



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 03-06-2023 (Saturday) **Meet Time: 10.30 a.m. to 12.30 noon**

The meeting started with the welcome address delivered by Dr.B.Kanimozhi, Professor and HOD (Session Chair). She introduced the new course and the revised courses offered to Mechatronics Engineering students 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.B.Kanimozhi	Professor and HOD	Sathyabama Institute of Science & Technology	Chair person
2	Dr. L. Vijayaraghavan	Professor	IIT Madras, Chennai	BoS Member (External)
3	Dr. N. Ganesh Kumar	Associate Professor	PSG Tech, Coimbatore	BoS Member (External)
4	Dr. M Sangeetha	Associate Professor	Sathyabama Institute of Science & Technology	Member
5	Dr. J. R. Deepak	Associate Professor	Sathyabama Institute of Science & Technology	Member
6	Mr. V. Jayaprakash	Assistant Professor	Sathyabama Institute of Science & Technology	Member
7	Dr. J. Senthil Kumar	Assistant Professor	Sathyabama Institute of Science & Technology	Member
8	Mr. K. Balachandar	Assistant Professor	Sathyabama Institute of Science & Technology	Member
9	Mr. R P Anirudh	Students	Sathyabama Institute of Science & Technology	Student Member

The following new courses 2023 Regulation is offered for students

Theory SMRB1101 Digital Electronics

The following revised courses 2019 Regulation are offered for students

Theory SMRA1601 Sensors and Instrumentation
Theory SMRA1602 Micro Electro Mechanical Systems
Practical SMRA2601 Sensors and Instrumentation Lab

Dr. M Sangeetha, suggested the revised theory course **SMRA1601 Sensors and Instrumentation** 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.

- As per the suggestions given by Dr. J R Deepak the revised theory course **SMRA1602 - Micro Electro**

Mechanical Systems (Regulation 2019) is offers to students 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. K Balachandar revised the theory course **SMR1302 - Sensors and Instrumentation** (Regulation 2018)as **SMRA1601Sensors and Instrumentation** (Regulation 2019). Learning this course will help the student to design and calibrate the instruments for manufacturing industries. He also presented the revised practical course **SMRA2601 Sensors and Instrumentation Lab** (Regulation 2019). This course enables the students to build his career in quality, automation and instrumentation engineering sectors.

- r. 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.

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SMRB1101 DIGITAL ELECTRONICS

COURSE OBJECTIVES

- ☐ To understand the fundamentals of digital logic
- ☐ To understand the various number systems and codes
- ☐ To design various combinational and sequential circuits

UNIT 1 LOGIC GATES AND MINIMIZATION CIRCUITS

9 Hrs.

Basic digital circuits AND - OR - NAND - NOR - EX-OR - EX-NOR operations - universal building block construction using logic gates - Boolean Algebra- Simplification of Boolean functions - special forms of Boolean functions – min term (SOP) – max term (POS) - K Map representation of logic functions - simplification of logic functions using K Map - Don't care conditions, Quine-McCluskey method of minimization.

UNIT 2 COMBINATIONAL CIRCUITS

9 Hrs.

Half and Full Adders - Half and Full Subtractors - Code Converters Encoder - Decoder – Multiplexer Demultiplexer - Binary/ BCD adders, subtractors - Carry look ahead adder - parity checker - parity generators - Magnitude comparator

UNIT 3 SEQUENTIAL CIRCUITS

9 Hrs.

General model of sequential circuits - flip-flops - latches - level triggering, edge triggering – master slave configuration - Mealy/Moore models - state diagram - state table - State minimization - State assignment - Excitation table and maps - shift registers - Ring counter

UNIT 4 MEMORY DEVICES

9 Hrs.

Memory types and terminology - static and dynamic RAM - ECL RAM - Non-Volatile RAM - Sequential Memories: Recirculation shift Registers-First in first out memories - Magnetic core memories - magnetic disk memories - Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT 5 SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS AND VHDL

9 Hrs.

Design of synchronous sequential circuits – parity checker – sequence detector – Asynchronous sequential logic: Race conditions and Cycles – Hazards in combinational circuits. Introduction to VHDL -Behavioral, Data Flow and Structural Model – Operators – Data objects – Data types, Attributes – Test Benches – Simple programs FOR.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply Boolean algebra principles and different types of number systems to design the digital circuits.

CO2 - Design and realize the combinational circuits using logic gates

CO3 -Design and construct synchronous sequential circuits using basic flip flops

CO4 - Analyze the various memory devices, Programmable Logic Devices and logic families

CO5 - Design and analyze the synchronous, asynchronous logic families & Hazards and mapping of data path elements using VHDL

CO6 - Analysis and Design of Various Digital Electronic Circuits.

• REVISED COURSES

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 sensors Velocity measurement: tachometers, tach generators 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 & 1 phase 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/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 Displacement, 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”, Oxford Science 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.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

- PART A : 2 Questions from each unit, each carrying 2 marks 20 Marks
- PART B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

SMRA1601 SENSORS AND INSTRUMENTATION

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

- ÿ To understand the characteristics of instruments and the sources and types of errors.
- ÿ To be familiar with different types of sensors.
- ÿ To know the techniques and methods for measurement of displacement, force, velocity.
- ÿ To know the techniques and methods for measurement of Pressure, Temperature, Flow, Level.

UNIT 1 MEASUREMENTS 9 Hrs.

General Configuration and functional description of measuring instruments-Characteristics of instruments-Static characteristics -Dynamic characteristics - Types of errors -sources of errors- methods of elimination-Analysis of data - Limiting Errors-Relative limiting error-Combination of Quantities with limiting errors – Statistical treatment of data: Histogram, Mean, Measure of dispersion from the mean, Range, Deviation, Average deviation, Standard Deviation, variance.

UNIT 2 SENSORS 9 Hrs.

Sensors for Motion and Position Measurement, GPS, INS, Doppler, SONAR, Thermal Sensors – Gas Thermometric Sensors, Acoustic Temperature Sensor, Thermo-EMF Sensors, NQR Thermometry, Heat Flux Sensor, Chemical Sensor, Hall Effect Sensor, Tactile sensor, Ultrasonic sensor, High speed Image sensor.

UNIT 3 MEASUREMENT OF DISPLACEMENT, FORCE, VELOCITY 9 Hrs.

Transducers for displacement-potentiometer, LVDT, Capacitance types, Optical Encoder, Transducers for Strain-Strain gauge, gauge factor, temperature compensation, Wheatstone bridge, Force Measurement – Load cell, different types of load cells – elastic load cell-strain gauge load cell. Torque measurement-Using strain gauge and magneto elastic principle. Transducers for velocity– Revolution counter-capacitive tachometer-type tachometer, D.C and A.C tachometer generators – stroboscopic methods.Measurement of Acceleration - Elementary accelerometer, Seismic accelerometer, Practical accelerometers.

UNIT 4 MEASUREMENT OF TEMPERATURE AND PRESSURE 9 Hrs.

Measurement of Temperature- Thermometer, Thermocouple, Thermistor, Pyrometer. Measurement of Pressure: Manometers – different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, thermocouple gauge, ionization gauge, Differential pressure Transmitter - electrical & pneumatic types.

UNIT 5 MEASUREMENT OF FLOW, LEVEL 9 Hrs.

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Doherty tube, Positive displacement meter, turbine flow meter, electromagnetic flow meter, ultrasonic flow meter, open channel flow measurement, solid flow measurement. Level: Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods-resistance type, capacitance type, ultrasonic level gauging.

Max. 45 Hrs.

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 Displacement, 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. Sawhney A.K., “Electrical & Electronic Measurements and Instrumentation”, Dhanpat Rai Publications, 2001.
2. Patranabis.D, ‘Sensors and Transducers’, Prentice Hall of India, 1999.
3. Doebelin E.O. “Measurement System Applications and Design”, TMH, 5th Edition, 2004.
4. Rangan C.S. Mani V.S.V: and Sharma G.R., “Instrumentation Devices and Systems” Tata McGraw Hill.
5. Renganathan.S, “Transducer Engineering” -Allied Publishers Limited.
6. D.V.S Murthy –“Transducer and Instrumentation”, PHI, 1st Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice 20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

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 piezoresistors - 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 - bimetallic – conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - mechanical and nonmechanicalmicropumps - micro valves - valvelessmicropumps - 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.

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B.E. / B. TechREGULAR 77 REGULATIONS 2018

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 ZvonkoVranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 Exam Duration : 3 Hrs.

PART A : 2 Questions from each unit, each carrying 2 marks 20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

SMRA1602 MICRO ELECTRO MECHANICAL SYSTEMS

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

ÿ To have adequate knowledge in MEMS and Microsystems.

ÿ To understand the fabrication procedures and have knowledge on MEMS sensors and actuators and their applications.

ÿ To be made aware of the MEMS design procedures and RFMEMS.

ÿ To investigate various applications of MEMS.

UNIT 1 INTRODUCTION 9 Hrs.

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT 2 MICRO SENSORS AND ACTUATORS 9 Hrs.

Micro-sensing for MEMS: Piezo-resistive Pressure Sensor, Capacitive sensor, Piezoelectric sensing, Resonant sensing, Surface Acoustic Wave Sensors Vibratory gyroscope, Electromechanical transducers: Piezoelectric transducers, Electrostrictive transducers, Magnetostrictive transducers, Electrostatic actuators, Electromagnetic transducers, Electrodynamic transducers, Case Study-Piezo-resistive pressure sensor, Comb drive actuators.

UNIT 3 MICROMACHINING 9 Hrs.

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies – Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistraction methods – LIGA Process – Assembly of 3D MEMS – Foundry process.

UNIT 4 POLYMER AND OPTICAL MEMS 9 Hrs.

Polymers in MEMS– Polyimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

UNIT 5 MEMS PACKAGING AND APPLICATIONS 9 Hrs.

MEMS packaging: Role of MEMS packaging, Types of MEMS packaging, selection of packaging materials, flip-chip and multichip Unit packaging, RF MEMS packaging issues. Micro-machined transmission line and components, micro-machined RF Filters, Micromachined Phase shifters, and Micro-machined antenna, Gyros and Bio-MEMS.Recent.

Max. 45 Hrs.

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. Vijay K. Varadan, K. J. Vinoy and K. A. Jose , “RF MEMS & Their Applications”, John Wiley & Sons, 2003.

2. Tai - Rai Hsu, “MEMS and Microsystems Design and Manufacturing”, Tata MC Graw Hill, New Delhi, Edition 2002.

3. Gabriel M Rebeiz, “RF MEMS - Theory Design and Technology”, John Wiley and Sons, 2003.

4. NadimMaluf, “An introduction to Micro electro mechanical system design”, ArtechHouse ,2000.

5. Chang Liu, ‘Foundations of MEMS’, Pearson Education Inc., 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice 20 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

SMR4051 SENSORS AND INSTRUMENTATION LAB

L T P Credits Total Marks

0 0 4 2 100

SUGGESTED LIST OF EXPERIMENTS

1. Study Of Sensors And Measuring Instruments
2. Measurement Of Strain Using Strain Gauge
3. Study Of Distance Measurement Using Ultrasonic Transducer
4. To Determine Output Characteristics Of LVDT And Measure Displacement Using LVDT
5. Flow Measurement and Level Detection.
6. Measurement of Inductance, Resistance and Capacitance.
7. Voltage and Current detection
8. Temperature Measurement using Thermocouple
9. Resistance Measurement using Potentiometer
10. SONAR

COURSE OUTCOMES

On completion of the course, students are able to

- CO1 - Understand the functioning of few sensors and transducers
- CO2 - Understand the characteristics of few sensors and transducers
- CO3 - Understand the process and need for calibration.
- CO4 - Calibrate voltmeters and ammeters.
- CO5 - Choose the sensor for measurement of few parameters.
- CO6 - Use the appropriate sensor and calibrate

SMRA2601 SENSORS AND INSTRUMENTATION LAB

L T P Credits Total Marks

0 0 3 2 100

COURSE OBJECTIVES

1. To understand the working of sensors and transducers.
2. To understand the characteristics of sensors.
3. To calibrate voltmeter and ammeter.

SUGGESTED LIST OF EXPERIMENTS

1. Characteristics of Thermocouple.
2. Characteristics of Potentiometer.
3. Characteristics of Strain Gauge.
4. Characteristics of LVDT.
5. Calibration of Voltmeter using Potentiometer.
6. Calibration of Ammeter using Potentiometer.
7. Characteristics of Load Cell.
8. Characteristics of Resistance Thermometer.
9. Characteristics of Thermistor.
10. Characteristics of Synchros.
11. Characteristics of Piezoelectric Sensor.
12. Characteristics of Hall Effect Sensor.

COURSE OUTCOMES

On completion of the course, students are able to

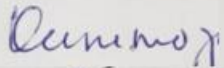
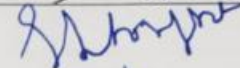
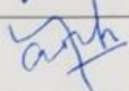
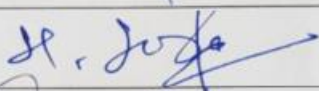
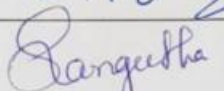
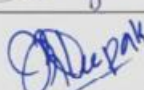
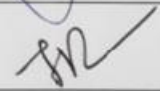
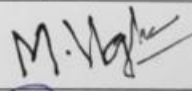
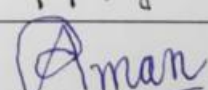
- CO1 - Understand the functioning of few sensors and transducers.
- CO2 - Understand the characteristics of few sensors and transducers.
- CO3 - Understand the process and need for calibration.
- CO4 - Calibrate voltmeters and ammeters.

CO5 - Choose the sensor for measurement of few parameters.
CO6 - Use the appropriate sensor and calibrate.

	New Course
	Portions Removed
	Portions Included

- Signature of BOS members

- Signature of BOS members

Sl. No.	Name	Signature
1	Dr. B. Kanimozhi	
2	Dr.L.Vijayaraghavan	
3	Dr.N.Ganesh Kumar	
4	Dr. S. Sivasaravanan	
5	Dr. M Sangeetha	
6	Dr. J. R. Deepak	
7	Mr. V. Jayaprakash	
8	Mr. J. Senthil Kumar	
9	Mr. M Vigneshwar	
10	Mr Aman Dinodya	



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Department of Mechatronics Engineering **School of Mechanical Engineering**

Minutes of Board of Studies Meeting held 05-12-2023 (Friday)

Meet Time: 9.45 a.m. to 11.45 noon

The meeting started with the welcome address delivered by Dr.B.Kanimozhi, Professor and HOD (Session Chair). She introduced the new course and the revised courses offered to Mechatronics Engineering students 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.B.Kanimozhi	Professor and HOD	Sathyabama Institute of Science & Technology	Chair person
2	Dr. L. Vijayaraghavan	Professor	IIT Madras, Chennai	BoS Member (External)
3	Dr. N. Ganesh Kumar	Associate Professor	PSG Tech, Coimbatore	BoS Member (External)
4	Dr. M Sangeetha	Associate Professor	Sathyabama Institute of Science & Technology	Member
5	Dr. J. R. Deepak	Associate Professor	Sathyabama Institute of Science & Technology	Member
6	Mr. V. Jayaprakash	Assistant Professor	Sathyabama Institute of Science & Technology	Member
7	Dr. J. Senthil Kumar	Assistant Professor	Sathyabama Institute of Science & Technology	Member
8	Mr. K. Balachandar	Assistant Professor	Sathyabama Institute of Science & Technology	Member
9	Mr. R P Anirudh	Students	Sathyabama Institute of Science & Technology	Student Member

The following new courses 2023 Regulation is offered for students

Theory SMRB1201 Materials and Measurement
Theory + Practical SMRB1401 Solid and Fluid Mechanics
Practical SMRB2401 Hydraulics Lab
Practical SMRB2402 Metallurgy & Metrology Lab

New Professional Electives Courses 2019 Regulation are offered for students

Theory Course SMRA3001 Instrumentation in Industries
Theory Course SMRA3002 Virtual Instrumentation
Theory Course SMRA3003 Artificial Intelligence and Expert systems
Theory Course SMRA3004 Medical Mechatronics
Theory Course SMRA3005 Experimental stress analysis
Theory Course SMRA4001 Flexible Manufacturing systems

- Dr. J. Senthil Kumar, proposed the revised theory course entitled **SMRB1201 Materials and Measurement** offered in 2023 syllabus in the second semester as the students has to learn the basics of electrical machines.
- Dr. J. R. Deepak, suggested the revised theory course **SMRB1401 Solid and Fluid Mechanics** in the second 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 solid and fluid mechanics with mathematical systems. This also makes the students to perform a vital role in designing and developing systems for manufacturing operations.
- Mr. K Balachandar revised the practical course **Practical SMRB2401 Hydraulics Lab Practical SMRB2402 Metallurgy & Metrology Lab** (Regulation 2023). This course enables the students to build his career in quality, automation and instrumentation engineering sectors.
- Based on the industrial needs Dr. B. Kanimozhi proposed the following **New Professional Electives Courses 2019 Regulation which are offered for students**

Theory Course SMRA3001 Instrumentation in Industries
 Theory Course SMRA3002 Virtual Instrumentation
 Theory Course SMRA3003 Artificial Intelligence and Expert systems
 Theory Course SMRA3004 Medical Mechatronics
 Theory Course SMRA3005 Experimental stress analysis
 Theory Course SMRA4001 Flexible Manufacturing systems

The internal and external board members welcomed the inclusion of new **Professional Electives Courses 2019 Regulation which are offered for students**.

R. 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 2023 Syllabus

SMRB1201 MATERIALS AND MEASUREMENTS

L T P EL Credits Total Marks

3 0 0 0 3 100

COURSE OBJECTIVES

To enable students to develop a fundamental understanding of materials engineering, including the construction of phase diagrams, selection and application of heat treatment processes, and identification of suitable alloys for engineering applications.

To facilitate the acquisition of knowledge in the properties and applications of polymers, ceramics, and composites, as well as the various testing procedures and failure mechanisms used in materials engineering.

To provide students with the necessary skills and knowledge for accurate measurement in manufacturing, covering terminology, instruments, tolerance analysis, gauge design, surface metrology, and GD&T.

UNIT 1 CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS

9 Hrs.

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams - Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions - Iron - Iron carbide equilibrium diagram - Classification of steel and cast iron microstructure, properties, and application.

UNIT 2 HEAT TREATMENT

9 Hrs.

Definition - Full annealing, stress relief, recrystallization, and spheroidising - normalizing, hardening, and tempering of steel - Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram - continuous cooling transformation (CCT) diagram - Austempering, Martempering - Hardenability, Jominy endquench test - case hardening, carburizing, nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening - Thermomechanical treatments - elementary ideas on sintering.

UNIT 3 METALLIC AND NON-METALLIC MATERIALS

9 Hrs.

Effect of alloying elements on steel: Mn, Si, Cr, Mo, V, Ti, W. Properties and applications of stainless steel, tool steel, HSLA - Types of cast iron: grey, white and their properties and applications - Copper and its alloys, Aluminium and its alloys properties and applications - Polymers: types of polymer, commodity and engineering polymers, properties and applications - Thermoset polymers - Engineering ceramics: properties and applications - Composites: matrix and reinforcement materials, applications of composites, nanocomposites.

UNIT 4 MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS AND ASSEMBLY AND TRANSMISSION ELEMENTS

9 Hrs.

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch, Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT 5 TOLERANCE ANALYSIS

9 Hrs.

Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental concepts of material science, crystallography, and phase diagrams, and their applications

CO2 - Compare the different types and grades of ferrous and non-ferrous alloys, their compositions, properties, and applications, and determine the suitability of different alloys for specific engineering purposes.

CO3 - Apply the concepts of various strengthening processes, such as precipitation hardening, work hardening, and solid solution strengthening, in the making of steels and other materials, and analyse their effects on the material properties.

CO4 - Understand the methods of measurement and selection of measuring instruments, standards of measurement

CO5 - Identify and apply various measuring instruments

CO6 - Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design.

TEXT / REFERENCE BOOKS

1. Avenner S.H, —Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill, Indian Edition, 2017
2. Raghavan V, —Material Science and Engineering, 5th Edition, Prentice Hall, 2005.
3. William D Callister —Material Science and Engineering, John Wiley and Sons 2007.
4. Khurmi.R.S, Sedha R.S, —Material Science, 4th Edition, S.Chand& Co., 2009
5. Dieter.G.E, —Mechanical Metallurgy, 3rd Edition, McGraw Hill, 1988.
6. Beckwith T.G. and Marangoni, —Mechanical Measurements, Addison Wesley, 2000.
7. Gupta I C, —Text Book of Engineering Metrology, Dhanpat Rai Publishers, 2003.
8. Jain R.K., —Engineering Metrology, Khanna Publishers, 2009

	New Course
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SMRB2401 HYDRAULICS LAB

COURSE OBJECTIVES

- ☐ To practically perform various principles of Fluid Mechanics.
- ☐ To understand the principle of flow measurements by various types of flow measuring devices.
- ☐ To evaluate the performance of hydraulic machines.

FLUID MECHANICS LAB

1. Measurement of friction factor in pipe flow.
2. Determination of discharge coefficient for venturimeter.
3. Determination of discharge coefficient for orifice meter.
4. Determination of discharge coefficients for notches.
5. Determination of Meta centric height of ship model.
6. Determination of Co-efficient of discharge of Orifice and Mouth Piece.
7. Determination of Co-efficient of velocity in Pitot tube.

FLUID MACHINERY LAB

1. Study and Performance characteristics of Centrifugal Pump.
2. Study and Performance characteristics of Reciprocating Pump.
3. Study and Performance characteristics of Multistage Centrifugal Pump.
4. Study and Performance characteristics of Gear Pump.
5. Study and Performance characteristics of Jet Pump.
6. Study and Performance characteristics of Deep well Turbine Pump.
7. Study and Performance characteristics of Pelton Wheel Turbine.
8. Study and Performance Characteristics of Francis Turbine.
9. Study and Performance characteristics of Kaplan Turbine

SMRB2402 METALLURGY AND METROLOGY LAB

COURSE OBJECTIVES

- ☐ Generate knowledge and skill in use of precision instruments.
- ☐ Learn a basic understanding of various instruments used in linear and angular.
- ☐ To know the micro structure of different materials

LIST OF EXPERIMENTS IN METROLOGY

1. Angle measurement using Sine bar
2. Angle measurement using Bevel Protractor.
3. Bore Measurement by two ball and four ball method
4. Testing Squareness of a Tri-square using Slip Gauges.
5. Measurement of dimensions with Tool Maker's Microscope
6. Measurement of gear tooth thickness
7. Gear profile checking using Profile projector
8. Composite error in gears using Parkinson Gear Tester
9. Measurement of surface finish.
10. Electronic Comparator

LIST OF EXPERIMENTS IN METALLURGY LAB

1. To study the metallurgical microscope.
2. Studying the preparation of a specimen for metallographic examination
3. To study the microstructure of plain carbon steel (Low carbon steel, medium carbon steel and high speed steel).
4. To study the effect of heat treatment on plain carbon steel (Annealing, Normalizing and Hardening)
5. To study the microstructure of alloy steels (Stainless steels, Tool steels)
6. To study the microstructure of cast iron (Grey cast iron, white cast iron, malleable cast iron and spheroidal graphite cast iron)
7. To study the microstructure of light alloys (Aluminium alloy and Magnesium alloy)
8. To study the microstructure of heavy alloys (Copper alloy, Nickel alloy)
9. To determine the Hardenability of steel by Jominy end quench testing.
10. To study the hardness of ferrous and non-ferrous alloy

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SMRA3001 INSTRUMENTATION IN INDUSTRIES

COURSE OBJECTIVES □ To introduce the complete operation of various industries. □ To provide an exposure to the process and instrumentation & control applications in various industries like paper, petrochemical, iron and steel, mining, pharmaceutical, nuclear and power plant industries.

UNIT 1 OVERVIEW DESCRIPTION OF INDUSTRIAL PROCESSES 11 Hrs.
Description of process in Paper Industries Description of process in petrochemical industries: Description of process in iron and steel and mining industries - Description of process in pharmaceutical and nuclear industries.

UNIT 2 INSTRUMENTATION IN PAPER INDUSTRIES 7 Hrs.
Measurement of Basic weight, thickness, density, Porosity, smoothness, softness, hardness and compressibility; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency – moisture analyzers oxidation - reduction potential and pH.

UNIT 3 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES 7 Hrs.P & I
diagram of petroleum refinery, measurement and control of absolute pressure, density, conductivity, differential pressure and flow of evaporators. Measurement and control of column pressure, liquid distillate, vapour distillate.

UNIT 4 INSTRUMENTATION IN IRON AND STEEL AND MINING INDUSTRIES 11 Hrs.Iron and steel: Selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning – special gauges for measurement of thickness and shape. Mining Industry: Weighing - conveyor belts - metal detectors – level sensors – nuclear density detectors – flow meters, Coal analyzer - thermogravimetry – gross calorific value - total sulphur analysis - ash analyser - online monitor- air quality monitoring- Sampling of ambient air – general air sampling system - Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - PH Meter - pollution monitoring instruments.

UNIT 5 INSTRUMENTATION IN PHARMACEUTICAL, NUCLEAR AND POWER PLANT INDUSTRIES 9 Hrs.
Pharmaceutical Industries: Flow measurement - pressure measurement – smoke detector Nuclear Industries: Radiation detection instruments – Area monitors and in-place detectors – Temperature measuring devices – level sensors. Power Plant Industries: Metal temperature measurements, flow of feed water – fuel, air, steam with correction factor for temperature and pressure.

Max. 45 Hrs.

SMRA3002 VIRTUAL INSTRUMENTATION

UNIT 1 REVIEW OF DIGITAL INSTRUMENTATION

6Hrs.

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT 2 FUNDAMENTALS OF VIRTUAL INSTRUMENTATION

10 Hrs.

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multichannel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT 3 CLUSTER OF INSTRUMENTS IN VI SYSTEM

10Hrs.

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

UNIT 4 GRAPHICAL PROGRAMMING ENVIRONMENT IN VI

10Hrs.

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

UNIT 5 ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI

9 Hrs.

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.
4. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
5. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.
6. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi, 2010.
7. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.

	New Course
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SMRA3003 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

COURSE OBJECTIVES

- To understand Basic Concepts of Artificial Intelligence and Expert Systems.
- To provide knowledge on Various Techniques and Tools involved in Artificial Intelligence.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction: History, Definition of AI, Emulation of human cognitive process, knowledge search tradeoff, stored knowledge, semantic nets. An abstract view of modeling, elementary knowledge. Computational logic, analysis of compound statements using simple logic connectives, predicate logic, knowledge organization and manipulation, knowledge acquisition.

UNIT 2 PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE

9 Hrs.

LISP and other programming languages- introduction to LISP, syntax and numerical function, LISP and PROLOG distinction, input output and local variables, Interaction and recursion, property list and arrays alternative languages, formalized symbolic logics- properties of WFRS, non-deductive inference methods. Inconsistencies and uncertainties- Truth maintenance systems, default reasoning and closed world assumption, Model and temporary logic.

UNIT 3 SEARCH METHODS AND KNOWLEDGE REPRESENTATION

9 Hrs.

Fuzzy logic - concepts, Introduction to Fuzzy logic with examples, probabilistic reasoning, Bayesian probabilistic inference, Dempster Shafer theory, possible world representation, Ad-Hoc methods. Structure knowledge: Graph, frames and related structures, Object oriented representation- object classes, message and methods, simulation examples using OOPS programs, OOP languages. Search and control strategies - Concepts, search problems, uniformed or Blined search, searching AND – OR graphs.

UNIT 4 KNOWLEDGE ORGANISATION AND COMMUNICATION IN EXPERT SYSTEMS

9 Hrs.

Matching techniques- Need for matching, matching problem, partial matching, Fuzzy matching, RETE matching algorithm. Knowledge organization- Indexing and retrieval techniques, integration of knowledge in memory organization systems, Perception, communication and Expert systems. Overview of Linguistics, Basic passim techniques, semantic analysis and representation structures, natural language generation and system.

UNIT 5 PATTERN RECOGNITION AND LEARNING TECHNIQUES

9 Hrs.

Pattern recognition system- understanding speech recognition, Image transformation, low level processing, medium and high level processing, vision system architecture, Rule based system architecture, knowledge acquisition and validation, knowledge system building tools, use of AI and ES in manufacturing and design, types of learning- general learning model, performance measures, learning automate genetic algorithm, learning by induction - LEX, ID3, INDUCE systems. Max. 45 Hrs.

COURSE OUTCOMES: On completion of the course, student will be able to

- CO1 - Understand the Basics about Artificial Intelligence and Expert Systems.
- CO2 - Understand the Programming Logics in Artificial Intelligence.
- CO3 - Understand Various search methods in Artificial Intelligence.
- CO4 - Understand the Knowledge about the Expert Systems.
- CO5 - Understand The Image processing and analysis.
- CO6 - Understand the latest developments in Knowledge systems and Tools.

SMRA3004 MEDICAL MECHATRONICS

COURSE OBJECTIVES

- To identify different types of biomedical units such as pathological, diagnostic, therapeutic and prosthetic devices.
- To educate students the different mechanism to measure and monitor different biomedical parameters.

UNIT 1 INTRODUCTION

9 Hrs.

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential Different electrodes for measurement, Classification of Biomedical instruments, ECG, EEG, EMG – machine description – methods of measurement.

UNIT 2 SENSORS AND TRANSDUCERS

9 Hrs.

Basic transducer principles Types — resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation Sensor applications in medicine – External and implantable sensors.

UNIT 3 ORTHOTICS AND PROSTHETICS

9 Hrs.

Need and Classification of orthotics and prosthetics, Gait Cycle, Upper and Lower limb Prosthetic devices. Upper and Lower limb Orthotic devices, FES system, Design of manual and powered wheelchairs.

UNIT 4 MEDICAL IMAGING

9 Hrs.

Computed Tomography, Spiral or Helical , Angiography., Magnetic resonance imaging, Nuclear medical imaging, Ultrasound Imaging, Thermography, Endoscopy, Laparoscopy.

UNIT 5 APPLICATIONS & CASE STUDIES

9 Hrs.

Robots in surgery, Nano robots in medicine, Rehabilitation robots, Navigation Handheld snake like robots, Smart sensors for detecting kidney stones ,Active prosthetic Knee, Smart system for cardiovascular plaque detection.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comment on various measurement systems used in diagnostics.

CO2 - Describe the sensors and transducers used in biomedical engineering.

CO3 - Design suitable orthotic and prosthetic devices and applications.

CO4 - Explain the working of different imaging techniques in Biomedical Engineering.

CO5 - Analyse the applications of mechatronics in medicine.

CO6 - Design medical equipment using the mechanical aspects gained.

TEXT / REFERENCE BOOKS

1. SiamakNajarian“ Mechatronics in Medicine – A Bio medical engg approach" , McGraw – Hill Education , 2011.
2. R.S. Khandpur, Handbook of biomedical Instrumentation, Tata McGraw Hill Publication company Ltd, New Delhi, 2014.
3. Joseph J. Carr, John Michael Brown, Introduction to Biomedical Equipment Technology 4th Edition, Pearson Education, 2012.
4. John G. Webster, Biomedical Instrumentation, Wiley Publications.2007. 5. Textbook of rehabilitation, Sunder, Jaypee Publications, 2010.

SMRA3005 EXPERIMENTAL STRESS ANALYSIS

COURSE OBJECTIVES

- ☐ To understand the fundamental concepts and gain experimental knowledge of stress/strain developed in engineering materials and structures.
- ☐ To gain knowledge of stress/strain measuring gauges.
- ☐ To handle measuring gauges to measure stress/strain and apply various methods.
- ☐ To gain the knowledge of Moire and Photoelasticity techniques.
- ☐ To gain the knowledge of Brittle and Birefringent coating methods.

UNIT 1 OVERVIEW OF EXPERIMENTAL STRESS ANALYSIS

7 Hrs.

Introduction - Concept of stress and strain – stress and strain relations - Experimental stress analysis - Advantages – Methods - Simplification of problems - Selection of Experimental Techniques.

UNIT 2 STRAIN MEASUREMENT AND RECORDING INSTRUMENTS

10 Hrs.

Introduction - Principle - Types of strain gauges – Applications – Materials - Strain Sensitivity - Bridge Sensitivity - Gauge factor – Calibration and Temperature compensation - Wheatstone Bridge and Potentiometer Circuits - Rosettes strain gauges and analysis - Strain Gauge Selection - Stress Gauges - Load Cells - Data Acquisition - Six Component Balance - Recording Instruments - Static and Dynamic recording at various frequencies.

UNIT 3 MOIRE METHODS

10 Hrs.

Introduction - Mechanism of formation of Moire fringes - Geometrical approach to Moire fringe analysis - Displacement field approach to Moire fringe analysis - Out of plane measurements Tardy's Method - Babinet Soleil Method - Sharpening and multiplication of Moire - Fringes, Experimental procedure and techniques.

UNIT 4 PHOTO ELASTICITY METHODS

10 Hrs.

Introduction – Two and three dimensional photoelasticity - Concept of light - Methods - Materials for Photo elasticity - Photoelastic Effects -Temporary double refraction - Stress optic law - Effects of stressed model in a plane Polariscopes - Fringe multiplication - Isochromatic fringe patterns - Isoclinic fringe patterns - Compensation techniques - Calibration methods - Separation and Shear Difference Methods - Scaling model to prototype stresses.

UNIT 5 BRITTLE AND BIREFRINGENT COATING METHODS

8 Hrs.

Introduction - Types of Coating methods – Brittle and Birefringent coatings -Test procedures– applications – Failure theories - Coating Materials- Coating stresses and strains - effect of coating thickness -Crack pattern – Crack detection– Calibration procedures –Brittle coating data analysis- Fringe-order determinations and stress separation method..

COURSE OUTCOMES On completion of the course, student will be able to

CO1 - Understand the basics of experimental stress analysis.

CO2 - Remember and explain overall concepts of stress/strain analysis and recording instruments by using experimental means of stress and strain gauges.

CO3 - Discuss the theory and practice of Moire methods and evaluate stress/strain.

CO4 - Analyze the theory and practice of Photoelasticity analysis methods for various materials.

CO5 - Describe and compare the Brittle and Birefringent coatings and working of strain gauges.

CO6 - Develop a procedure to solve the practical problems

	New Course
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SMRA4001 FLEXIBLE MANUFACTURING SYSTEMS

COURSE OBJECTIVES

- ☐ To understand and develop knowledge on the various flexible manufacturing systems and its applications.
- ☐ To get introduced to the simulation process and FMS database.
- ☐ To explore the future prospects of AI and Expert systems in FMS.

UNIT 1 INTRODUCTION

9Hrs.

FMS– development of manufacturing systems – benefits – major elements – types of flexibility-part selection problems– FMS application and flexibility –single product, single batch, N – batch scheduling problem – knowledge based scheduling system.

UNIT 2 COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS

9 Hrs.

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – Object oriented control architecture trends.

UNIT 3 FMS SIMULATION AND DATA BASE

9Hrs.

Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database- predictive control algorithms for on line scheduling of FMS.

UNIT 4 GROUP TECHNOLOGY AND JUSTIFICATION OF FMS

9Hrs.

Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justificationMeasuring flexibility and performance of FMS.

UNIT 5 APPLICATIONS OF FMS AND FACTORY OF THE FUTURE

9Hrs.

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – Case studies. FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

Max. 45 Hrs.

COURSE OUTCOMES On completion of the course, student will be able to

CO1 - Identify the need and role of Flexible Manufacturing System in Industry.

CO2 - Assess the concepts and linkage of software in FMS.

CO3 - Demonstrate the simulation process involved and its data flow.

CO4 - Justify the importance of FMS and its importance in group technology.

CO5 - Compare and categorise the level of FMS needed in an manufacturing industry.

CO6 - Appreciate and explore the penetration of AI in FMS.

TEXT / REFERENCE BOOKS

1 Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc., 2012.

2 Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 2010.

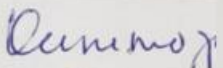
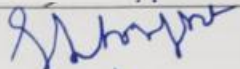
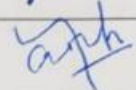
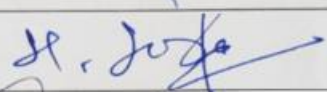
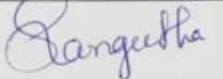
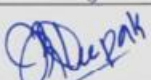
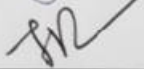
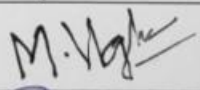
3 Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 2015.

4 Jan Beier, “Simulation approach towards energy flexible manufacturing systems”, Springer Publications, 2017.

5 H.K. Shivanand, “Flexible Manufacturing System”, New Age International Publishers, 2011. 6 TaiichiOhno, “Toyota production system: beyond large-scale production”, Productivity Press

- Signature of BOS members

- Signature of BOS members

Sl. No.	Name	Signature
1	Dr. B. Kanimozhi	
2	Dr.L.Vijayaraghavan	
3	Dr.N.Ganesh Kumar	
4	Dr. S. Sivasaravanan	
5	Dr. M Sangeetha	
6	Dr. J. R. Deepak	
7	Mr. V. Jayaprakash	
8	Mr. J. Senthil Kumar	
9	Mr. M Vigneshwar	
10	Mr Aman Dinodya	