Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Branch- Common to All Discipline

ES401	Energy & Environmental Engineering	3L-1T-0P	4 Credits

The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.*

Module 1: Introduction to Energy Science:

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment; Overview of energy systems, sources, transformations, efficiency, and storage; Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

***Module2*: Ecosystems**

- Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a.)Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

***Module 3*: Biodiversity and its conservation**

- Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

***Module 4:* Environmental Pollution**

- Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides.

***Module 5:* Social Issues and the Environment**

- From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns. Case Studies
  Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

Module 6: Field work

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCES:

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)
6. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.
7. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam

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New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics Engineering IV- Semester

RM-402 Robotics Engineering

Course Objectives:

1. To understand the importance of robotics in scientific and industrial domains.
2. To introduce mathematical aspects of robotics such as spatial transformations, kinematics, dynamics, trajectory generation, actuators and control.
3. To learn about different types of end effectors and drive systems
4. To understand the criteria to select sensors, basic knowledge of piezoelectric sensors and Image processing
5. To learn about safety and economics of robots.

Module 1 Introduction: Need and importance, basic concepts, structure and classification of industrial robots, Geometric classification and control classification, Robot Elements , terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Module 2 End Effectors and Drive systems: Drive systems for robots, salient features and comparison, different types of end effectors, design, applications.

Module 3 Sensors: Sensor evaluation and selection, Piezoelectric sensors , linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image Processing and object recognition.

Module 4 Robot Programming: Teaching of robots, manual, walk through, teach pendant, off line programming , Language based programming, task level programming, Robot programming synthesis, robot programming for foundry, press work and heat treatment, welding, machine tools, material handling, warehousing assembly, etc., automatic storage and retrieval system.

Module 5 Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots. Robot integration with CAD/CAM/CIM, Collision free motion planning.

REFERENCES:

1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Groover M.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl□; TMH
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy ; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics □Control, sensing□; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
9. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
10. Saha S; Introduction to Robotics; TMH 11. Yu Kozyhev; Industrial Robots Handbook; MIR Pub.

List of Suggested Experiments:

1. To study components of real Robot and its DH Parameters.
2. Study of Forward Kinematics and validation using a software (Robo Analyzer or any other free software tools)
3. Study of inverse kinematics of any real Robot and validation using any software
4. Study of positioning and orientation of Robot arm
5. Image processing for color/shape detection
6. Control experiment using available hardware/software
7. Integration of assorted sensors (IR, Potentiometer, strain gauges etc.)microcontroller and Robot operating System in a Robotic System
8. Project work

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Robotics and Mechatronics Engineering IV- Semester

RM-403 Robotic Control Systems and Microcontrollers

Course Objectives:

1. To understand about control system, its types and control approaches of Robots.
2. To learn PLC, basic structure of PLC and methods of PLC programming.
3. To know about the logic, instructions and application of PLC.
4. To learn about basic components of Microcontroller.
5. To understand the concept of working of 8051 microcontroller.

Syllabus

Module 1 Introduction to control system and control approaches of Robots: Types of control system and their utility. Hydraulic power generation and transmission, valve control pressure flow relationship for hydraulic valves, valve configurations and constructions, steady state operating forces, transient forces and valve instability. Circuit design, Pneumatic valves, Dynamic response gearing and control approaches of Robots, Control loops using Current amplifier.

Module 2 Introduction to Programmable Logic Controllers : Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing's, types of variables, definition of firmware, software, programming software tool and interfacing with PC (RS232 & TCP-IP), methods of PLC programming (LD, ST, FBD & SFC), function blocks logical / mathematical operators & data types, array & data structure, PID, types of tasks and configuration, difference between relay logic and PLC, selection of PLC controller.

Module 3 : Logic, instructions & Application of PLC: What is logic, Conventional Ladder v/s PLCladder, series and parallel function of OR, AND, NOT logic, Ex Or logic, Analysis of rung. Timer and Counter Instructions; on delay and Off delay and retentive timer instructions, PLC counter up and down instructions, combining counters and timers, Comparison and data handling instructions, Sequencer instruction, Visualization Systems, Types of visualization system, PC based Controller, Applications of HMI's.

Module 4: Introduction of Microcontrollers: Block diagram of microcontroller : CPU, input device, output device, memory and buses, common features of Microcontrollers : On-chip Oscillator, program and data memory, I/O Ports, Watchdog- timer reset, SFRs, Timers, Counters, Interrupts, ADC, PWM, microprocessor and microcontroller, Hierarchy of microcontrollers, architectures of microcontroller Harvard , Von Neumann RISC and CISC, applications of microcontrollers.

Module 5 : 8051 Microcontroller Hardware : Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports, Functions of each pin of 8051, Clock circuit, reset Circuit , phase and state in machine cycle of 8051.

REFERENCES:

1. Programmable Logic Controllers by W.Bolton
2. S.K.Pillai. A First course on electric drives –Wiley Eastern 1990
3. Programmable Logic Controllers by Hugh Jack
4. Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5
5. Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
6. A.E. Fitzerald ,C.Kingsley and S.D Umans, Electric Machinery - McGraw Hill Int. Student edition
7. S.K.Pillai. A First course on electric drives –Wiley Eastern 1990 5.Programmable Logic Controllers by Hugh Jack
8. J.F. Blackburn, G. Rechthof, J.L. Shearer. Fluid Power Control MIT, 1960
9. B.W. Anderson, The Analysis and Design of Pneumatic Systems, Wiley, 1967
10. Pal Ajit ,Microcontrollers : Principles And Applications, EEE, PHI ,New Delhi,(Latest edition)
11. Rao Dr. K Uma, The 8051 Microcontrollers: Architecture, Programming and Applications, Pearson Education India, New Delhi,(Latest edition)
12. Mazidi Ali, Muhammad Mazidi Gillispie Janice, The 8051 microcontroller and embedded systems, PHI, New Delhi,(Latest edition)

List of Major Equipment/ Instrument with Broad Specifications

1. Programmable Logic Controller Trainer, mod. PLC-8/EV
2. Electro-pneumatic system elements (cylinders, directional control valves,sensors…)
3. DELTA's PLC DVP Series Model.
4. Microcontroller 8051 trainer Kit.
5. 8051 Simulator software (Free downloadable).
6. Computer System (p-IV and latest version).
7. Peripheral Interfacing Trainer kits.

List of Software/Learning Websites

i. www.academia.edu ii www.learners TV.com iii www.nptel.iitm.ac.in iv www.8052.com

List of Experiments Suggested:

1. To study hydraulic and pneumatic valves.
2. To study basic structure of PLC, working principle and data storage methods.
3. To familiarize with Programmable Logic Controllers (PLC) as hardware and the software used to program
4. To familiarize with programming PLC using ladder logic diagrams in order to control an electro-pneumatic system.
5. Write (draw) the ladder diagrams that do all the following logical functions:
   Q 0.1 = NOT I0.1 Q 0.2 = I0.2 (OR) I0.3 Q 0.3 = I0.4 (AND) I0.5 Q 0.4 = I1.2 (XOR) I1.3
6. To study various methods of PLC programming
7. To identify various blocks of 8051 microcontroller development board.
8. To test and verify the features of 8051 Trainer Kit
9. To develop a practical application using 8051 Microcontroller

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Robotics and Mechatronics Engineering IV-Semester

RM-404 Machine Drawing & Design

Course Objectives:

To enable the students to prepare a detailed assembly drawing for machine components.

Outcomes :

1. To understand Indian standards for machine drawing.
2. To understand Fits and Tolerances in technical drawing.
3. To prepare assembly drawing of joints, couplings and machine elements.
4. To know the basics of design of any components
5. To design and prepare knuckle joint, cotter joints and riveted joints.

Module 1. Drawing conventions: IS codes, sectional views and sectioning, surface finish and tolerances representation of machine parts such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears, Rivet heads and Riveted joints, Welded joints.

Module 2. **Assembly Machine Drawing** : Basic concept of assembly drawing ,bill of materials, Assembly drawing of Cotter and Knuckle joints, pedestal and footstep bearings.

Module 3. Assembly Drawing of Engine parts: crosshead and stuffing box, IC engines parts - piston and connecting rods; lathe machine parts; Tool post and Tail Stock.

Module 4.**Fundamentals of Machine Design**: Concept of Design, Product Life Cycle, basic design considerations and guidelines, Design essentials, Concept of Factor of safety, Safe or working stress, Flowchart representing the Design Process for Machine Design, Basic design equation for component subjected to static loads, variable loads, Design equations for combined static and dynamic Loading.

Module 5 Design of Joints: Knuckle joint, Cotter Joints (Socket and Spigot, Sleeve and Cotter, Gib and Cotter,) Design of Riveted Joints, Circumferential and Longitudinal Joints, Design of Welded joint.

REFERENCES:

1. Bhatt, ND; Machine Drawing; Charotar Publication
2. Dwivedi K.K. Pandey M ,Machine Drawing and Design, Dhanpat Rai & Co. Delhi
3. K C John ,Machine Drawing , PHI
4. Singh A; Machine Drawing; TMH publication
5. Narayana and Reddy; Machine Drawing; New age, Delhi.
6. Shigley JE et al; Mechanical Engineering Design, TMH
7. Khurmi R.S. Machine Design, S Chand
8. Sharma and Agrawal ,Machine Design

Suggested List of Experiments:

1. Draw assembly drawing of Knuckle joint.
2. Draw Assembly drawing of Cotter joint (Socket and Spigot, Sleeve and Cotter, Gib and Cotter).
3. Draw assembly drawing of Plummer block.
4. Draw assembly drawing of Foot step Bearing.
5. Draw assembly drawing of Cross head.
6. Draw assembly drawing of stuffing box.
7. Draw assembly drawing of piston.
8. Draw assembly drawing of connecting rod.
9. Draw assembly drawing of Tailstock.
10. Draw assembly drawing of Tool post.
11. Design a knuckle joint subjected to axial load.
12. Design a cotter joint (Socket and Spigot, Sleeve and Cotter, Gib and Cotter).

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Robotics and Mechatronics Engineering IV-Semester

RM-405 Materials Technology

Course Objectives:

1. To understand the basics of solidification of metals, bonds in different metals and different mechanical properties of engineering materials
2. To learn about cooling curves ,phase diagrams and Iron carbon diagram
3. To compare the application of various heat treatment processes
4. To understand the difference between working principle of destructive and non destructive methods
5. To perform chemical Analysis of different alloying elements.

Syllabus:

Module 1 Solidification of metals , Crystallisation, Crystal and amorphous , different types of bonds in different metals, Crystallography. Stability and metastability of metals. Different mechanical properties of metals and other engineering materials like strength, hardness, elasticity, plasticity, Malleability, Ductility, Creep, Fatigue etc. Introduction to industrial metals, steels and prevailing manufacturing methods by manufacturers.

Module 2 Cooling curves, Isomorphous, Utectic, Eutectoid , Eutectoid solid solution, Peritectic and other phase diagrams, Alloying , Characteristics of alloying elements, Iron – Carbon phase diagram, T-T-T diagrams, Types of Cast Iron. Types of Stainless Steels, Elastic, anelastic and Viscoelastic behavior.

Module 3 Heat treatment of metals, Based on phase diagram and T-T-T-Diagram the heat treatment of various metals, Bulk heat treatments, surface heat treatments, Case carburising, Types of Anealing, Normalizing, Spherodising, Phase Transformations like Parlite, Cementite, Austenite, Troostite, Bainite, Hard and soft Marten site etc. Laser hardening, Cyniding, Boriding, Nitriding, Flame hardening, Ion implantation, Etc. Heat treatment cycles. Metallographic studies, Optical Microscope, Electron Microscope.

Module 4 Destructive and non-destructive testing methods, Tensile test, Compression test, shear test, bend test, Different types of Hardness tests, Impact tests, Fatigue tests, Harden ability test. Fracture analysis, NDT Methods. Different properties of Steels, Aluminium and it’s alloys, Copper and it’s alloys, Manganese and it’s alloys, Chromium and it’s alloys, Nickel and it’s alloys.

Module 5 Chemical Analysis of different alloying elements in commercial metals, C, Fe, Cr, Ni, Mn, Mg, S, P, Co, Mo, Etc. Different chemical reagents, Equipments , Volumetric and Gravimetric analysis, Spot test, Colorimetric methods, Optical and spectrophotometric analysis.

REFERENCES:

1. V. Raghwan, Material Science.
2. G.E.Dieter, Mechanical Metallurgy.
3. P Chalmers, Physical Metallurgy.
4. R. C.Rollason, Metallurgy for mechanical engineers.
5. Khanna O.P. Materials Science.

Suggested List of experiments:

1. Metallographic studies – Study of Optical microscope, Optically flat surface preparation, etching reagents, Grain size- ASME no., micro structures, Image analysis, Standard specimen,
2. Carbon, sulphur, Phosphorus determination, Strauhlin's apparatus, Eggert's Method in different samples.
3. Hardness and Hardenability test, Jeremy Cony test. Soft and hard Martensite.
4. Different heat treatment cycles using electric furnace [Programmable preferred], Annealing, Case carburising, Normalising, etc.
5. Gravimetric / Volumetric - chemical analysis of alloying elements like, Cr, Ni, Mn, Si etc.
6. Study of different instrumental method of analysis, spectrophotometers, Differential Scanning calorimeter,
7. Spot test for quick assessment of alloying elements like Mn, Cr, Ni, etc.
8. Experiments / study of Non Destructive Methods, Ultrasonic test, Magnetic particle inspection, Dye penetration test, Eddy current test, Radiography test.
9. Cupping test / formability test for sheet metal

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Robotics and Mechatronics Engineering IV- Semester

RM-406 CAD/CAM/CIM Lab

OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

Suggested List of Experiments:

1. Study of basic concepts of CAD/CAM
2. Study and development of 2 D model using CAD software.
3. Study and development of 3 D model using CAD software.
4. To study about the important features, programming structures, codes used in manual part programming.
5. To write NC Part program for step turning and taper turning
6. Study of Group technology and part families.
7. Study of Computer Aided Process Planning.
8. Study of Flexible Manufacturing System
9. Introduction of 3D Modeling software ,
10. Creation of 3D assembly model of following machine elements using 3D Modeling software
    1. Flange Coupling 2. Plummer Block 3. Screw Jack 4. Lathe Tailstock 5. Universal Joint
11. To write the part program for any component. Assuming the work piece is Aluminum and the speed is 1200 rpm, feed 20 mm/min and maximum depth of cut is 1 mm.
    a. With Canned cycle
    b. Without Canned cycle
