KALINGA UNIVERSITY

RAIPUR | INDIA

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B.Voc.)

Automation

(W.e.f. 2025 – 2026)

NAAC GRADE B+ Accredited University

nirf RANKING 2025 Ranked in Top 101-150 Universities

Kalinga University, Naya Raipur, Chhattisgarh

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B.VOC SYLLABUS FOR AUTOMATION

Semester-01								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVATM101	Communication Skills	3	3	0	0	30	70	100
BVATM102	Fundamentals of Information Technology	3	3	0	0	30	70	100
BVATM103	Fundamentals of Automation	3	3	0	0	30	70	100
BVATM104	Introduction to Robotics	3	3	0	0	30	70	100
BVATM105P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-02								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVATM201	Basic Control system for robots	3	3	0	0	30	70	100
BVATM202	Environmental Studies	3	3	0	0	30	70	100
BVATM203	Basics of Mechanical Systems	3	3	0	0	30	70	100
BVATM204	Basics of Electronics and Electrical Systems	3	3	0	0	30	70	100
BVATM205P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-03								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVATM301	Instrumentation for Robotics and Automation	3	3	0	0	30	70	100
BVATM302	Fault Analysis & Repair	3	3	0	0	30	70	100
BVATM303	Mobile Robots	3	3	0	0	30	70	100
BVATM304	Kinematics and Dynamics of Robotics	3	3	0	0	30	70	100
BVATM305P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-04								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVATM401	Introduction to Computer Aided Design	3	3	0	0	30	70	100
BVATM402	Industrial Automation	3	3	0	0	30	70	100
BVATM403	IOT & Embedded Systems	3	3	0	0	30	70	100
BVATM404	Electrical Drives and Control for Automation	3	3	0	0	30	70	100
BVATM405P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-05								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVATM501	Automatic Control System	3	3	0	0	30	70	100
BVATM502	Manufacturing & Quality Norms	3	3	0	0	30	70	100
BVATM503	Robotics for Industrial Automation	3	3	0	0	30	70	100
BVATM504	Sensors and Transducers	3	3	0	0	30	70	100
BVATM505P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

Semester-06								
Course Code	**Course Title**	**Credits**	**L**	**T**	**P**	**Internal Marks**	**End Semester Exam Marks**	**Total Marks**
BVMT601	Manufacturing Automation and Ergonomics	3	3	0	0	30	70	100
BVMT602	Robotic Design and Control	3	3	0	0	30	70	100
BVMT603	IoT in Industrial Automation	3	3	0	0	30	70	100
BVMT604	Entrepreneurship Development	3	3	0	0	30	70	100
BVMT605P	**On Job Training/ Internship/Workshop**	18	0	0	36	50	150	200
Total		**30**	**12**	**0**	**36**	**170**	**430**	**600**

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SEMESTER-01

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COMMUNICATION SKILLS
BVATM101

Course Outcomes:

After successful completion of this course, learners will be able to:

- Explain the fundamentals of communication, including its types, modes, channels, barriers, and the role of English as a global language in personal, academic, and professional contexts.
- Demonstrate effective verbal and non-verbal communication skills by applying appropriate strategies for interpersonal, group, social, and business communication while recognizing language variations, accents, and dialects.
- Develop effective speaking skills by participating confidently in interviews, group discussions, public speaking, dialogues, and other professional communication situations.
- Analyze and interpret written texts through effective reading, comprehension, translation, and critical evaluation of content, audience, purpose, tone, and stylistic features.
- Produce clear, coherent, and professional written communication by preparing reports, letters, notes, essays, articles, newsletters, diary entries, and other forms of written documents for academic and workplace applications.

Unit 1: **06**

Introduction:

- Theory of communication, types and modes of communication, mediums and channels of communication, barriers to communication, English as a global language, the lingua franca, social influences on English

Unit 2: **06**

Language of Communication:

- Verbal and non-verbal (spoken and written) personal, social and business barriers and strategies intra-personal, inter-personal and group communication, varieties of English, language, accent, dialect, colloquialism, historical influences on English

Unit 3: **06**

Speaking Skills:

- Monologue dialogue group discussion effective communication/ mis-communication interview public speech, regional influences on English, convergence and divergence, linguistic imperialism

Unit 4: **06**

Reading and Understanding:

- Close reading, reading analysis of a text - audience and purpose, content and theme, tone and mood, stylistic devices, structure comprehension- analysis and interpretation translation(from Indian language to English and vice-versa) literary/knowledge texts

Unit 5: **06**

Writing Skills:

- Documenting report writing making notes letter writing, writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters it will enhance language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note taking etc. while, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. it is hoped that after studying this course, students will find a difference in their personal and professional interactions.

References:

- K. K. Sinha – Business Communication, Galgotia Publishing Company, New Delhi.
- Raman Sharma – Technical Communication: Principles and Practice, Oxford University Press India.
- Sanjay Kumar & Pushp Lata – Communication Skills, Oxford University Press India.
- Meenakshi Raman & Sangeeta Sharma – Technical Communication: Principles and Practice, Oxford University Press India.
- Krishna Mohan & Meera Banerji – Developing Communication Skills, Macmillan Education India.

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FUNDAMENTALS OF INFORMATION TECHNOLOGY BVATM102

Course Outcomes:

After successful completion of this course, learners will be able to:

- Explain the fundamentals of computer systems, including their characteristics, classification, historical development, hardware, software, and the von Neumann architecture.
- Identify and describe the functions of computer hardware components, memory devices, storage media, input/output devices, and peripheral equipment used in modern computing systems.
- Demonstrate an understanding of system software, application software, operating systems, programming languages, databases, utilities, and computer security concepts, including virus protection and open-source software.
- Explain the concepts of computer networks and the Internet, including networking components, Internet services, web technologies, e-mail communication, and methods of Internet connectivity.
- Apply the principles of information technology and basic programming concepts by explaining IT applications in various sectors, interpreting algorithms, pseudocode and flowcharts, and describing the stages of program development, testing, debugging, and documentation.

Unit-1: **06**

Computer characteristics:

- Speed, storage, accuracy, diligence; digital signals, binary system, ASCII; historic evolution of computers;
- **Classification of computers:** microcomputer, minicomputer, mainframes, supercomputers;
- **Personal computers:** desktop, laptops, palmtop, tablet; hardware & software; von Neumann model.

Unit-2: **06**

Hardware:

- CPU, memory, input devices, output devices.
- **Memory units:** RAM (SDRAM, DDR RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory;
- **Auxiliary storage:** Magnetic devices, optical devices; floppy, hard disk, memory stick, CD, DVD, CD/DVD-Writer**;**
- **Input devices:** keyboard, mouse, scanner, speech input devices, digital camera, touch screen voice input, joystick, optical readers, bar code reader;
- **Output devices:** Display device, size and resolution; CRT, LCD, LED;
- **Printers:** Dot-matrix, inkjet, laser; plotters, sound cards & speaker.

Unit-3: **06**

Software:

- System software, application software; concepts of files and folders, introduction to operating systems, different types of operating systems: single user, multitasking, time-sharing multi-user; booting, POST;
- **Basic features of two GUI operating systems:** Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases;
- **Application software:** Generic features of word processors, spread sheets and presentation software; generic introduction to latex for scientific typesetting; utilities and their use; computer viruses & protection, free software, open source.

Unit-4: **06**

Computer Networks and Internet:

- Connecting computers, requirements for a network: server, workstation, switch, router, network operating systems; internet: brief history, world wide web, websites, URL, browsers, search engines, search tips; internet connections: isp, dial-up, cable modem, well, dsl, leased line wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, web pages, web programming languages.

Unit-5: **06**

Information Technology and Society:

- Indian IT Act, intellectual property rights, issues. application of information technology in railways, airlines, banking, insurance, inventory control, financial systems, hotel management, education, video games, telephone exchanges, mobile phones, information kiosks, special effects in movies.
- **Programming Concepts & Techniques:** Program concept, characteristics of programme, stages in program development, tips for program designing, programming aids, algorithms, pseudo code, notations, design, flowcharts, symbols, rules, compiler & interpreter. introduction to programming techniques, top-down & bottom-up approach, unstructured, & modular programming, cohesion, coupling, debugging, syntax & logical errors, linking and loading, testing and debugging, documentation.

References:

- V. Rajaraman – Fundamentals of Computers, PHI Learning Pvt. Ltd., New Delhi.
- Reema Thareja – Computer Fundamentals and Programming in C, Oxford University Press India.
- E. Balagurusamy – Fundamentals of Computers, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
- Ramesh Bangia – Computer Fundamentals and Information Technology, Firewall Media (Laxmi Publications), New Delhi.
- Alexis Leon & Mathews Leon – Fundamentals of Information Technology, Vikas Publishing House Pvt. Ltd., New Delhi.

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FUNDAMENTALS OF AUTOMATION
BVATM103

Course Outcomes:

- Explain the concepts, goals, principles, types, and elements of automation and describe the role of fluid power and robotics in industrial automation.
- Describe manufacturing automation systems, automatic transfer machines, automated part handling, CNC machine tools, and programmable robots.
- Analyze automated flow lines, workpart transport methods, transfer mechanisms, buffer storage, and control functions used in manufacturing systems.
- Explain the construction, operation, and industrial applications of automated guided vehicle systems and automated storage and retrieval systems.
- Evaluate barcode, RFID, and other product identification technologies and their integration with modern automated manufacturing systems.

Unit 1: **06**

Introduction to Automation and Fluid Power Systems:

- Introduction to automation, need and importance of automation, advantages and limitations of automation, goals of automation, laws and principles of automation, types of automation, elements of an automated system, introduction to fluid power, elements of fluid power systems, applications of fluid power, comparison between pneumatic and hydraulic systems, advantages and limitations of pneumatic and hydraulic systems, and the role of robotics in industrial automation.

Unit 2: **06**

Manufacturing Automation and Programmable Automation:

- Introduction to manufacturing automation, classification and types of automatic transfer machines, automation in part handling and feeding, analysis of automated flow lines, design of single-model and multi-model production systems, programmable manufacturing automation, CNC machine tools, programmable robots, and applications of programmable automation in modern manufacturing industries.

Unit 3: **06**

Automated Flow Lines and Transfer Systems:

- Automated flow lines, methods of workpart transport, transfer mechanisms, transfer systems, buffer storage, functions and importance of buffer storage, control functions in automated production systems, automation for machining operations, design considerations for automated systems, fabrication considerations, and performance evaluation of automated flow lines.

Unit 4: **06**

Automated Material Handling and Storage Systems:

- Introduction to automated material handling systems, Automated Guided Vehicle (AGV) systems, types and applications of AGVs, automated storage systems, storage system performance, Automated Storage and Retrieval Systems (AS/RS), components and working principles of AS/RS, interfacing material handling and storage systems with manufacturing, and applications of automated material handling in industries.

Unit 5: **06**

Product Identification and Integrated Automation Systems:

- Introduction to product identification systems, barcodes, barcode technologies, Radio Frequency Identification (RFID), automatic identification and data capture technologies, applications of product identification systems in manufacturing and logistics, integration of automated handling, storage, and identification systems, flexible manufacturing systems, computer-integrated manufacturing, smart manufacturing, and emerging trends in industrial automation.

References:

- Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson Education.
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education.
- S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, McGraw Hill Education.
- Anthony Esposito, Fluid Power with Applications, Pearson Education.
- R. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, John Wiley & Sons.

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INTRODUCTION TO ROBOTICS
BVATM104

Course Outcomes:

- Explain the fundamental concepts, history, laws, anatomy, specifications, and basic components of robotic systems.
- Describe different robot configurations, wrist mechanisms, work envelopes, and robot performance characteristics.
- Explain the construction, operation, and applications of robot end effectors, grippers, drive systems, joints, links, feedback devices, and motion control systems.
- Describe the working principles and applications of robotic sensors, machine vision, and Artificial Intelligence.
- Evaluate the industrial, medical, domestic, defence, space, underwater, and emerging applications of robotic systems.

Unit 1: **06**

Fundamentals of Robotics:

- Introduction to robotics, basic concepts of robots, need and importance of robotics, laws of robotics, history and evolution of robots, robot anatomy, basic components of robotic systems, robot specifications, and performance characteristics of robots.

Unit 2: **06**

Robot Configurations and Performance Characteristics:

- Robot configurations including Cartesian, cylindrical, polar, and articulated robots, robot work envelope, robot wrist mechanisms, degrees of freedom, robot precision, accuracy, repeatability, resolution, and factors affecting robot performance.

Unit 3: **06**

Robot End Effectors, Drives and Motion Control:

- Classification and types of robot end effectors, mechanical actuation systems, gripper design, factors affecting gripper selection, robot drive systems and their types, position and velocity feedback devices, robot joints and links, types of robot joints, robot motion, and motion interpolation.

Unit 4: **06**

Robotic Sensors, Machine Vision and Artificial Intelligence:

- Introduction to sensors used in robotics, touch sensors, tactile sensors, proximity sensors, range sensors, force sensors, light sensors, and pressure sensors, principles and applications of robotic sensors, introduction to machine vision, components of machine vision systems, image sensing, and introduction to Artificial Intelligence and its applications in robotics.

Unit 5: **06**

Applications and Future Trends in Robotics:

- Industrial applications of robots, robots in manufacturing and automation, medical robotics, household and service robots, entertainment robots, space robotics, underwater robots, defence applications, disaster management robots, micro-robots, nanorobots, emerging applications, and future trends in robotics.

References:

- John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education.
- Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, 3rd Edition, John Wiley & Sons.
- Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, and Nicholas G. Odrey, Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill Education.
- R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education.
- S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVATM105P

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SEMESTER-02

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BASIC CONTROL SYSTEM FOR ROBOTS
BVATM201

Course Outcomes:

- Explain the fundamental concepts of control systems and develop mathematical models of electrical, mechanical, and electromechanical systems.
- Represent dynamic systems using transfer functions, block diagrams, signal flow graphs, and state-space models.
- Analyze the time response, transient performance, poles, zeros, and stability of control systems.
- Apply feedback principles, P, PI, PD, and PID controllers, and frequency-domain techniques to analyze robotic control systems.
- Design controllers using root-locus methods, state feedback, pole placement, observers, and LQR control techniques.

Unit 1: **06**

Introduction and Mathematical Modelling of Control Systems:

- Introduction to control systems, motivation for control systems, examples and applications of control systems in robotics, open-loop and closed-loop control systems, feedback control systems, mathematical modelling of electrical systems, mechanical systems, and electromechanical systems, Laplace transforms, transfer functions, electrical analogies of mechanical and other dynamical systems, linear and nonlinear systems, time-invariant and time-varying systems, and linearization of nonlinear systems.

Unit 2: **06**

System Representation and State-Space Modelling:

- State-space modelling of dynamical systems, state variables, state equations, output equations, state-space representation, block diagrams, block diagram reduction techniques, signal flow graphs, Mason's gain formula, distributed parameter systems, system representation, and applications of state-space models in robotic control systems.

Unit 3: **06**

Time Response and Stability Analysis:

- Time response of dynamical systems, obtaining system responses from mathematical models, poles and zeros and their effects on system response, standard first-order and second-order systems, step response of standard second-order systems, transient response, time-domain specifications, rise time, peak time, settling time, maximum overshoot, steady-state response, definition and concept of stability, Routh–Hurwitz stability criterion, and introduction to Lyapunov stability theory.

Unit 4: **06**

Feedback Control and Frequency-Domain Analysis:

- Principles and properties of feedback control systems, advantages and limitations of feedback, error analysis, proportional (P), proportional-integral (PI), proportional-derivative (PD), and proportional-integral-derivative (PID) controllers, frequency-domain analysis, Bode plots, Nyquist plots, Nyquist stability criterion, gain margin, phase margin, system robustness, and applications of feedback controllers in robotic systems.

Unit 5: **06**

Controller Design and State Feedback Control:

- Root-locus technique, rules and steps for constructing root-locus plots, controller design using root locus, state feedback control, pole placement using state feedback, controllability, pole placement using output feedback, observability, Luenberger observer, Linear Quadratic Regulator (LQR) control, and applications of modern controller design techniques in robotics.

References:

- K. Ogata, Modern Control Engineering, 5th Edition, Pearson Education.
- J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers.
- Norman S. Nise, Control Systems Engineering, 8th Edition, John Wiley & Sons.
- Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 13th Edition, Pearson Education.
- M. Gopal, Digital Control and State Variable Methods: Conventional and Neural Network Based Control Systems, McGraw Hill Education.

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ENVIRONMENTAL STUDIES
BVATM202

Course Outcomes:

After successful completion of this course, learners will be able to:

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.

Unit 1: **06**

Introduction to Environmental Studies:

- Multidisciplinary nature of environmental studies, Scope and importance; concept of sustainability and sustainable development.

Ecosystems:

- What is an ecosystem? Structure and function of the ecosystem;
- **Energy flow in an ecosystem:** food chains, food webs and ecological succession.
- **Case studies of the following ecosystems**: Forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-2: **06**

Natural Resources:

- **Renewable and Non--renewable Resources:** Land resources and land use change; Land degradation, soil erosion and desertification.
- **Deforestation:** Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- **Water:** Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- **Energy resources:** Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit-3: **06**

Biodiversity and Conservation:

- **Levels of biological diversity:** genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega--biodiversity nation; Endangered and endemic species of India
- **Threats to biodiversity:** Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions;
- **Conservation of biodiversity:** In--situ and Ex--situ conservation of biodiversity.
- **Ecosystem and biodiversity services:** Ecological, economic, social, ethical, aesthetic and Informational value.

Unit-4: **06**

Environmental Pollution:

- Types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks
- **Solid waste management:** Control measures of urban and industrial waste. Pollution case studies.

Environmental Policies & Practices:

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- **Environment Laws:** Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit-5: **06**

Human Communities and the Environment:

- **Human population growth:** Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies.
- **Disaster management:** floods, earthquake, cyclones and landslides.
- **Environmental movements:** Chipko, Silent valley, Bishnois of Rajasthan.
- **Environmental ethics:** Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

References:

- Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
- Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36--37.
- Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
- Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
- Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.

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BASICS OF MECHANICAL SYSTEMS
BVATM203

Course Outcomes:

- Explain the basic components and operating principles of mechanical systems, including gears, drives, bearings, pulleys, and mechanical joints.
- Apply the fundamental concepts of stress, strain, elasticity, and torsion to analyze simple mechanical components.
- Determine shear force and bending moment and prepare simple shear force and bending moment diagrams for different types of beams.
- Perform basic calculations related to pulleys, belts, gears, shafts, speed ratios, and mechanical power transmission.
- Explain the properties and behaviour of fluids and apply Bernoulli's theorem to solve basic fluid-flow and pressure-measurement problems.

Unit 1: **06**

Fundamentals of Mechanical Systems and Strength of Materials:

- Introduction to mechanical systems, basic mechanical components, gears, drives, bearings, pulleys, and their functions. Introduction to stress and strain, types of stress and strain, elastic constraints, elastic behaviour of materials, stress in circular shafts subjected to pure torsion, and basic concepts of riveted and bolted joints.

Unit 2: **06**

Shear Force and Bending Moment:

- Introduction to beams, types of beams including simply supported, cantilever, and overhanging beams. Concentrated loads and uniformly distributed loads, elementary concepts of shear force and bending moment, calculation of shear force and bending moment, simple shear force diagrams, bending moment diagrams, and the relationship between shear force and bending moment.

Unit 3: **06**

Pulleys, Belts and Mechanical Drives:

- Classification and types of pulleys, types and applications of belts, belt drive systems, simple calculations related to pulley diameter and speed ratio, principles of power transmission through belt and pulley systems, mechanical drives, and applications of pulleys and belts in engineering systems.

Unit 4: **06**

Gears and Shaft Power Transmission:

- Classification and types of gears, gear terminology, gear trains, applications of gears, simple calculations related to the number of gear teeth and speed ratio, power transmission through solid shafts, power transmission through hollow shafts, comparison of solid and hollow shafts, and applications of gears and shafts in mechanical systems.

Unit 5: **06**

Fundamentals of Fluid Mechanics:

- Properties of fluids, fluid pressure and its measurement, flow of fluids, velocity and discharge, types of fluid flow, Bernoulli's theorem and its applications, working principle of a venturimeter, flow through pipes, head loss due to friction, and practical applications of fluid mechanics in engineering systems.

References:

- R. S. Khurmi and J. K. Gupta, A Textbook of Machine Design, S. Chand Publishing.
- R. K. Rajput, Strength of Materials, S. Chand Publishing.
- S. Ramamrutham and R. Narayan, Strength of Materials, Dhanpat Rai Publishing Company.
- R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.
- V. B. Bhandari, Design of Machine Elements, McGraw Hill Education.

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BASICS OF ELECTRONICS AND ELECTRICAL SYSTEMS BVATM204

Course Outcomes:

- Apply Kirchhoff's laws and network theorems to analyze basic electrical circuits containing resistance, inductance, and capacitance.
- Analyze single-phase AC circuits, evaluate electrical power and power factor, and explain the operating principles of transformers.
- Explain the construction, operation, selection, and applications of LT switchgear, electrical wiring, cables, earthing systems, and batteries.
- Analyze the characteristics and applications of semiconductor diodes in switching and rectifier circuits.
- Perform number-system conversions and apply Boolean algebra and logic gates to analyze basic digital electronic circuits.

Unit 1: **06**

Basic Electrical Circuit Analysis:

- Introduction to electrical circuits, passive circuit elements including resistance, inductance, and capacitance, voltage and current sources, Kirchhoff's Current Law and Kirchhoff's Voltage Law, superposition theorem, Thevenin's theorem, Norton's theorem, and the application of network theorems in electrical circuit analysis.

Unit 2: **06**

AC Circuits and Transformers:

- Representation of sinusoidal waveforms, peak value, average value, RMS value, phasor representation, real power, reactive power, apparent power, power factor, analysis of single-phase AC circuits consisting of R, L, C, RL, RC, and RLC combinations in series and parallel, series and parallel resonance, concept, construction, working principle, and applications of transformers.

Unit 3: **06**

LT Switchgear, Wiring, Earthing and Batteries:

- Introduction to low-tension switchgear, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Moulded Case Circuit Breaker (MCCB), types of electrical wires and cables, selection of wires and cables, earthing methods and importance of earthing, types of batteries, battery characteristics, battery backup systems, and methods of power factor improvement.

Unit 4: **06**

Semiconductor Diodes and Rectifier Circuits:

- Introduction to semiconductor materials and semiconductor diodes, ideal and practical diode characteristics, diode resistance levels, diode equivalent circuits, load-line analysis, diode as a switch, diode as a rectifier, half-wave rectifiers, full-wave rectifiers, rectifier circuits with and without filters, and applications of diode-based electronic circuits.

Unit 5: **06**

Number Systems, Boolean Algebra and Logic Gates:

- Introduction to digital number systems, decimal, binary, octal, hexadecimal, and Binary-Coded Decimal (BCD) number systems, decimal-to-binary and binary-to-decimal conversion, representation of negative numbers, one's and two's complements, Boolean algebra, basic Boolean theorems and properties, Boolean expressions, truth tables, logic gates including NOT, OR, AND, NOR, NAND, XOR, and XNOR gates, and introduction to Integrated Circuits (ICs).

References:

- D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, McGraw Hill Education.
- B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology, Volume I: Basic Electrical Engineering, S. Chand Publishing.
- Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education.
- Thomas L. Floyd, Digital Fundamentals, Pearson Education.
- R. S. Sedha, A Textbook of Applied Electronics, S. Chand Publishing.

KALINGA UNIVERSITY
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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVATM205P

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SEMESTER-03

KALINGA UNIVERSITY
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INSTRUMENTATION FOR ROBOTICS AND AUTOMATION
BVATM301

Course Outcomes:

- Explain the working principles, characteristics, signal conditioning methods, and data acquisition techniques associated with sensors and transducers.
- Identify and select suitable position, motion, force, torque, environmental, tactile, and vision sensors for robotic and automation applications.
- Develop basic PLC programs using ladder logic, timers, counters, latching functions, and internal relays for industrial automation applications.
- Analyse open-loop and closed-loop control systems and apply ON–OFF, P, PI, PD, and PID control actions to mechatronic systems.
- Explain the architecture, components, and industrial applications of TIA, HMI, SCADA, and DCS systems.

Unit 1: **06**

Fundamentals of Sensors, Transducers and Data Acquisition:

- Introduction to sensors and transducers, classification of sensors, working principles of piezoelectric, capacitive, inductive, optical, and other commonly used sensors. Sensor characteristics including accuracy, precision, resolution, sensitivity, dynamic range, linearity, repeatability, and response characteristics. Signal conditioning techniques for amplification, filtering, isolation, and conversion of sensor signals. Principles of Analog-to-Digital Conversion (ADC) and Digital-to-Analog Conversion (DAC), data acquisition systems, types and specifications of DAQ systems, and interfacing of sensors with data acquisition systems.

Unit 2: **06**

Sensors for Robotics and Automation:

- Position and motion sensors including encoders, potentiometers, accelerometers, gyroscopes, LiDAR, and robotic vision systems. Force and torque sensors including touch sensors, strain gauges, piezoelectric sensors, and force–torque sensors. Environmental sensors for temperature, pressure, humidity, proximity, flow, velocity, and light measurement. Introduction to chemical sensors, acoustic sensors, tactile sensors, robotic vision sensors, and applications of sensors in robotic and automated systems.

Unit 3: **06**

Programmable Logic Controllers and Automation Strategies:

- Introduction to Programmable Logic Controllers (PLCs), basic structure and components of a PLC, principles of PLC operation, PLC programming languages, ladder diagrams, latching circuits, internal relays, timers, counters, selection criteria for PLCs, and industrial applications of PLCs. Broad classes of industrial automation and their comparative study. Principles and strategies of automation, USA principle, ten strategies for automation and production systems, and automation migration strategy.

Unit 4: **06**

Automatic Control Systems and Control Actions:

- Introduction to automatic control systems, mechatronic systems and their examples, components of mechatronic systems, open-loop and closed-loop control systems, effects of feedback, basic characteristics of feedback control systems, and classification of control systems. Control system parameters, controller modes, control actions, ON–OFF controllers, proportional (P) controllers, proportional–integral (PI) controllers, proportional–derivative (PD) controllers, and proportional–integral–derivative (PID) controllers.

Unit 5: **06**

Totally Integrated Automation, HMI, SCADA and DCS:

- Introduction to Totally Integrated Automation (TIA), need and importance of TIA, components and advantages of TIA systems, Programmable Automation Controllers (PACs), vertical integration structure, and the role of TIA in industrial automation. Human–Machine Interface (HMI), need and role of HMI systems, types and applications of HMI. Introduction to Supervisory Control and Data Acquisition (SCADA), developer and runtime packages, SCADA architecture, SCADA tools, tags, internal and external graphics, alarm logging, tag logging, structured tags, trends, historical data, report generation, and SCADA applications. Introduction to Distributed Control Systems (DCS), DCS architecture, case studies of machine automation and process automation, and comparison between SCADA and DCS.

References:

- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education.
- D. Patranabis, Sensors and Transducers, PHI Learning.
- John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Pearson Education.
- Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson Education.
- Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, International Society of Automation.

KALINGA UNIVERSITY
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FAULT ANALYSIS & REPAIR
BVATM302

Course Outcomes:

- Classify and identify faults in electronic systems using systematic troubleshooting techniques.
- Perform fault rectification, module replacement, and preventive maintenance of electronic equipment.
- Analyze and troubleshoot faults in smartphones, air conditioning systems, security systems, and electronically controlled doors.
- Apply hardware and software diagnostic techniques using appropriate testing methods and tools.
- Conduct visual inspections and electrical safety tests, including Earth Continuity and Insulation Resistance Tests, to ensure reliable and safe operation of electronic equipment.

Unit 1: **06**

Fault Classification and Identification:

- Introduction to faults in electronic systems, classification of faults, types of faults, fault identification techniques, causes of faults, and methods of fault diagnosis.

Unit 2: **06**

Fault Rectification and Equipment Maintenance:

- Fault rectification methods, repairing and replacing modules, preventive maintenance, corrective maintenance, maintenance procedures, and safety precautions during servicing.

Unit 3: **06**

Fault Analysis of Electronic Equipment:

- Fault analysis and troubleshooting of smartphones, air conditioning systems, security systems, electronically controlled doors, common faults, diagnostic procedures, and maintenance techniques.

Unit 4: **06**

Hardware and Software Fault Analysis:

- Hardware fault analysis, software fault analysis, hardware and software components, diagnostic tools, testing methods, troubleshooting procedures, fault isolation techniques, system verification, and corrective actions.

Unit 5: **06**

Visual Inspection and Electrical Safety Testing:

- Visual inspection techniques, inspection procedures for electronic equipment, Earth Continuity Test, Insulation Resistance Test, interpretation of test results, electrical safety standards, documentation, and preventive maintenance practices.

References:

- R. S. Khandpur, Troubleshooting Electronic Equipment, 2nd Edition, McGraw-Hill Education.
- Robert L. Boylestad, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education.
- Albert Paul Malvino and David J. Bates, Electronic Principles, 8th Edition, McGraw-Hill Education.
- K. Lal Kishore, Electronic Equipment Maintenance, Pearson Education India.
- IEC 60364 Series, Electrical Installations for Buildings – Inspection, Testing and Safety Requirements, International Electrotechnical Commission (IEC).

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RAIPUR INDIA

MOBILE ROBOTS
BVATM303

Course Outcomes:

- Explain the history, classification, locomotion mechanisms, and applications of mobile robots, including RISE applications.
- Analyse mobile robot kinematics, workspace, degrees of freedom, motion control, and perception systems.
- Apply localization, map representation, and navigation techniques to support autonomous mobile robot operation.
- Explain the principles, architectures, communication methods, and control strategies of multiple-robot and swarm robotic systems.
- Develop basic Arduino programs and interface sensors and actuators for mobile robot applications.

Unit 1: **06**

Introduction to Mobile Robots and Locomotion:

- Introduction to mobile robots, history and evolution of mobile robotics, classification of mobile robots, recent advances in mobile robotics, mobile robots for Risky Intervention and Surveillance Environment (RISE) applications, principles of robot locomotion, key issues in locomotion, legged mobile robots, wheeled mobile robots, aerial mobile robots, advantages, limitations, and applications of different locomotion systems.

Unit 2: **06**

Mobile Robot Kinematics and Perception:

- Introduction to mobile robot kinematics, robot position and orientation, coordinate systems, forward kinematic models, mobile robot workspace, degrees of freedom, holonomic and non-holonomic robots, advanced concepts of mobile robot kinematics, motion control and kinematic control. Introduction to robot perception, wheel and motor encoders, heading and orientation sensors, ground-based beacons, active ranging sensors, motion and speed sensors, vision-based sensors, and the role of perception systems in mobile robot navigation.

Unit 3: **06**

Mobile Robot Localization and Navigation:

- Introduction to mobile robot localization, challenges of localization, noise and aliasing, localization-based navigation, programmed navigation solutions, map representation, map decomposition strategies, current challenges in map representation, probabilistic map-based localization, localization algorithms, autonomous navigation, path planning, obstacle detection, and applications of localization techniques in mobile robotic systems.

Unit 4: **06**

Multiple-Robot Systems and Swarm Robotics:

- Introduction to multiple-robot systems, principles and challenges of multi-robot systems, history and development of multiple robots, control issues in autonomous robot colonies, centralized and decentralized robot control, architectures of multiple-robot systems, swarm robotics, cellular robotics, communication among multiple robots, cooperative robotics, formation control, robot soccer, heterogeneous robot teams, and applications of multi-robot systems.

Unit 5: **06**

Arduino and Programming for Mobile Robots:

- Introduction to Arduino, Arduino architecture, pin configuration, device and platform features, digital and analog input/output ports, Arduino interfacing boards, introduction to embedded C programming and the Arduino platform, Arduino data types, variables, constants, operators, control statements, arrays, functions, Arduino input/output functions, basic Arduino programming, sensor interfacing, actuator control, and applications of Arduino in mobile robotic systems.

References:

- Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, Introduction to Autonomous Mobile Robots, 2nd Edition, MIT Press.
- Gregory Dudek and Michael Jenkin, Computational Principles of Mobile Robotics, 2nd Edition, Cambridge University Press.
- Gaurav S. Sukhatme, Maja J. Matarić, and collaborators, Multi-Robot Systems: From Swarms to Intelligent Automata, Springer.
- John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education.
- Massimo Banzi and Michael Shiloh, Make: Getting Started with Arduino, 3rd Edition, Maker Media.

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KINEMATICS AND DYNAMICS OF ROBOTICS
BVATM304

Course Outcomes:

- Explain coordinate transformations, D-H parameters, actuators, sensors, and the mathematical foundations of robot kinematics.
- Analyse forward and inverse kinematics, workspace, constraint equations, and kinematic models of serial and parallel robots.
- Develop dynamic models of robotic manipulators using the Lagrangian approach and perform dynamic simulations.
- Analyse the modelling, dynamics, vibration characteristics, and control of flexible-link robotic manipulators.
- Apply robot modelling, trajectory planning, simulation, and optimization techniques to solve robotics and automation problems.

Unit 1: **06**

Fundamentals of Robot Kinematics:

- Introduction to robot kinematics, position and orientation of rigid bodies, coordinate frames, homogeneous transformation matrices, representation of robot joints and links, Denavit-Hartenberg (D-H) parameters, link transformation matrices, examples of D-H parameter assignment, types of robotic actuators including stepper motors, DC servo motors, and brushless DC motors. Introduction to robot sensors, internal and external sensors, common sensors used in robotic systems, and their applications.

Unit 2: **06**

Forward and Inverse Kinematics:

- Introduction to forward and inverse kinematics, direct kinematic problems, inverse kinematic solutions, kinematics of common serial manipulators, workspace analysis of serial robots, constrained and redundant robotic manipulators, active and passive joints, constraint equations, loop-closure equations, kinematic modelling of serial and parallel robotic systems, and applications of robot kinematics.

Unit 3: **06**

Robot Dynamics and Simulation:

- Introduction to robot dynamics, mass and inertia properties of robotic links, Lagrangian formulation of equations of motion for serial and parallel manipulators, kinetic and potential energy concepts, derivation of dynamic equations, computer generation of symbolic equations of motion, direct and inverse dynamic analysis, simulation of robot dynamic models, and performance evaluation of robotic systems.

Unit 4: **06**

Flexible Robot Manipulators:

- Introduction to flexible robotic systems, modelling of flexible links and flexible joints, kinematic modelling of multi-link flexible robots, dynamics of flexible manipulators, control techniques for flexible-link robots, vibration analysis, numerical simulation of flexible robotic systems, planar two-link flexible manipulators, experimental studies, and industrial applications.

Unit 5: **06**

Advanced Robot Modelling and Applications:

- Advanced concepts in robot modelling, dynamic performance analysis, trajectory planning, motion control, numerical methods for robot simulation, computer-aided robot modelling, optimization of robotic systems, integration of sensors and actuators in robotic manipulators, applications of robot kinematics and dynamics in industrial automation, medical robotics, aerospace, manufacturing, and research.

References:

- John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education.
- Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley.
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer.
- Saeed B. Niku, Introduction to Robotics: Analysis, Control and Applications, 3rd Edition, Wiley.
- Richard M. Murray, Zexiang Li, and S. Shankar Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVATM305P

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SEMESTER-04

KALINGA UNIVERSITY
RAIPUR INDIA

INTRODUCTION TO COMPUTER AIDED DESIGN
BVATM401

Course Outcomes:

- Explain the fundamentals, scope, applications, and role of CAD/CAM in engineering design and manufacturing.
- Apply two-dimensional and three-dimensional geometric transformation techniques in computer-aided design.
- Analyse and develop geometric models using curves, surfaces, wireframe, and parametric modelling techniques.
- Explain solid modelling methods, projection techniques, and hidden line/surface removal algorithms used in CAD systems.
- Describe CAD/CAM data exchange formats, graphics standards, and their applications in modern engineering industries.

Unit 1: **06**

Introduction to Computer Aided Design:

- Introduction to Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM), definition, scope, objectives, applications, CAD/CAM integration, design process, product development cycle, role of computers in engineering design, CAD hardware and software components, benefits and limitations of CAD systems.

Unit 2: **06**

Geometric Transformations and Computer Graphics:

- Introduction to computer graphics, two-dimensional (2D) and three-dimensional (3D) transformations including translation, rotation, scaling, reflection, shearing, composite transformations, homogeneous coordinates, viewing concepts, graphical representation of engineering objects, and applications of transformations in CAD systems.

Unit 3: **06**

Curves, Surfaces and Geometric Modelling:

- Analytical and synthetic curves, advantages, disadvantages and comparison with parametric curves, geometric modelling concepts, representation of curves and surfaces, wireframe models, parametric representations, parametric curves and surfaces, manipulation of curves and surfaces, Digital Differential Analyzer (DDA) line drawing algorithm, Bresenham's line algorithm, midpoint circle algorithm, midpoint ellipse algorithm, and applications in CAD.

Unit 4: **06**

Solid Modelling and Projection Techniques:

- Introduction to solid modelling, fundamentals of solid modelling, solid representation schemes, half-space modelling, boundary representation (B-Rep), constructive solid geometry (CSG), sweep representation, analytic solid modelling, perspective projection, parallel projection, hidden line and hidden surface removal algorithms, and applications of solid modelling in engineering design.

Unit 5: **06**

CAD/CAM Data Exchange and Graphics Standards:

- CAD/CAM data exchange concepts, types of CAD file formats, exchange of engineering design data, neutral file formats, graphics standards, interoperability of CAD systems, product data management, introduction to industry standards for CAD/CAM, and applications of CAD/CAM in product design, manufacturing, and industrial automation.

References:

- Ibrahim Zeid, CAD/CAM: Theory and Practice, McGraw-Hill Education.
- P. N. Rao, CAD/CAM: Principles and Applications, McGraw-Hill Education.
- Donald Hearn and M. Pauline Baker, Computer Graphics with OpenGL, Pearson Education.
- Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw-Hill Education.
- Mikell P. Groover and Emory W. Zimmers Jr., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education.

KALINGA UNIVERSITY
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INDUSTRIAL AUTOMATION
BVATM402

Course Outcomes:

- Explain the principles, hierarchy, and components of industrial automation systems used in manufacturing industries.
- Analyze automated identification systems, automated material handling systems, AGVs, and automated storage and retrieval systems.
- Develop PLC ladder programs using logic gates, timers, counters, and control instructions for industrial automation applications.
- Design and implement PLC-based control systems for motor control, process control, conveyor systems, bottle filling, and material handling applications.
- Evaluate the applications of HMI, VFD, SCADA, electro-pneumatic systems, and PLC-based automation in modern manufacturing industries.

Unit 1: **06**

Fundamentals of Industrial Automation:

- Introduction to industrial automation, need and benefits of industrial automation, automation hierarchy, basic components of automation systems, shop floor control, relationship between shop floor control and factory information systems, phases of shop floor control including order release, order scheduling, order progress, factory data collection systems, data input techniques, automated identification methods including barcodes, radio frequency identification (RFID), magnetic stripe, optical character recognition (OCR), and case studies on identification systems.

Unit 2: **06**

Automated Material Handling Systems:

- Introduction to automated material handling systems, Automatic Guided Vehicles (AGVs), driverless trains, AGV pallet trucks, AGV guidance and routing methods, traffic control and safety in AGV systems, on-board vehicle sensing, zone blocking, system management, remote cell stations, central computer control, applications of AGVs, automated storage and retrieval systems (AS/RS), basic components of AS/RS, relay logic, PLC-based automation systems, and case studies on automated material handling equipment.

Unit 3: **06**

Programmable Logic Controllers (PLC):

- Introduction to PLCs, block diagram and internal architecture of PLCs, PLC input/output modules, memory organization, PLC I/O devices, contact and coil programming, digital logic and ladder logic, conversion between logic diagrams and ladder diagrams, ladder programming for logic gates (AND, OR, NOT, NAND, NOR, EX-OR), basic PLC circuits including start-stop, seal-in circuits, forward and reverse motor control with and without interlocking, water level control systems, motor control applications, and relay-based automation.

Unit 4: **06**

PLC Programming and Industrial Applications:

- PLC arithmetic functions including addition, subtraction, multiplication, and division, comparison functions, timer functions, counter functions, skip functions, master control relay, jump instructions, MOVE and block MOVE functions, ladder programming for bottle filling systems, conveyor systems, mixing processes, automatic door control, car parking systems, net counting systems, and process automation applications.

Unit 5: **06**

HMI, SCADA and Industrial Automation Applications:

- Introduction to Human Machine Interface (HMI), Variable Frequency Drives (VFD), Supervisory Control and Data Acquisition (SCADA), SCADA architecture, benefits and applications of SCADA, electro-pneumatic systems, conveyor automation, sorting and packaging systems, gripper movement control, process automation including temperature and pressure control, mixing and blending operations, manufacturing automation, assembly line automation, CNC machine integration with PLCs, and modern industrial automation systems.

References:

- Frank D. Petruzella, Programmable Logic Controllers, 5th Edition, McGraw-Hill Education.
- John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, 5th Edition, Pearson Education.
- Stenerson, Jon, Industrial Automation and Process Control, Pearson Education.
- Bolton, W., Programmable Logic Controllers, 6th Edition, Newnes (Elsevier).
- Krishna Kant, Computer-Based Industrial Control, 2nd Edition, PHI Learning Pvt. Ltd.

KALINGA UNIVERSITY
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IOT & EMBEDDED SYSTEMS
BVATM403

Course Outcomes:

- Explain the fundamentals of embedded systems, IoT architecture, and the features of commonly used embedded platforms.
- Describe the architecture, features, and programming environment of Arduino Uno and the ATmega328 microcontroller.
- Develop Embedded C programs using the Arduino IDE by applying variables, functions, control statements, and programming constructs.
- Analyse the architecture of the PIC18 microcontroller and develop basic assembly language, I/O, and ADC programs with simulation.
- Design and implement embedded applications by interfacing sensors, displays, switches, and DC motors using Arduino and PIC microcontrollers.

Unit 1: **06**

Fundamentals of Embedded Systems and IoT:

- Introduction to embedded systems, characteristics and applications of embedded systems, components of embedded systems, embedded hardware and software, introduction to the Internet of Things (IoT), architecture of IoT systems, applications of IoT, comparison of 8051, Arduino, and PIC microcontrollers, advantages and limitations of embedded platforms.

Unit 2: **06**

Arduino Architecture and Embedded System Design:

- Introduction to Arduino, history and Arduino family including Mega, Nano, Bluetooth, and Lilypad boards. Architecture of Arduino Uno, ATmega328 microcontroller, pin configuration, memory organization, power supply, power connectors, analog input pins, digital input/output connections, communication interfaces, and Arduino development environment.

Unit 3: **06**

Embedded C Programming for Arduino:

- Introduction to Embedded C programming, installation and configuration of the Arduino Integrated Development Environment (IDE), program structure, Arduino functions, parameters, variables (global, local, and static), data types including integer, float, and Boolean, preprocessor directives, control statements, looping statements, logical operators, mathematical operators, functions, return values, coding standards, debugging techniques, and Arduino program development.

Unit 4: **06**

PIC18 Microcontroller Architecture and Programming:

- Introduction to PIC18 microcontroller architecture, features of PIC18, WREG register, file registers, access bank, status register, data formats, assembler directives, branch instructions, subroutines, time-delay loops, PIC assembly language programming, Proteus simulation model, input/output port programming, analog-to-digital converter (ADC) programming, and interfacing techniques.

Unit 5: **06**

Interfacing and IoT Applications:

- Interfacing LEDs with Arduino and PIC microcontrollers, LED blinking programs, interfacing switches and seven-segment displays, interfacing temperature, light, and proximity sensors with LED and LCD displays, DC motor interfacing, speed and direction control using Arduino and PIC, Proteus simulation, introduction to IoT-based embedded applications, sensor-based monitoring systems, smart automation, and real-time embedded system applications.

References:

- Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw-Hill Education.
- Shibu K. V., Introduction to Embedded Systems, McGraw-Hill Education.
- Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi, The AVR Microcontroller and Embedded Systems Using Arduino, Pearson Education.
- Muhammad Ali Mazidi, Rolin McKinlay, and Danny Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18, Pearson Education.
- Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.

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ELECTRICAL DRIVES AND CONTROL FOR AUTOMATION BVATM404

Course Outcomes:

- Explain the components, characteristics, operating principles, and applications of electrical drive systems used in industrial automation.
- Analyse the performance, braking methods, and converter-based speed control techniques of various DC motor drives.
- Evaluate induction motor drives under different operating conditions and apply variable frequency and stator control techniques.
- Explain the operating principles, speed control methods, and inverter-fed operation of synchronous motor drives.
- Select and integrate modern electrical drive systems with automation technologies such as PLCs, CNC machines, robotics, and industrial control systems.

Unit 1: **06**

Fundamentals of Electrical Drives:

- Introduction to electrical drives, components of electrical drives including electric machines, power converters, controllers, and control circuits. Dynamics of electrical drives, torque equation, equivalent drive parameters, types of load torques, load characteristics, four-quadrant operation of motors, steady-state stability, load equalization, selection of electrical drives, and applications in industrial automation.

Unit 2: **06**

DC Motor Drives and Control:

- Construction, operating principles, characteristics, and performance of DC motors including shunt, series, compound, permanent magnet, universal, and DC servo motors. Braking methods including regenerative braking, dynamic braking, and plugging. Transient analysis of separately excited DC motors. Converter control of DC motors using single-phase and three-phase converters. Speed control methods and industrial applications of DC drives.

Unit 3: **06**

Induction Motor Drives:

- Principles of induction motor drives, stator voltage control, torque-slip characteristics, operation under different load conditions, operation with unbalanced source voltages and single phasing, performance under non-sinusoidal voltage supply, stator frequency control, variable frequency (V/F) control, controlled current operation, controlled slip operation, efficiency improvement, and applications in industrial automation.

Unit 4: **06**

Synchronous Motor Drives:

- Construction and operating principles of synchronous motors, speed control methods, adjustable frequency operation, principles of synchronous motor control, voltage source inverter (VSI) drives with open-loop control, self-controlled synchronous motors, electronic commutation techniques, load-commutated thyristor inverter drives, performance characteristics, and industrial applications.

Unit 5: **06**

Advanced Electrical Drives for Industrial Automation:

- Introduction to modern electrical drive systems, brushless DC (BLDC) motor drives, servo drives, stepper motor drives, AC and DC drive selection criteria, energy-efficient drive systems, drive protection and monitoring, programmable drive controllers, integration of electrical drives with PLCs, CNC machines, robotics, Industrial IoT (IIoT), and smart manufacturing applications.

References:

- G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House.
- Vedam Subrahmanyam, Electric Drives: Concepts and Applications, Tata McGraw-Hill.
- Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education.
- R. Krishnan, Electric Motor Drives: Modeling, Analysis, and Control, Prentice Hall.
- N. K. De and Prashant K. Sen, Electric Drives, PHI Learning.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVATM405P

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SEMESTER-05

KALINGA UNIVERSITY
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AUTOMATIC CONTROL SYSTEM
BVATM501

Course Outcomes:

- Explain the fundamentals of automatic control systems, mathematical modelling, transfer functions, block diagrams, and signal flow graphs.
- Analyse the time-domain response and performance of control systems using standard test signals, error constants, and PID controllers.
- Evaluate control system performance using frequency-domain techniques such as Bode plots, polar plots, and frequency response analysis.
- Apply the root locus technique to analyse system stability and design suitable controllers.
- Develop state-space models of linear systems and analyse system behaviour using modern control system concepts.

Unit 1: **06**

Fundamentals of Automatic Control Systems:

- Introduction to automatic control systems, open-loop and closed-loop control systems, comparison and applications, elements of closed-loop systems, transfer functions, mathematical modelling of mechanical and electrical systems, transfer function of DC generators, block diagrams, block diagram reduction techniques, signal flow graphs, Mason's gain formula, speed mode, torque mode, and applications of automatic control systems.

Unit 2: **06**

Time-Domain Analysis of Control Systems:

- Standard test signals, time response of first-order and second-order systems, transient and steady-state response, time-domain performance specifications, types of control systems, steady-state error analysis, static error constants, introduction to proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) controllers, controller tuning concepts, and applications.

Unit 3: **06**

Frequency-Domain Analysis:

- Introduction to frequency-domain analysis, frequency response specifications, correlation between time-domain and frequency-domain responses, polar plots, Bode plots, gain margin, phase margin, all-pass systems, minimum phase systems, non-minimum phase systems, frequency response analysis, and stability assessment.

Unit 4: **06**

Root Locus Technique and Stability Analysis:

- Introduction to root locus method, root locus concepts, construction of root loci, root contours, effects of pole-zero locations on system performance, stability analysis using root locus, controller design using root locus techniques, and practical applications in automatic control systems.

Unit 5: **06**

State-Space Analysis and Modern Control Systems:

- Introduction to state-space analysis, concepts of state, state variables, state equations, state models for linear time-invariant (LTI) systems, state-space representation using physical variables, phase variables, canonical variables, state transition matrix, controllability, observability, introduction to modern control systems, and engineering applications.

References:

- J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers.
- Norman S. Nise, Control Systems Engineering, 8th Edition, Wiley.
- Katsuhiko Ogata, Modern Control Engineering, 5th Edition, Pearson Education.
- Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, Wiley.
- Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education.

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MANUFACTURING & QUALITY NORMS
BVATM502

Course Outcomes:

- Explain manufacturing processes, work instructions, and quality norms followed in electronics manufacturing industries.
- Perform packing line operations, product identification, labeling, and outgoing quality assurance activities according to industry standards.
- Apply testing and inspection procedures to evaluate the quality of electronic components and finished products.
- Implement quality assurance practices using acceptance quality level (AQL), sampling techniques, and acceptance/rejection criteria.
- Analyze manufacturing defects and apply corrective actions and continuous quality improvement techniques to enhance product quality.

Unit 1: **06**

Manufacturing Operations and Work Instructions:

- Introduction to manufacturing and quality norms, manufacturing practices for different applications, manpower deployment, work instructions, process criticality, sequence of manufacturing operations, operation-wise practical understanding, process documentation, and acceptance and rejection criteria for manufacturing operations.

Unit 2: **06**

Packing Line Operations and Quality Systems:

- Packing line process, packing line operation sequence, importance of packing operations, quality systems, acceptance and rejection criteria during outgoing quality assurance (OQA), assembly of electronic components, inspection and testing of assembled products, labels and barcode scanning, importance of product identification, stages of packing, packaging standards, and acceptance criteria.

Unit 3: **06**

Testing and Quality Inspection:

- Testing procedures for electronic equipment and devices, practical training in testing and inspection, quality inspection methods, operation-wise testing procedures, quality norms, defect identification, acceptance and rejection criteria, and documentation of inspection results.

Unit 4: **06**

Quality Assurance and Sampling Techniques:

- Introduction to quality assurance (QA), acceptance quality level (AQL), sampling techniques, acceptance sampling plans, rejection criteria, statistical sampling methods, inspection procedures, QA documentation, and quality control practices in manufacturing industries.

Unit 5: **06**

Defect Analysis and Continuous Quality Improvement:

- Types of manufacturing defects, defect analysis techniques, root cause analysis, corrective and preventive actions (CAPA), continuous quality improvement, process monitoring, quality audits, documentation, and quality management practices for achieving product reliability.

References:

- Dale H. Besterfield, Quality Control, 9th Edition, Pearson Education.
- Douglas C. Montgomery, Introduction to Statistical Quality Control, 8th Edition, John Wiley & Sons.
- Amitava Mitra, Fundamentals of Quality Control and Improvement, 4th Edition, John Wiley & Sons.
- P. N. Mukherjee, Total Quality Management, PHI Learning Pvt. Ltd.
- ISO 9001:2015, Quality Management Systems – Requirements, International Organization for Standardization (ISO).

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ROBOTICS FOR INDUSTRIAL AUTOMATION
BVATM503

Course Outcomes:

- Explain the fundamentals of robotics, robot anatomy, classification, performance parameters, and principles of industrial automation.
- Select suitable grippers, sensors, and vision systems for industrial robotic applications.
- Analyse robot drive systems, actuators, transmission mechanisms, and control strategies used in robotic systems.
- Develop basic robot programs using industrial programming methods, commands, and modern robotic programming languages.
- Evaluate industrial robotic applications and emerging technologies including collaborative robots, Industry 4.0, IoT, AI, and smart manufacturing.

Unit 1: **06**

Fundamentals of Robotics and Industrial Automation:

- Introduction to robotics, history and evolution of robotics, definition and basic concepts of robotics, Three Laws of Robotics, elements of robotic systems, robot anatomy, degrees of freedom (DOF), work envelope, robot configurations, misunderstood robotic devices, classification of robotic systems based on work volume, drive systems, and applications. Performance parameters including resolution, accuracy, repeatability, dexterity, compliance, and Remote Center Compliance (RCC) devices. Introduction to automation, principles and strategies of automation, types and levels of automation, need for automation, and industrial applications of robots.

Unit 2: **06**

Robotic Grippers, Sensors and Vision Systems:

- Introduction to robotic grippers, classification and types of grippers, mechanical, pneumatic, hydraulic, magnetic, vacuum, and adhesive grippers. Design guidelines for robotic grippers, force analysis of basic gripper systems. Introduction to robotic sensors, classification and applications of sensors, characteristics and selection of sensing devices, position, proximity, force, torque, tactile, vision, and environmental sensors. Need for sensors and machine vision systems in robot control and industrial automation.

Unit 3: **06**

Robot Drives, Actuators and Control Systems:

- Introduction to robot drive systems, types of electrical, hydraulic, and pneumatic drives, transmission systems including gears, belts, chains, lead screws, and harmonic drives. Selection of actuators for robotic systems, DC motors, servo motors, stepper motors, and brushless DC motors. Introduction to robot control systems, open-loop and closed-loop control, feedback systems, types of controllers, motion control, and industrial robot control applications.

Unit 4: **06**

Robot Programming and Programming Languages:

- Introduction to robot programming, methods of robot programming including lead-through programming, teach pendant programming, offline programming, and online programming. Programming commands including WAIT, SIGNAL, DELAY, loops, and subroutines. Generations of robot programming languages, introduction to VAL, RAIL, AML, Python, Robot Operating System (ROS), evolution of robotic programming languages from WAVE to ROS, and industrial robot programming applications.

Unit 5: **06**

Industrial Applications and Emerging Trends in Robotics:

- Industrial applications of robotics in manufacturing, welding, material handling, assembly, inspection, packaging, painting, and machine tending. Collaborative robots (Cobots), flexible manufacturing systems, integration of robots with PLC, IoT, artificial intelligence, and machine vision. Robot safety standards, human–robot collaboration, predictive maintenance, Industry 4.0, smart factories, and future trends in industrial robotics.

References:

- Mikell P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill Education.
- John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education.
- Saeed B. Niku, Introduction to Robotics: Analysis, Control and Applications, 3rd Edition, Wiley.
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer.
- Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley.

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SENSORS AND TRANSDUCERS
BVATM504

Course Outcomes:

- Explain the principles of industrial measurement systems, sensors, transducers, and their static and dynamic characteristics.
- Select and apply suitable displacement sensors and transducers for industrial measurement applications.
- Analyze velocity, speed, vibration, and acceleration measurement techniques using various industrial sensors.
- Evaluate force, torque, pressure, and temperature measurement methods using appropriate transducers and instrumentation.
- Select suitable sensors and measuring instruments for industrial process control, monitoring, and automation applications.

Unit 1: **06**

Introduction to Measurement Systems:

- Measurement and measurement systems, industrial measuring parameters and their units, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria, and importance of sensors and transducers in industrial measurement.

Unit 2: **06**

Displacement Measurement:

- Displacement measurement using resistive transducers including potentiometers and strain gauges, inductive transducers including LVDT and eddy current sensors, capacitive transducers including capacitance pickups and differential capacitive transducers, piezoelectric transducers, ultrasonic transducers, Hall effect transducers, and optical transducers.

Unit 3: **06**

Velocity, Speed, Vibration and Acceleration Measurement:

- Velocity and speed measurement using electromagnetic tachometers, photoelectric tachometers, toothed rotor variable reluctance tachometers, magnetic pickups, encoders, photoelectric pickups, stroboscopes, and shaft speed measurement techniques. Vibration and acceleration measurement using eddy current transducers, piezoelectric transducers, seismic transducers, potentiometric accelerometers, LVDT accelerometers, and piezoelectric accelerometers.

Unit 4: **06**

Force and Torque Measurement:

- Basic methods of force measurement, elastic force transducers, strain gauge load cells, piezoelectric force transducers, vibrating wire force transducers, strain gauge torque meters, inductive torque meters, magnetostrictive transducers, torsion bar dynamometers, servo-controlled and absorption dynamometers, instantaneous power measurement, and alternator power measurement.

Unit 5: **06**

Pressure and Temperature Measurement:

- Pressure measurement including pressure definitions, pressure scales, standards, working principles, types of pressure sensors, materials, design criteria, manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure gauges, vacuum gauges, dead weight testers, and vacuum gauge testers.
- Temperature measurement including temperature scales, standards and units, classification of temperature sensors, bimetallic thermometers, filled system thermometers, SAMA classifications, resistance temperature detectors (RTDs), thermistors, thermocouples, thermocouple tables, lead wire compensation, cold junction compensation techniques, thermowells, thermopiles, pyrometers, and temperature IC sensors such as AD590 and LM35.

References:

- D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall of India.
- K. Sawhney, A Course in Mechanical Measurements and Instrumentation, Dhanpat Rai Publications.
- Ernest O. Doebelin and Dhanesh N. Manik, Measurement Systems: Application and Design, 6th Edition, McGraw-Hill Education.
- R. K. Rajput, Electronic Measurements and Instrumentation, S. Chand & Company Ltd.
- Bela G. Lipták (Ed.), Instrument Engineers' Handbook: Process Measurement and Analysis, 4th Edition, CRC Press.

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ON JOB TRAINING/INTERNSHIP/WORKSHOP
BVATM505P

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SEMESTER-06

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MANUFACTURING AUTOMATION AND ERGONOMICS BVATM601

Course Outcomes:

- Explain the concepts, principles, and strategies of manufacturing automation and their applications in modern industries.
- Analyze automated flow lines, assembly systems, line balancing techniques, and Industry 4.0 technologies for efficient manufacturing.
- Describe advanced manufacturing technologies, including nanotechnology, AFM, SEM, TEM, and advanced electronic packaging.
- Explain the construction, classification, and industrial applications of robotic systems and manipulators used in manufacturing automation.
- Apply ergonomic principles and human-machine interaction concepts to improve workplace safety, productivity, and manufacturing efficiency.

Unit 1: **06**

Introduction to Manufacturing Automation:

- Introduction to manufacturing automation, types and strategies of automation, principles of manufacturing automation, pneumatic and hydraulic components and circuits, automation in machine tools, mechanical feeding systems, automatic tool changing systems, machine tool control, transfer automation, and the role of automation in product realization.

Unit 2: **06**

Automated Flow Lines and Assembly Systems:

- Automated flow lines, methods of automation, mechanical buffer storage, storage control functions, design and fabrication considerations, assembly processes, assembly systems, assembly line balancing, methods of line balancing, techniques for improving line balance, flexible assembly lines, and Industry 4.0 technologies for improving manufacturing efficiency and productivity.

Unit 3: **06**

Advanced Manufacturing Technologies:

- Advancements in manufacturing, nanotechnology and its industrial applications, Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), advanced electronic packaging technologies, smart manufacturing, and emerging trends in advanced production systems.

Unit 4: **06**

Industrial Robotics:

- Introduction to robotics, classification of robots, robot work envelope, manipulators, electronic and pneumatic manipulators, end effectors, robot control systems, robot configurations, industrial robot applications, and the role of robotics in automated manufacturing.

Unit 5: **06**

Ergonomics and Human-Machine Interaction:

- Introduction to ergonomics, evolution and definitions of ergonomics, scope of ergonomics, principles and aspects of ergonomics, application areas of ergonomics, workplace design, human factors engineering, man-machine interaction, occupational safety, productivity improvement, and ergonomic considerations in manufacturing industries.

References:

- Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 5th Edition, Pearson Education.
- Serope Kalpakjian and Steven R. Schmid, Manufacturing Engineering and Technology, 8th Edition, Pearson Education.
- R. S. Khurmi and J. K. Gupta, Industrial Engineering and Production Management, S. Chand & Company Ltd.
- Jan Dul and Bernard Weerdmeester, Ergonomics for Beginners: A Quick Reference Guide, 3rd Edition, CRC Press.
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 7th Edition, Pearson Education.

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ROBOTIC DESIGN AND CONTROL
BVATM602

Course Outcomes:

- Explain the principles of robotic system design, dynamic modelling, and nonlinear system behaviour.
- Analyse the stability of robotic systems using Lyapunov methods and stability theorems.
- Apply joint space and task space control techniques for robotic position, velocity, trajectory, and force control.
- Evaluate nonlinear control methods including computed torque, adaptive, sliding mode, robust, and optimal control for robotic systems.
- Design observer-based control systems and perform simulation and analysis of robotic systems using MATLAB or MATHEMATICA.

Unit 1: **06**

Fundamentals of Robotic System Design and Dynamics:

- Introduction to robotic systems, components and architecture of robotic systems, design considerations for robotic manipulators, forward dynamics, inverse dynamics, mathematical modelling of robotic systems, properties of dynamic models, case studies of robotic systems, introduction to nonlinear systems, and basic nonlinear control concepts.

Unit 2: **06**

Stability Analysis of Robotic Systems:

- Introduction to system stability, concepts of stability in robotic systems, types of stability, Lyapunov stability theory, direct and indirect methods of Lyapunov stability analysis, Lyapunov functions, stability theorems, stability lemmas, equilibrium analysis, and applications of stability analysis in robotic control.

Unit 3: **06**

Joint Space and Task Space Control:

- Introduction to robot control schemes, joint space control, task space control, position control, velocity control, trajectory planning and tracking, force control, hybrid position-force control, motion planning, performance evaluation of control systems, and industrial applications of robotic control strategies.

Unit 4: **06**

Nonlinear Control Techniques for Robotics:

- Introduction to nonlinear control systems, proportional and derivative (PD) control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer-based control, robust control, optimal control, comparison of nonlinear control techniques, and applications in industrial robotic systems.

Unit 5: **06**

Observer Design and Simulation of Robotic Systems:

- Introduction to nonlinear observer design, observer design based on position, velocity, and acceleration feedback, state estimation techniques, numerical simulation of robotic control systems, modelling and analysis using MATLAB and MATHEMATICA, validation of robotic control algorithms, performance analysis, and case studies of robotic control applications.

References:

- Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley.
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer.
- John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education.
- Frank L. Lewis, Darren M. Dawson, and Chaouki T. Abdallah, Robot Manipulator Control: Theory and Practice, CRC Press.
- Richard M. Murray, Zexiang Li, and S. Shankar Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press.

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IOT IN INDUSTRIAL AUTOMATION
BVATM603

Course Outcomes:

After successful completion of this course, students will be able to:

- Explain the fundamentals of Industrial Internet of Things (IIoT), Industry 4.0, and smart factory concepts.
- Demonstrate the use of IIoT hardware, sensors, actuators, embedded systems, and communication technologies for industrial automation.
- Analyze IoT-based data acquisition, cloud computing, edge computing, and predictive maintenance techniques used in industrial applications.
- Apply cyber-physical systems, artificial intelligence, big data analytics, and digital technologies in modern industrial environments.
- Develop IIoT-based solutions and evaluate industrial applications addressing automation, monitoring, safety, security, and societal needs.

Unit 1: **06**

Fundamentals of Industrial IoT and Industry 4.0:

- Introduction to Industrial Internet of Things (IIoT). Evolution of industrial revolutions. Industry 4.0 concepts and smart manufacturing. Role of IoT and IIoT in industrial automation. Support systems for Industry 4.0. Smart factories, connected industries, and digital transformation.

Unit 2: **06**

IIoT Devices, Sensors and Communication Systems:

- Industrial sensors and actuators. Sensor networks for industrial applications. Process automation and data acquisition systems. Microcontrollers and embedded PCs for IIoT. Wireless sensor nodes. Bluetooth, Wi-Fi and LoRa communication protocols. IoT gateway and industrial connectivity.

Unit 3: **06**

Data Monitoring, Cloud Computing and Cyber-Physical Systems:

- IoT edge computing and edge programming. Cloud computing for industrial automation. Real-time data monitoring dashboards. Data analytics and predictive maintenance. Cyber-Physical Systems (CPS). Product Lifecycle Management (PLM). Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI), Big Data, and advanced industrial analytics.

Unit 4: **06**

Industrial IoT Applications:

- Applications of IIoT in healthcare, power plants, manufacturing industries, inventory management, quality control, plant safety and security, facility management, smart monitoring, and industrial process optimization. Industrial case studies and implementation examples.

Unit 5: **06**

IIoT System Development and Future Trends:

- Development of IIoT applications using embedded development boards and edge computing platforms. Mini projects based on industrial automation and current societal needs. Emerging trends in IIoT, digital twins, smart factories, autonomous systems, cybersecurity challenges, and future opportunities in Industrial IoT.

References:

- Boyes, H., Hallaq, B., Cunningham, J., & Watson, T., The Industrial Internet of Things (IIoT): An Analysis Framework, Springer.
- Gilchrist, A., Industry 4.0: The Industrial Internet of Things, Apress.
- Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress Publications.
- Bahga, A., & Madisetti, V., Internet of Things: A Hands-on Approach, Universities Press.
- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos & David Boyle, From Machine-to-Machine to the Internet of Things, Academic Press.

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ENTREPRENEURSHIP DEVELOPMENT
BVATM604

Course Outcomes:

- Explain the concepts, characteristics, and importance of entrepreneurship and Entrepreneurship Development Programmes (EDPs).
- Identify business opportunities and prepare strategies for project selection, financing, and enterprise establishment.
- Develop business plans and understand the procedures for establishing and managing small business enterprises.
- Analyze the role of financial and governmental institutions in promoting entrepreneurship and supporting small businesses.
- Prepare project reports and evaluate entrepreneurial challenges using practical case studies and business planning techniques.

Unit 1: **06**

Introduction to Entrepreneurship and Entrepreneurship Development Programme:

- Concept of entrepreneur and entrepreneurship, definition, characteristics and traits of entrepreneurs, classification of entrepreneurs, women entrepreneurs, role of entrepreneurs in economic development, entrepreneurship in India, concept of Entrepreneurship Development Programme (EDP), need for entrepreneurial training, phases of EDP, curriculum and contents of training programmes, support systems, target groups, and institutions conducting EDPs in India.

Unit 2: **06**

Project Identification and Entrepreneurial Finance:

- Business opportunity identification, promotion of a business venture, opportunity analysis, project identification and selection, analysis of external environment including economic, social, technological, and competitive factors, legal requirements for establishing a new enterprise, project financing, term loans, bridge finance, venture capital, government financial assistance, and procedures for approaching financial institutions for loans.

Unit 3: **06**

Small Business Enterprise Development:

- Concept of small business enterprises, identification of business opportunities in different sectors, selection of suitable business opportunities, procedures and formalities for establishing small business enterprises, registration requirements, and challenges in setting up new ventures.

Unit 4: **06**

Institutional Support for Entrepreneurship:

- Role and functions of institutions supporting entrepreneurship, Entrepreneurship Development Institute of India (EDII), Small Industries Development Organization (SIDO), National Small Industries Corporation (NSIC), National Institute for Entrepreneurship and Small Business Development (NIESBUD), support schemes for small enterprises, causes of sickness in small business enterprises, and remedial measures.

Unit 5: **06**

Project Formulation and Entrepreneurial Case Studies:

- Meaning and significance of project reports, contents of a project report, project formulation, planning commission guidelines for preparing project reports, preparation of project reports for small business enterprises, problems faced by entrepreneurs, entrepreneurial success and failure factors, and case studies of successful entrepreneurs.

References:

- Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
- S. S. Khanka, Entrepreneurial Development, S. Chand & Company Ltd.
- Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, Entrepreneurship, 11th Edition, McGraw-Hill Education.
- Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education.
- David H. Holt, Entrepreneurship: New Venture Creation, Prentice Hall of India.

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