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, Mumabai,
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

Automation and Robotics Engineering IV- Semester

AB-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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Automation and Robotics Engineering IV-Semester

AB-403 Industrial Automation

Course Objectives: Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robots in automation. This course will provide opportunity to learn industrial automation techniques.
After learning the course the students should be able to:

1. Understand various automation components and systems.
2. Draw block diagram of industrial automation and cotrol system.
3. Explain architecture of industrial automation system.
4. Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.
5. Explain fundamentals of process control.
6. List basic devices used in automated systems.
7. Use programmable logic controllers for industrial automation.
8. Draw block diagram of supervisory control and data acquisition (SCADA).
9. Integrate SCADA with PLC systems.
10. Use Internet of Things for industrial automation.
11. Know use of robot for industrial applications.

Syllabus

Module 1:

Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus.

Module 2:

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

Module 3:
Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

Module 4:
Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

Module 5:
Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS and Advantages of DCS.

Module 6:
Overview of Industrial automation using robots: Basic construction and configuration of robot, Pick and place robot, Welding robot.

REFERENCE BOOKS:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies.
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI.
3. Industrial control handbook, Parr, Newnem.
4. Programmable logic controller, Dunning, Delmar.

SUGGESTED LIST OF EXPERIMENTS:

(**General guidelines:** Institute may change list of experiments based on laboratory set up available)

1. Use industrial grade sensors and transducer introduction and characteristics like proximity detector, linear encoder, rotary encoder, touch sensor, force sensor, accelerometer, RTDs, load cells and LVDT for measurement
2. Use various actuators such as relay, solenoid valve, process control valve and motors for control applications

3. Simulate analog and digital function blocks
4. Relay logic diagram and ladder logic diagram

5. Understand and perform experiments on timers and counters
6. Logic implementation for traffic Control Application
7. Logic implementation for Bottle Filling Application
8. Tune PID controller for heat exchanger using DCS
9. FBD for autoclavable laboratory fermentor
10. Develop graphical user interface for the plant visited by you
11. Industrial visit report

MAJOR EQUIPMENT:

1. ADC, DAC and Controller, Switches, LEDs, Solenoid valves
2. Relay, motor
3. PLC with software
4. MATLAB or LABView or other similar software
5. AC Servo drives and DC Servo drives
6. Zeegbee and Bluetooth based short range automation system.
7. IoT boards.
8. Robot for demonstration

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Automation and Robotics Engineering IV- Semester

AB-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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Automation and Robotics Engineering IV- Semester

AB-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, Cyaniding, 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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Automation and Robotics Engineering IV-Semester

AB-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
