle topology and architecture, powertrain and transmission systems, brake systems, vehicle development. Automotive sensors and instrumentation, mechatronics systems and components, actuators, automotive networking and bus systems. Mechanical Sciences: Thermodynamics laws and their application, irreversibility and energy, introduction to vehicle dynamics, tractive effort, vehicle chassis and body design, power steering, tyres, brakes, transmission systems, stress-strain relations and viscosity, mass and momentum balance, flow through pipe. Heat Transfer Mechanisms Heat transfer, heating and cooling systems and applications to the powertrain. OR Electrical Sciences: Network analysis, network theorems, electromagnetism, Faraday's law of electromagnetism, transformers, analog circuits, operational amplifiers, digital circuits, digital controllers and their applications to the powertrain.

TextBooks

i) Per Enge, Nick Enge and Stephen Zoepf: Electric Vehicle Engineering, McGraw Hill, 2021 (ISBN 978126046078) ii) Mehdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi: Modern Electric Hybrid Electric & Fuel Cell Vehicles, CRC Press, 2019 (ISBN 9780367137465) iii) James D. Halderman and Curt Ward: Electric and Hybrid Electric Vehicles, Pearson Education, 2023 (ISBN: 9789356066281) iv) William Crouse and Donald Anglin: Automotive Mechanics, McGraw Hill Education, 2017 (ISBN: 9780070634350) v) William Bolton: Mechatronics: Electronic Control Systems In Mechanical and Electrical Engineering, Pearson Education, 2023 (ISBN: 9789357052849)

Reference Books

i) Iqbal Husain: Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2021 (ISBN 9780367693930) ii) William Ribbens: Understanding Automotive Electronics: An Engineering Perspective, Butterworth-Heinemann Inc., 2017 (ISBN: 9780128104347) iii) James Larminie and John Lowry: Electric Vehicle Technology Explained, John Wiley & Sons, 2012 (ISBN: 9781119942733) iv) Konrad Reif (Editor): Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics, Springer Nature, 2015 (ISBN: 9783658039745) v) R. Bosch GmbH: Automotive Handbook, Wiley Blackwell, 2022 (ISBN: 9781119911906)

Prerequisite

NIL

Data Visualization for Engineers - ED5518

Approved Details

Description

Introduce students to the use of graphical methods for data analysis, from an analytics perspective. The course will introduce a formal thought process on graphing data to communicate information and to learn its structure, towards decision making

Course Content

Data to visualization: Types of data, scale, nonlinear axes and coloursBasics: Introduction to statistics, optimization and regressionHistory of visualization: Early maps and diagrams, measurement and theory, modern statistical graphicsTypes of plots: Quantile plots, Scatter plots, Box plots, Histograms, Stem and leaf diagrams, Parallel coordinate plots, Heat map, Nested axis plots, Violin plots, Self organizing maps, t-distributed Stochastic neighbour embedding and RadvizData's structure: Understanding correlation, sensitivity analysis and factor effectsApplications: Assess regression models, Design space exploration, Reduced order modelling, Clustering, Explainable AI, Anomaly detection, graphical optimization, Pareto front visualization and Data storytelling

TextBooks

Chambers, J. M. (2018). Graphical methods for data analysis. CRC Press.Cook, R. D. (2009). Regression graphics: Ideas for studying regressions through graphics. John Wiley & Sons.

Reference Books

Grant, R. (2018). Data visualization: Charts, maps, and interactive graphics. CRC Press.Wilke, C. O. (2019). Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media.

Prerequisite

NIL

Project III - ED5603

Approved Details

Description

Course Content

Text Books

Reference Books

Prerequisite

NIL

Medical Image Analysis - ED6001

Approved Details

Description

Understand theory & practice for medical image analysis : Imaging modalities Image processing pipeline Segmentation Registration Image analysis Machine learning Algorithms Established methods and recent trends

Course Content

Preliminaries: Applied digital image processing, Medical imaging modalities, Image processing software tools. Segmentation: Description as a partitioning methodology, Segmentation by thresholding, Connected component analysis, Region based methods, Texture segmentation, Atlas based segmentation, Boundary based methods, Extension to 3D image stacks, Evaluation of segmentation algorithms. Registration : Description, Coordinate systems, Subject and Atlas space, Coordinate transforms, Rigid body reg

Text Books

Insight into Images: Principles and Practice for Segmentation, Registration, and Image Analysis, Terry S. Yoo, AK Peters (Editor), 1st edition (2004), ISBN : 1568812175.

Reference Books

Handbook of Medical Imaging : Processing and Analysis, Second Edition (Academic Press Series in Biomedical Engineering), Issac Bankman, Academic Press, 2nd edition (2008), ISBN: 0123739047 Medical Image Registration (Biomedical Engineering), Joseph V. Hajnal (Editor), Derek L.G. Hill (Editor) and David J. Hawkes (Editor), CRC, 1st Edition (2001), ISBN: 0849300649. Machine Vision, Wesley E. Snyder and Hairong Qi, Cambridge University Press (2004), ISBN: 052183046X.

Prerequisite

NIL

Optimization methods in Engineering Design - ED6002

Approved Details

Description

To introduce fundamentals of optimization techniques and prepare students to solve unconstrained and constrained engineering optimization problems.

Course Content

Fundamentals of optimization with single objective. Classical optimization methods. Unconstrained optimization, univariate, direct search and gradient based methods. Constrained optimization, Kuhn-Tucker conditions, sensitivity analysis, direct search methods, feasible direction and gradient projection methods. Interactive design optimization with constraint corrections. Special techniques like Geometric programming and genetic algorithms. Metamodelling techniques such as regression, krigging, radial basis function to approximate objective and constraint functions. Introduction to multi objective optimization and pareto optimality.

TextBooks

1. Introduction to optimum design, J S Arora, Elsevier India Pvt. Ltd., 2004. 2. Engineering Design via Surrogate Modelling: A practical Guide, A I J Forrester, A Sobester and A J Keane, Wiley, 2008

Reference Books

1. Optimization for engineering design: algorithms and examples, Kalyanmoy Deb, Prentice Hall of India Pvt. Ltd., 2005.

Prerequisite

NIL

Mechanics of Robots - ED6007

Approved Details

Description

To provide the students a foundation in the kinematics and dynamics of robots, primarily serial manipulators, such that they can model these mathematically and simulate on a computer through their own codes; to prepare them for follow-up courses on control, path-planning, and design.

Course Content

Spatial motion of robot links: types of joints in serial robots; descriptions of link orientation, in terms of Euler angles, Rodrigue's parameters, rotation matrices and quaternions; homogeneous transformations; DH parameters. Kinematic analysis: forward and inverse kinematics of planar and spatial robots, up to 6-DoF wrist-decoupled spatial robots; introduction to singularities. Velocity and acceleration analysis of robot manipulators: forward and inverse velocity Jacobian matrices and their physical significance; concept of velocity ellipse with applications to the understanding of singularities and kinematic isotropy. Dynamics of robots: inertia of the robot links; formulation of the equation of motion via the Lagrangian approach; forward and inverse dynamic simulations of spatial 6-DoF serial robots.

TextBooks

1. John J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall, 2003 2. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2006

Reference Books

1. Richard M. Murray, Zexiang Li, S. Shankar Sastry, A Mathematical Introduction to Robotic Manipulation CRC Press, 1994 2. Lung-Wen Tsai, Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley Interscience, 1999

Prerequisite

NIL

Introduction to Research - ED6021

Approved Details

Description

NIL

Course Content

NIL

TextBooks

NIL

Reference Books

NIL

Prerequisite

NIL

Special Topics in Engineering Design - ED6999

Approved Details

Description

The course envisages to train research scholar in the preparation of a “critical review of literature”, present the same in the form of a written report and make as oral presentation before members of DC and invitees and take feedback.

Course Content

Review of literature in the related area.

TextBooks

As prescribed by the guide.

Reference Books

Relevant journal paper.

Prerequisite

NIL

Special Topics in Engineering Design - ED7999

Approved Details

Description

The course envisages to train research scholar in presenting simulation / preliminary experimental / analytical verification of prior art in the area of research, in the form of a report and an oral presentation to the DC and invitees and take feedback

Course Content

To be suggested by the guide

TextBooks

To be prescribed by the guide.

Reference Books

To be prescribed by the guide.

Prerequisite

NIL

Project II - ID5691

Approved Details

Description

IDDD-Robotics-Project phase II

Course Content

TextBooks

Reference Books

Prerequisite

NIL

IDDD EV Project II - ID5991

Approved Details

Description

Course Content

TextBooks

Reference Books

Prerequisite

NIL

Robot control - ID6071

Approved Details

Description

The purpose of this course is to introduce students to basics of modelling, and control of robot systems. At the end of this course students must be able to develop linear model for a robotic system, analyse stability, observability, controllability, design full state feedback controller to meet performance requirements using pole-placement, Linear Quadratic Regulator (LQR) approach, design state observer, and model-predictive controllers.

Course Content

Introduction & Motivation: Role of Controls, Mathematical Preliminaries, Review of classical control concepts, Intro to modern control theory: State Space Design: Modeling of physical systems, Linearization, Concepts of state, State- space, Representation of Linear system, Controllability and Observability, State Observers. Advanced Controller Design: Kalman Filters as Dynamic System State Observers; Linear Quadratic Regulator (LQR) design, Design of model-predictive controller. Case study on control of robotic manipulators, mobile robots and other robotic systems.

TextBooks

Modern Control Engineering, K. Ogata, Pearson, 2010 Robot Modeling and Control, M. Spong, M. Vidyasagar, S. Hutchinson, Wiley & Sons, 2005

Reference Books

Introduction to Robotics: Mechanics and Control, John J. Craig, Addison-Wesley Publishing Company, 3rd Edition, 2003 Handbook of Robotics, Oussama Khatib, Springer, 2008 Wang, Liuping (2009). Model Predictive Control System Design and Implementation Using MATLAB. Springer Science & Business Media

Prerequisite

NIL

Robotics Laboratory - ID6100

Approved Details

Description

Hands-on experience in design/control/planning of robots/robot applications.

Course Content

1. Robot Operating System (ROS) applications2. Robot path planning using A* algorithm and its implementation3. Manipulator programming and path planning (serial/parallel arms)4. Mobile Manipulation/ planning 5. Inverted pendulum/control 6. Mobile robot control 7. Robot calibration 8. Automated manufacturing using industrial robots

TextBooks

Laboratory manuals

Reference Books

NIL

Prerequisite

NIL