SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with 'A' grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.

Department of Mechatronics Engineering

School of Mechanical Engineering

Minutes of Board of Studies Meeting held on 21-12-2020 (Monday)

Meet Time: 10.00 a.m. to 12.30 noon

The meeting started with the welcome address delivered by Dr. S. Prakash, Professor and Dean (Session Chair). He introduced the courses to the BOS panel members. The following are the BOS members were present during the Mechatronics Engineering BOS meeting.

Sl. No.	Name	Designation	Institution	Role
1	Dr. S. Prakash	Professor and Dean	Sathyabama Institute of Science & Technology	Chair person
2	Dr.L.Vijayaraghavan	Professor	IIT Madras, Chennai	BoS Member (External)
3	Dr.N.GaneshKumar	Associate Professor	PSG Tech, Coimbatore	BoS Member (External)
4	Dr. B. Kanimozhi	Professor	Sathyabama Institute of Science & Technology	Member
5	Dr. S. Sivasaravanan	Associate Professor	Sathyabama Institute of Science & Technology	Member
6	Dr. M Sangeetha	Associate Professor	Sathyabama Institute of Science & Technology	Member
7	Mr. J. R. Deepak	Associate Professor	Sathyabama Institute of Science & Technology	Member
8	Dr.J. Lilly Mercy	Assistant Professor	Sathyabama Institute of Science & Technology	Member
9	Mr. V. Jayaprakash	Assistant Professor	Sathyabama Institute of Science & Technology	Member
10	Mr. J. Senthil Kumar	Assistant Professor	Sathyabama Institute of Science & Technology	Member
11	Mr. M Vigneshwar	Students	Sathyabama Institute of Science & Technology	Student Member
12	Mr Aman Dinodya	Students	Sathyabama Institute of Science & Technology	Student Member

Following are the discussions made in the BOS meeting

- Dr. Sangeetha suggested to revise the course **SMR1301 - Micro Electro Mechanical Systems** according to the current industrial needs which enables the student to learn basics of COMSOL software and to design micro devices, micro systems for various applications.

- Mr. J. Senthil Kumar recommended the updation in **SMR1302 - Sensors and Instrumentation** which enables the students to build his career in quality, automation and instrumentation engineering sectors. **SMR1302 Sensors and Instrumentation** help the student to design and calibration of instruments.

- **SMR1303 PLC and automation** course was proposed by Mr. V. Jayaprakash as the students has to learn the basics of SCADA, PLC and Automation enhances the programing skill which will help the student to become a PLC programmer in automation industries.

- Mr. V. Jayaprakash, proposed a new course **SMRA1201 - Fundamentals of Automation and Control** replacing **SMR1101 Digital Electronics** offered in 2018 syllabus in the second semester as the students has to learn the basics of Automation and Control which will be a prerequisite for the upcoming papers. He also suggested a new course **SMRA1401 Automation and Programmable Logic Controller** in the fourth semester as the students has to learn the basics of PLC and Automation.

- Dr. J. Lilly Mercy, suggested a new theory course **SMRA1402 Signal and Control System** in the fourth semester for students which is a prerequisite course for the other core courses. Dr. N. Ganesh Kumar, Associate Professor from PSG Tech (External BOS members) appreciated the inclusion of this paper in fourth semester which will enable the student to understand various types of system and different transfer function analyzing techniques associated with control systems. This course enhances the employability skills in antenna engineering satellite communications telecommunications Robotic vision and AI. This also makes the students to perform a vital role in designing and developing systems for manufacturing operations.

- Dr. L. Vijayaraghavan, Professor from IIT Madras, Chennai and Dr. N. Ganesh Kumar, Associate Professor from PSG Tech (External BOS members) reviewed all the courses. The Board members appreciated the inclusion of the new courses in 2019 Regulation.

New Course proposed in 2018 Syllabus

SMR1301 MICRO ELECTRO MECHANICAL SYSTEMS

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

On completion of this course the student will recognize

• Acquire knowledge about the Micromachining

• Acquire knowledge about MEMS Devices

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to MEMS: Introduction to Microsystems and microelectronics - Market scenario for MEMS. Working principle: Trimmers scaling vector and scaling laws - scaling in geometry – scaling in rigid body dynamics- scaling in electrostatic forces - scaling in electricity - scaling in fluid mechanics - scaling in heat transfer. Materials for MEMS: Silicon as a MEMS material – Crystal structure of silicon - Miller indices - silicon compounds - SiO2, SiC, Si3N4 and polycrystalline silicon - silicon piezo-resistors - Gallium arsenide - polymers for MEMS -quartz.

UNIT 2 FABRICATION OF MEMS 9 Hrs.

Clean room technology - Substrates and wafer - single crystal silicon wafer formation – ideal substrates - mechanical properties - Processes for bulk micro machining - Wet Vs dry etching - Chemical etching of Silicon - etchant systems and etching process - Reactive ion etching and DRIE - mask layout design. Processes for Surface micro machining - Deposition processes - ion implantation -Diffusion - oxidation - chemical vapor deposition -physical vapor deposition - deposition by epitaxy - photolithography and photoresists. Limitations of Bulk and surface micromachining - LIGA, SLIGA and other micro molding processes such as HeXIL

UNIT 3 DESIGN CONSIDERATIONS BASED ON MICROMECHANICS 9 Hrs.

Micromechanics considerations - static bending of thin plates - circular plates with edge fixed - rectangular plate with all edges fixed - square plate with all edges fixed - mechanical vibration - resonant vibration - micro accelerometers - design theory and damping coefficients – thermos mechanics - thermal stresses - fracture mechanics - stress intensity factors - fracture toughness – and interfacial fracture mechanics

UNIT 4 MEMS DEVICES 9 Hrs.

Micro actuation techniques - piezoelectric crystals - Shape memory alloys - bimetallics – conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - mechanical and nonmechanical micropumps - micro valves - valveless micropumps - Lab on Chip. Types of micro sensors – Micro accelerometer – Micro pressure sensors, MEMS

switches/resonators, MEMS reliability.

UNIT 5 MICROSYSTEM PACKAGING AND DESIGN 9 Hrs.

Micro system packaging - materials die level device level - system level - packaging techniques – die preparation - surface bonding - wire bonding - sealing - Case studies. Design considerations – process design - mechanical design - applications of micro system in automotive - bio medical - aerospace - telecommunication industries

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basics of MEMS technology and microsystems.

CO2 - Acquire knowledge in the types and procedures involved in MEMS fabrication.

CO3 - Apply the acquired knowledge in understanding MEMS sensors and actuators.

CO4 - Analyse various MEMS design and familiarise with optical RF MEMS.

CO5 - Ability to understand the operation of micro devices, micro systems and their applications.

CO6 - Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT / REFERENCE BOOKS

1. William I. Fletcher, 'An Engineering Approach to Digital Design', PHI.
2. B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4th Edition
3. Morris Mano, Digital Design, Pearson Education, Asia 2002.
4. John F.Wakerley, Digital Design Principles And Practices,Third Edition Updated,Pearson Education,Singapore, 2002
5. Anil K. Maini, Digital Electronics, Principles, Devices and Applications, Wiley
6. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition

SMR1302 SENSORS AND INSTRUMENTATION

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

• The principle and applications of various measurement systems.

• Learn about sensors and its uses.

UNIT 1 MEASUREMENT SYSTEMS 9 Hrs

Generalized Measurement System – Performance Characteristics: Static and Dynamic Characteristics – Errors in Measurements – Calibration and Standards – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers- General working principles of Resistive, capacitive and inductive type transducers with governing equations.

UNIT 2 MEASUREMENT OF NON ELECTRICAL PARAMETERS - 1 9 Hrs

Linear and angular displacement: Resistive, capacitive, inductive types and Optics (encoders), proximity sensorsVelocity measurement: tachometers, tachogenerators and resolvers Temperature measurement: Contact type: Bimetallic, RTD, Thermocouple and Thermistor Non- Contact type: Radiation Pyrometer – Optical Pyrometer Humidity: Capacitive and resistive and hot and wet bulbs. Other sensors: Fire, smoke and metal detectors.

UNIT 3 MEASUREMENT OF NON ELECTRICAL PARAMETERS - 2 9 Hrs

Force measurement: Resistive type strain gauges: Bridge configurations, Temperature compensation, Load cells, Fiber optic strain gauge- Semiconductor strain gauges- Piezo electric transducers.Vacuum Measurement: McLeod Gauge, Thermal Conductivity Gauge – Ionization Gauge. Airflow: Anemometers Light: UV, IR, Light emitter and detector Introduction to Acoustics and acoustic sensors: Ultrasonic sensor- Types and working of Microphones and Hydrophones – Sound level meters- Nuclear radiation sensors.

UNIT 4 MEASUREMENT OF ELECTRICAL PARAMETERS 9 Hrs

3 phase &1phase 1 watt meter and power factor - Resistive, capacitive and inductive measurements- Instrument Transformers: CT and PT; their errors, Applications of CT and PT in the extension of instrument range.

UNIT 5 SIGNAL CONDITIONING AND DATA ACQUISITION 9 Hrs

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / De multiplexer – Analog to Digital converter – Digital to Analog converter- I/P and P/I converter - Instrumentation Amplifier-V/F and F/V converter Data Acquisition -Data Logging – Data conversion – Introduction to Digital Transmission system.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the characteristics of instruments and determine the errors associated with it.
CO2 - List the various sensors and its applications.
CO3 - Understand the techniques of measurement of Dispalcement, Force, Velocity, Industrial parameters..
CO4 - Apply the knowledge of measurement in industries
CO5 - Select a device for particular measurement
CO6 - Develop an appropriate method for measurement

TEXT/ REFERENCE BOOKS:

1. Ernest O. Doebelin, "Measurement Systems – Applications and Design", Tata McGrawHill, 2009.
2. D. Patranabis, "Sensors and Transducers", PHI, New Delhi, 2nd Edition, 2010.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", OxfordScience Publications, 1999
4. A.K. Sawney and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

SMR1303 PLC AND AUTOMATION

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

On completion of this course the student will recognize

• Acquire knowledge about the PLC and automation systems

• Acquire knowledge about applications of PLC
• Acquire knowledge about Automation in various fileds.

UNIT 1 PROGRAMMABLE LOGIC CONTROLLERS 9 Hrs

Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section - Analog I/O modules - digital I/O modules CPU processor memory module – PLC programming Simple instructions - Output control devices - Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

UNIT 2 INSTRUCTIONS 9 Hrs

Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions - Data manipulating instructions-math instructions

UNIT 3 APPLICATION OF PLC 9 Hrs

Traffic light control, 24 hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control.

UNIT 4 NETWORKING OF PLC AND SCADA 9 Hrs

Networking of PLCs-Data communication-Fieldbus, PROFI bus, and Mod bus-OSI Model types-OPC function. Supervisory Control and Data Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data Storage

UNIT 5 DISTRIBUTED CONTROL SYSTEM 9 Hrs

Evolution - Architectures - Comparison - Local control unit - Process interfacing issues - Communication facilities. Operator interfaces - Low level and high level operator interfaces -Operator displays - Engineering interfaces - Low level and high level engineering interfaces Applications of DCS in - Pulp and paper environment -Power plant - Petroleum – Refining environment Introduction to Soft PLC.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the working of actuators, control valves, controllers, PLC.
CO2 - Explain the use of actuators, control valves, controllers.
CO3 - Select an appropriate controller for a process..
CO4 - Apply the knowledge of PLC in control
CO5 - Develop a program using ladder logic
CO6 - Design a control system using PLC.

TEXT / REFERENCE BOOKS

1. Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd.,New Delhi, 2010.
2. Lucas, M.P., Distributed Control System, Van Nonstrand reinhold Co. NY, 1986.
3. Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi, 2004.
4. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, (4e), ISA Publication, 2009.
5. Bolton , "Programmable Logic Controllers 5th Edition Newnes,2009

New Course proposed in 2019 Syllabus

SMRA1201 FUNDAMENTALS OF AUTOMATION AND CONTROL

L T P Credits Total Marks
3 0 0 3 100

COURSE OBJECTIVES

ÿ Be aware of the scope and usefulness of industrial automation and its consequences.
ÿ To apply automation technologies.
ÿ Learn the most common sensors and ways of wiring.
ÿ Differentiate the different types of actuators.

UNIT 1 MODELING AND ANALYSIS OF DYNAMIC SYSTEMS 9 Hrs.

Fundamental concepts in dynamic systems: systems, models, linearity, static behavior, dynamic behavior, modeling of continuous dynamic systems, Definition of transfer function. Block diagrams, Time response in linear systems.

UNIT 2 AUTOMATIC CONTROL 9 Hrs.

Concepts of feedback. Robustness, stability, accuracy, ability to follow set-points, PID control. Empirical tuning and analytical tuning, Feedback loop instrumentation, Control structures.

UNIT 3 INDUSTRIAL AUTOMATION 9 Hrs.

Concept of industrial automation, Continuous and discrete systems, Integrated production systems: CAD/CAM, CAE and CIM, General structure of an automated system, Examples of automated production systems.

UNIT 4 COMPONENTS OF AN AUTOMATED SYSTEMS 9 Hrs.

Control devices – open loop, closed loop, feedback control, Sensors- Types of sensors, Selection of Sensors, Application of sensors, Actuators- Types of actuators, Application of actuators.

UNIT 5 COMPUTER BASED INDUSTRIAL CONTROL 9 Hrs.

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems & RTU. Distributed Control System: Functional Requirements, Configurations & some

popular Distributed Control Systems. (SLE: Display Systems in Process Control Environment.)
Max: 45 Hrs.
COURSE OUTCOMES
On completion of the course, student will be able to
CO1 - Select & identify suitable automation hardware for the given application.
CO2 - Describe & explain potential areas of automation.
CO3 - Differentiate various control aspects of automation.
CO4 - Demonstrate the self-learning capability of Industrial Automation.
CO5 - SCADA architecture, communication in SCADA, develops any application based on SCADA along with GUI using SCADA software.
CO6 - Understand evolution and architecture of DCS, hierarchical control in DCS, programming DCS through function Block Diagram (FBD) method.
TEXT / REFERENCE BOOK
1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th Edition, 2009.
2. Computer Based Industrial Control- Krishna Kant, EEE-PHI, 2nd Edition, 2010.
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk.
4. Performance Modeling of Automated Manufacturing Systems,-Viswanandham, PHI, 1st Edition, 2009

SMRA1401 AUTOMATION AND PROGRAMMABLE LOGIC CONTROLLER
L T P Credits Total Marks
3 0 0 3 100
COURSE OBJECTIVES
ÿ To familiarise with the actuators, control valves and different types of controllers.
ÿ To learn about the architecture of PLC and its working.
ÿ To write programs using ladder logic.
ÿ To design a PLC based control system.
UNIT 1 ACTUATORS AND CONTROL VALVES 8 Hrs.
Control valve:, Control valve Characteristics (Inherent & Installed) Control valve terminology: Range ability, Turndown, valve capacity, viscosity index, AO, AC (Fail Safe Action) etc. Classification of control valve based on: valve body, Construction, type of actuation and application . Construction & applications of Globe: Single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly. Types of actuators: Construction, Advantages, Disadvantages & applications: Spring Diaphragm & Smart actuators. Positioners, Volume boosters, Pressure boosters, Reversing relay, Solenoid valves, Air lock, Position indicating switches, Electro pneumatic converter, Hand wheel, Motors.
UNIT 2 CONTROLLERS 9 Hrs.
Controllers: Discontinuous: ON/OFF, Multi-position Control, Floating Control, Continuous Controller: P, I, D controllers, Composite controllers, Anti-reset windup, Rate before Reset, Concept of Bump less transfers in PID controller, Effect of process characteristics on PID combination, Selection & application of controller actions.
UNIT 3 BASICS OF PROGRAMMABLE LOGIC CONTROLLER (PLC) 9 Hrs.
PLC Architecture and specifications – PLC hardware components Analog & digital Input/ Output modules - Power supplies – I/O slots, CPU & memory module – Programming devices –General PLC programming procedures - programming on-off outputs, Auxiliary commands and functions - creating ladder diagrams from process control descriptions – PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches – Latching relays.
UNIT 4 PLC INTERMEDIATE FUNCTIONS 11 Hrs.
Arithmetic functions - number comparison functions - skip and MCR functions - data move systems. PLC Advanced intermediate functions- utilizing digital bits - sequencer functions - PLC Advanced functions: alternate-programming languages - operation. PLC basic programming – digital logic Gates – Boolean algebra. Basic PLC functions-register basics-timers-countes.
UNIT 5 APPLICATIONS OF PLC 8 Hrs.
Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application - Case Study of Bottle Filling System, Field Bus and HART Protocol.
Max. 45 Hrs.
COURSE OUTCOMES
On completion of the course, student will be able to
CO1 - Understand the working of actuators, control valves, controllers, PLC.
CO2 - Explain the use of actuators, control valves, controllers.
CO3 - Select an appropriate controller for a process.
CO4 - Apply the knowledge of PLC in control.
CO5 - Develop a program using ladder logic.
CO6 - Design a control system using PLC.
TEXT/ REFERENCE BOOKS
1. Process control and Instrument technology, C.D.Johnson, TMH.

2. Instrumentation for Process measurement and control , N.A. Anderson, CRC Press.
3. Introduction to Programmable Logic Controller, Gary Dunning, DELMAR Cengage Learning.
4. Programmable Logic Controller, Webb, PHI Reference Books.

SMRA1402 SIGNAL AND CONTROL SYSTEM ENGINEERING

L T P Credits Total Marks
3 0 0 3 100

COURSE OBJECTIVES

ÿ To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.
ÿ To analyze the response and error of various types of system in time domain.
ÿ To understand the stability analysis of frequency domain systems.

UNIT 1 SYSTEM CONCEPTS 9 Hrs.

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph- Mason's Gain Formula.

UNIT 2 TIME RESPOSE ANALYSIS OF CONTROL SYSTEMS 9 Hrs.

Standard test signals, Time response of first order and second order systems with unit step as input, Time domain specification, steady state errors and static error constants, Concept of stability- P, PI, PD and PID controllers.

UNIT 3 FREQUENCY RESPONSE AND STABILITY ANALYSIS OF CONTROL SYSTEM 9 Hrs.

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin – Bode Plot The concept of stability- Routh Hurwitz stability Criterion.- Root Locus Analysis.

UNIT 4 CLASSIFICATION OF SIGNALS 9 Hrs.

Continuous time signals (CT signals) and Discrete time signals (DT signals) –Basic operations on signals-elementary signals- Step, Ramp, Pulse, Impulse, Exponential – Classification of CT and DT signals – Periodic, aperiodic signalsDeterministic and Random signals-even and odd signals – Real and Complex signals – Energy and power signals.

UNIT 5 FOURIER TRANSFORM AND LAPLACE TRANSFORM 9 Hrs.

Continuous time Fourier Transform –Properties of CTFT-Inverse Fourier transform- unilateral and bilateral Laplace Transform analysis with examples – Basic properties – Parseval's relation -Inverse Laplace transform using partial fraction expansion method – Relation between Fourier transform and Laplace transform.

Max. 45 Hrs.

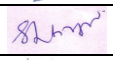
COURSE OUTCOMES

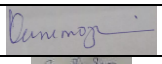
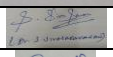
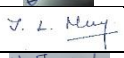
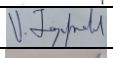
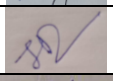
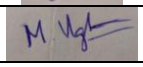
On completion of the course, student will be able to
CO1 - Understand the types of control systems in different domains.
CO2 - Analyse the response of any linear time invariant system.
CO3 - Determine and analyse the stability of the system.
CO4 - Perform the analysis of the control system by Routh Hurwitz and Root Locus.
CO5 - Understand mathematical description and representation of continuous and discrete time signals.
CO6 - Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier transform and laplace transform.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International (p) Limited Publishers, 2nd Edition, 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th Edition, 2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition 2009.
4. M.N. Bandyo padhyay, "Control Engineering, Theory and Practice" PHI, 4th Print, 2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, 200, reprint 2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd Edition, reprint 2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised reprint 2007.
8. Allan V. Oppenheim et al, 'Signals and Systems', 2nd Edition, Prentice Hall of India Pvt. Ltd., 1997.
9. P.Ramesh Babu et al, 'Signals and Systems', 4th Edition, Scitech publishers, 2010.

- Signature of BOS members

Sl. No.	Name	Signature
1	Dr. S. Prakash	
2	Dr.L.Vijayaraghavan	
3	Dr.N.Ganesh Kumar	

4	Dr. B. Kanimozhi	
5	Dr. S. Sivasaravanan	
6	Dr. M Sangeetha	
7	Dr. J. R. Deepak	
8	Dr.J. Lilly Mercy	
9	Mr. V. Jayaprakash	
10	Mr. J. Senthil Kumar	
11	Mr. M Vigneshwar	
12	Mr Aman Dinodya