VEER NARMAD SOUTH GUJARAT UNIVERSITY

PG DIPLOMA IN INDUSTRIAL AUTOMATION

Semester-I

Sr. No.	Subject Code	Subject Name	Scheme		Marks	
			L	P	L	P
1	IA 101	Industrial Automation	3	9	100	150
2	IA 102	Industrial Instrumentation – I	3		100	
3	IA 103	Industrial Power Electronics	3		100	
4	IA 104	Microcontrollers and Embedded System Design	3		100	
5	IA 105	Process Control	3		100	
6	IA 106	Project	0	3	0	50
		TOTAL	15	12	500	200

Semester-II

Sr. No.	Subject Code	Subject Name	Scheme		Marks	
			L	P	L	P
1	IA 201	Distributed Control System and Data Communication	3	9	100	150
2	IA 202	Industrial Instrumentation – II	3		100	
3	IA 203	Industrial Drives	3		100	
4	IA 204	Project Management and Quality Standards	3		100	
5	IA 205	Project	0	6	0	200
		TOTAL	12	15	400	350

Minimum Marks required for passing is 40% in each theory papers, practical and project separately.

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Semester-I

IA 101
INDUSTRIAL AUTOMATION

Nature of Industrial Process: continuous & discrete state sequential process, process variables and their classification.

Introduction to Process Control Philosophies: type of relays, ladder logic methodology, ladder symbols.

Introduction to Programmable Logic Controllers: advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.

PLC programming methodologies: ladder diagram, STL, functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC.

PLC functions: bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

PLC Data Handling: data move instructions, table and register moves, PLC FIFO & LIFO functions**.**

PLC arithmetic and logical functions: addition, subtraction, multiplication, division instructions, increment decrement, trigonometric and log functions, AND, OR, XOR, NOT functions, PLC compare and convert functions.

PLC program control and interrupts: jumps, subroutine, sequence control relay, watchdog.

Analog value processing: types of analog modules, analog input and output examples, PID control of continuous process.

Text/References:

- JOHN WEBB: Programmable Logic Controllers Principles & applications, PHI
- T. A. HUGHES: Programmable Controllers
- C. D. JOHNSON: Process Control Instrumentation

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Semester-I

IA 102
INDUSTRIAL INSTRUMENTATION – I

Introduction to measurements and instrumentation: Static and dynamic characteristics of instrumentation, operational modes of instrumentation, measurement standards.

Signal Processing Elements and Signal Conditioning: Amplifiers, V-I converter, I-V converters, V-F converters, F-V converters, Modulation, Filters, ADC, DAC, Telemetry, Isolation techniques.

Measurement of process variables (Temperature, Flow, Pressure, Level): Types, Application and Selection.

Electromagnetic Compatibility: Grounding and shielding, EMI and EMC testing

Text/References:

- DOEBLIN: Measurement Systems: Application and Design, TMH
- LIPTAK: Instrumentation Engineering Handbook, Chilton Book Company
- T. H. RATHORE: Digital measurement techniques
- R. K. JAIN: Mechanical and Industrial Measurements, Khanna Publishers.
- PATRANABIS: Principle of Industrial Instrumentation, TMH
- W. G. ANDREWS: Applied Instrumentation in Process Industries (Volume I & II), Gulf Book
- JOHN G. WEBSTER: The Measurement, Instrumentation and Sensors Handbook, CRC Press

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Semester-I

IA 103
INDUSTRIAL POWER ELECTRONICS

Introduction to power switching devices: Thyristor, Triac, MOSFET, IGBT their characteristics, internal structure, firing circuits, protection scheme including snubber, mounting requirements.

Phase Controlled Rectifiers: single phase bridge rectifier with R, RL and RLE load, three phase semi-converter, three phase full-converter, dual converter, harmonic issues in controlled rectifiers.

Inverters: single phase bridge inverter, three phase bridge inverter, 120 and 180 degree mode of operation, voltage and frequency control in inverters, different methods of PWM, harmonic elimination with PWM, performance parameters.

DC - DC Converters: Principle of operation of buck, boost, buck-boost, Flyback, Input & output filter design.

AC voltage controllers: single phase and three phase ac voltage controllers, harmonic performance, different topologies for three phase controllers.

Modeling of Power Electronics converters: PSIM / pSpice / Matlab.

Power electronics for Induction heating and welding

Introduction of UPS: online and offline systems, UPS architecture, Battery bank management.

Text/References:

- NED MOHAN TORE. M. UNDELAND & WILLIAM. P. ROBBINS; "Power Electronics: Converters, Applications and Design", 3rd Edition, John Wiley and Sons, 2003
- RASHID M. H, Power Electronics – Circuits, Devices and Applications", PHI / Pearson Education, 3rd Edition, 2004.
- B. K. BOSE: Power Electronics and AC drives, Prentice Hall, 1986
- S. N. SINGH: Power Electronics:

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Semester-I

IA 104
MICROCONTROLLERS AND EMBEDDED SYSTEM DESIGN

Introduction to microcontrollers: difference between microprocessor & microcontrollers, different microcontroller families and applications, overview of 8, 16 and 32 bit microcontroller architecture; embedded system overview.

Introduction to 8051 family architecture: 8051 pin diagram, 8051 architecture, special function registers, programming model, internal memory structure, on-chip peripherals, and external memory interfacing and interrupts.

Assembly language programming: data transfer instructions, arithmetic instructions, logical instructions, bit manipulation instruction and program flow control instructions.

Introduction to Software Development tools: introduction to cross compilers, assemblers, linkers and debuggers; introduction to assembler directives; introduction to emulators and other debuggers.

Embedded 'C' programming: introduction to embedded C, data types, device drivers programming and C library functions.

Study of interfacing technique and peripherals: interfacing peripherals like external memory, keyboard, display modules, ADC, DAC, stepper motors and serial port.

Serial Communication: serial communication modes and applications.

Software architectures for Embedded Systems: embedded system architectures like round robin, round robin with interrupts and introduction to RTOS

Advanced Microcontrollers: introduction to advanced microcontroller families like ARM, AVR, PIC and MSP430.

Text/References:

- KENETH AYALA: The 8051 Microcontroller Architecture & Programming, Thomson Learning.
- S. K. SHAH: Microcontrollers Programming & Interfacing.
- VALVANO: Introduction to **Embedded** Microcomputer Systems

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Semester-I

IA 105
PROCESS CONTROL

Introduction to Process Control System: Process dynamics, Degree of freedom of a process.

Sample Data System: Process modeling for sampled data system, Time domain and frequency domain modeling, Z-Transformation**.**

Control System Components: Electrical, Pneumatic and Hydraulic systems modeling.

Control Modes: P, I, D control, Evaluation, Tuning of controllers.

Control Strategies: Feedback control, Feed Forward Control, Ratio Control, Cascade Control, Over-ride control, Optimizing control system, Computed variable control system.

Control of Packaged systems: Boiler, Turbine, Heat Exchanger, Distillation Column (Case Studies)

Text/References:

- ANDREWS: Applied Instrumentation in Process Industries (Volume-IV)
- D. PATRANABIS: Principles of Process Control, TMH
- LIPTAK: Process Control
- C. D. JOHNSON: Process Control Instrumentation
- S. K. Singh: Computer aided process control, PHI
- B. C. KUO: Automatic Control System, PHI
- K. OGATA: Discrete Time Control System, Pearson Education India

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Semester-II

IA 201
DISTRIBUTED CONTROL SYSTEM AND DATA COMMUNICATION

Introduction to Data Acquisition System: Architecture of different type of DAS, PC based DAS

Distributed Control System: Evolution of DCS, Architecture of DCS, Direct Digital Control, Hierarchical structure, different functional levels, database organization for DCS, data communication link, reliability and consideration in DCS, flow sheet symbols

Introduction to communication system: Significance and impact on distributed industrial control and automation. Digital signal formats, error detection, correction and recovery circuit, message and packet switching.

Basic standards and protocols for data communication: RS485, Industrial Ethernet, Concept of Fieldbus, study of MODBUS protocol, HART

Text/References:

- LIPTAK: Instrumentation Engineering Handbook, Chilton Book Company
- POPOVIC & BHATKAR: Distributed Computer Control for Industrial Automation
- KRISHNA KANT: Computer Based Industrial Control, PHI
- DCS Manuals of Allen Bradley, ABB, Honeywell
- Manuals for Fieldbus System

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Semester-II

IA 202
INDUSTRIAL INSTRUMENTATION – II

Measurement of process variables (Displacement, Force, Velocity, Torque, pH, Conductivity, Position): Types, Application and Selection

Instrument Air System: Sizing criterion, air supply source, dryers, distribution system

Control Valve: Classification, Characteristic, Sizing, Testing procedure of Control valve, valve accessories and positioners.

Control Room and Control Panels: Control room layout, Electrical and Instrumentation Power Systems, Control Panel types, Panel bid specification and panel inspection

Area classification and Intrinsic Safety: Hazardous Area definitions, Protection methods, NEMA enclosures, Ingress Protection, Purging and intrinsic safety.

Text/References:

- LIPTAK: Instrumentation Engineering Handbook, Chilton Book Company
- ANDREWS: Applied Instrumentation in Process Industries (Volume II & III)
- DOEBLIN: Measurement Systems: Application and Design, TMH
- T. H. RATHORE: Digital measurement techniques
- R. K. JAIN: Mechanical and Industrial Measurements, Khanna Publishers.

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Semester-II

IA 203
INDUSTRIAL DRIVES

Introduction to electrical drives

Induction motor drives: different methods of speed control, variable voltage control, variable frequency control and V/F control, Field oriented control, direct torque control and vector control drives for induction motors.

Stepper Motor Drives: Full step/Half step mode, L/nR drive, PWM drive.

Servo Motor Drives: types of servo motor, closed loop position and speed control with servo motors.

Drives for BLDC motor

Text/References:

- G.K.DUBEY, Fundamentals of Electrical Drives, Narosa Publications, 1995.
- BOSE BK. " Modern Power Electronics & AC drives" IEEE press, 1998
- NED MOHAN: Power Electronics: Converters, Applications and Design
- ATHANI V. V.: Stepper motor Principle and Application, New Age International
- VEDAM SUBHARAMANIAN "Electric drives: Concepts and Applications", TMH, 1994

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Semester-II

IA 204
PROJECT MANAGEMENT AND QUALITY STANDARDS

Introduction: Foundations of Project Management, Project Life Cycle, Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure, documentation.

Project Monitoring, Control and Costing: Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT Modeling, Time-cost Trade-offs, Estimation of Project Costs, Monitoring Project Progress, Project Appraisal and Selection, Recent Trends in Project Management, Introduction to project management software.

Quality Systems: Introduction to ISO, TQM and 6σ, Quality Systems Standards,
Quality functions & functions-various definitions such as quality function, quality measurement, quality costs. Quality in production, design, marketing etc. Quality conduit, SQC, quality assurance, total quality control,TQM- Introduction, history, principles, Quality policy, Quality system, Quality management, TQM system & models, Essentials of TQM, ISO 9000 quality management system, ISO 9000 elements, applications and benefits. Zero defect. Implementation registration & certification for ISO 9000, Case studies on TQM.

Text/Reference:

- LIPTAK: Process Control Handbook
- ANDREWS: Applied Instrumentation in Process Industries
- TAPAN BAGCHI: ISO-9000 Concepts, Methods and Implementation, WHEELER
- ISO-9000 Guidelines for the process industries
- N. LOGO THETIS, “Managing for total quality”-Prentice Hall of India Pvt. Ltd.-1997.
- JOEL E. ROSS, “Total Quality Management”-Varity Book International, New delhi-1995.
- S.M. SUNDAVA RAJU, “Total Quality Management”-Tata Mc Graw Hill Publishing Co. P. Ltd, New Delhi-1995.
- A.N.SINGH, “reparation, Implementation & Registration of ISO 9000 Quality System”- Dolphin Books, New Delhi-1993.

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Semester-I

Proposed List of Practicals for PG Diploma in Industrial Automation

1. Introduction to software development tools.
2. Introduction to assembly language programming.
3. Write an assembly language program to toggle a relay at 1sec using timer 0 interrupt.
4. Write a 'C' program to interface Seven Segment displays.
5. Write a 'C' program to interface Matrix Keyboard.
6. Write a 'C' program to interface 16x2 LCD modules.
7. Write a 'C' program to interface Analog to Digital Converters & Digital to Analog Converters.
8. Write a 'C' program to vary speed of DC motor using PWM.
9. Write a 'C' program to interface PC through RS232 port.
10. Study of PLC architecture and connection details.
11. Introduction to bit logic instruction set - I.
12. Introduction to bit logic instruction set - II.
13. Study of PLC timers with ladder programming.
14. Study of PLC counters with ladder programming.
15. Introduction to PLC arithmetic and logical instructions - I.
16. Introduction to PLC arithmetic and logical instructions - II.
17. Study of PLC interrupts.
18. Introduction to PLC program control instructions - I.
19. Introduction to PLC program control instructions - II.
20. Communication of PLC with PC with Free Port Protocol.
21. Introduction to Analog value processing on PLC.
22. Mini Project on Industrial Problem.
23. Design a signal conditioning block for given input output relationship.
24. Study of instrumentation amplifier.
25. Study of V to I & I to V converters.
26. Study of isolation techniques.
27. Study of standard signals.
28. Study of pneumatic actuators and pneumatic system.
29. Study of temperature & pressure sensors.
30. Study of firing circuits for Thyristors using opto-coupler and pulse transformer.
31. Study of driver ICs for MOSFET & IGBT.
32. Study of PWM IC LM 3524.
33. Study of harmonics in power system.
34. Study of three phase inverter.
35. Study of AC voltage controller.
36. Study of induction heating.
37. Study of DC-DC converter.

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Semester-II

Proposed List of Practicals for PG Diploma in Industrial Automation

1. Study of induction motor drive.
2. Study of V/F and Vector control modes of operation of AC drive.
3. Study of AC drive parameters – I.
4. Study of AC drives parameters – II.
5. Interfacing AC drive with PLC-I.
6. Interfacing AC drive with PLC-II.
7. Design of stepper motor drive with Microcontroller.
8. Design of PMDC drive with encoder feedback.
9. Study of servo drive and position control.
10. Study of DCS-I.
11. Study of DCS-II.
12. Study of HMI.
13. HMI configuration - I.
14. HMI configuration - II.
15. HMI configuration - III.
16. Study of SCADA.
17. SCADA configuration - I.
18. SCADA configuration - II.
19. SCADA configuration - III.
20. Study of PC based DAS-I
21. Study of PC based DAS-II
22. Study of data communication protocols - I.
23. Study of data communication protocols - II.
24. Study of control valves-I.
25. Study of control valves-II.
26. Study of displacement sensors.
27. Study of Level Measurement.
28. Study of strain gauge and torque measurement.
29. Simulation of Process Control on MATLAB - I.
30. Simulation of Process Control on MATLAB - II.
31. Simulation of Process Control on MATLAB - III.

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Practical List (Semester I)

1. Introduction to CAD/MCAD Packages, GUI/Global trends in CAD Industry.
2. GUI & Sketcher Environments.
3. 3D Modeling Commands.
4. 3D Editing Tools.
5. Surfacing
6. Pull Down Menu Options
7. Misc. Command (Family of Part, Design Sensors, Library etc.)
8. Assembly I
9. Assembly II / Exploded View
10. Drafting I
11. Drafting II
12. Sheet Metal Design
13. Motion
14. Query Session
15. Project feasibility study and Project selection for design and development
16. Project : Punching machine (With motion)
17. Project : Fuel tank of bike
18. Project : Mouse
19. Project : Ordinary CRT Monitor
20. Project : Helmet
21. Project : Mobile Phone
22. Project : Wheel rim and Tyre design
23. Project : Wrist watch (Including gear system) (With motion)
24. Project : Motion of I.C. Engine
25. Project : Various types of Cams and Gears
26. Introduction to CAM Packages, GUI/Global trends in CAD/CAM Industry
27. GUI & Environments, The operation navigator, Objects, Operations, Post processing, Shop Documentation.
28. Planer milling, Profile milling, Planer milling single level, Planer milling Multi-level, Planer milling-multi region.
29. Face milling, Cavity milling, Z-level milling.
30. Surface contouring, Area milling drive methods
31. Flow cut drive method; Radial cut drive method, Engraving.
32. Spiral drive method, Surface area drive method.
33. Introduction to turning operations, Lathe cross- sections, Common turning parameters.
34. Rough turn, Finish turn, Centerline drilling, Groove OD, Thread OD.
35. IPW Management for Multiple spindles.
36. Drilling, Fixed axis drilling,
37. Multi axis drilling, drilling patterns.
38. Query Session
39. Project feasibility study and Project selection for computer aided manufacturing
40. Project : Milling
41. Project : Lathe
42. Project: Drilling

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Practical List (Semester II)

1. Introduction to different Finite Element Solver.
2. Introduction to creating and editing simple finite element model.
3. To study how to mesh the part with free shell mesh, mapped shell mesh, free solid mesh and mapped solid mesh with quality check of meshing.
4. To study the effect of different of elements (2-D element with linear and parabolic shape function, 3-D element with linear and parabolic shape function, Plane stress element, Plane strain element, Membrane element etc.) on a simple model subject to simple loading.
5. Introduction to boundary condition set-I. (Geometrical based boundary conditions.)
6. Introduction to boundary condition set-II. (FE based boundary conditions.)
7. Study of different type of boundary condition sets.
8. Introduction to solution set. (Memory usage, solver property, solver methodology, solver set creation etc.)
9. Introduction to the post processor-I. (Visualizer, results, template options, calculation domain, plot generation etc.)
10. Introduction to post processor-II. (Colorbar control, nodal value probe, result combination, report writing, animation of results etc.)
11. To study the thermal analysis.(Temperature set, Temperature loading, Thermal stress calculation etc,)
12. To study the Axysymmetric analysis.(Axysymmetric modeling, Axysymmetric loading, effect of element edge/surface on loading)
13. To study the buckling analysis.
14. To study the beam analysis. (Beam section generation, beam loading, beam Visualizer)
15. Project: FE analysis of pressure vessel.
16. Project: FE analysis of different textile machine parts.
17. Introduction to manual part programming, part program syntax, CNC control system, control system specific command.
18. Finding co-ordinates of geometry, incremental and absolute part programming.

19. Machine zero, Program zero, Rapid travel, Up-milling, Down-milling.
20. Interpolation, Linear interpolation, Circular interpolation, Helical interpolation, Plane selection.
21. Position compensation, Cutter radius compensation, Work offsets.
22. Face milling, Peripheral milling, Slots and Pocket cutting.
23. Special milling operations, Helical milling, Thread milling, Eng milling using tapered end mills, Part reversals.
24. Machining holes, Pattern of holes.
25. Fixed cycles, Dwell cycles.
26. Standard tapping operation, rigid tapping.
27. Advance part programming, Block skip functions, mirror image, co-ordinate rotation, scaling function.
28. Development of sub-program.
29. Parametric programming, FANUC custom macros.
30. Query Session
31. Project feasibility study and Project selection.
32. Project: Development of part program for gears.
33. Project: Development of part program for cam profile.
34. Project: Development of part program for hole patterns.
35. Project: Development of part program for die and mould making.
36. Design Calculation for Pressure Vessel subjected to Internal & External Pressure
37. Design Calculation for Nozzle Reinforcement
38. GA Drawing Preparation/Modeling
39. Detail Drawing (Top Head /Bottom Head/Skirt to Head Junction)
40. Nozzle Drawing
41. Insulation & External drawings
42. Design Calculation for Pressure Vessel subjected to Internal & External Pressure
43. Design Calculation for Nozzle Reinforcement