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 04-06-2022 (Saturday)

Meet Time: 9.45 a.m. to 11.45 noon

The meeting started with the welcome address delivered by Dr. S. Prakash, Professor and Dean (Session Chair). He 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. 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	Dr. 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

- Dr. S. Prakash proposed a new course entitled **SMEA3005 - Non-Destructive Testing and Techniques (Theory Course)** based on the current industrial requirements. Learning this course helps the students to improve the skill in the field of NDT and Quality Inspection. On learning this course students will be able to work with various NDT technologies like Radiography, Thermography, Ultrasonic Methods etc. which can be applied for various industrial applications. More over students will be able to develop new hybrid NDT Technologies for detecting various defects and for quality inspection in industries. On learning the course curriculum, the student will also be able to choose the correct NDT method for inspecting various components.

- Dr. J. R. Deepak proposed the revised theory course entitled **SMRA1701 - Robotics and Machine Vision System (Theory Course) 2019 regulation** from **SMR1401 - Robotics and Machine Vision System (Theory Course)** from the **2018 regulation** based on the futuristic requirements for the students in the field of Robotics and Automation. The course curriculum enables the student to select the appropriate end effector, actuator, driver for various industrial process and loading applications.

- **SMRA2701 - Robotics and CAM Lab (Practical Course) 2019 regulation** was also revised and proposed from **SPR4054 - CAD / CAM Lab and SMR4052 - Robotics Lab (Practical Course) 2018 regulation** by Dr. M. Sangeetha based on the futuristic requirements for the students in the field of robotics and Automation. On learning these courses students will be able to design and develop various robots and End effectors for various applications. Students will be able to write programs for robots for various industrial automation applications.

- Dr. N. Ganesh Kumar, Associate Professor from PSG Tech appreciated the idea of introducing **SMRA2701 - Robotics and CAM Lab (Practical Course)** and **SMRA1701 - Robotics and Machine Vision System (Theory Course)** saying that skill set of the mechatronics engineering students of Sathyabama Institute of science and technology will match the current needs of the robotics and Automation Industry.

- 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.

- ## NEWELY PROPOSED AND REVISED COURSES

SMEA3005	Non-Destructive Testing and Techniques	2022	7	New
SMRA1701	Robotics and Machine Vision System	2022	7	Revised
SMRA2701	Robotics and CAM Lab	2022	7	Revised

- ## NEW COURSES

SMEA3005 NON-DESTRUCTIVE TESTING AND TECHNIQUES
L T P Credits Total Marks
3 0 0 3 100
COURSE OBJECTIVES
 To enable the student to understand the modern NDT techniques.
 To present the underlying principles and alternatives for destructive testing procedures.
 To provide the student with the opportunity for hands-on experience for diverse domains of application.
UNIT 1 INTRODUCTION AND VISUAL INSPECTION METHODS 9 Hrs.
Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual Inspection-Unaided, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength and surface defects.
UNIT 2 LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 9 Hrs.
Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Magnetic particle Inspection – Scope, principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing. Advantages, limitations Interpretation of results. DC and AC magnetization, Skin Effect, use of dye and wet powders for magna glow testing, different methods to generate magnetic fields, Applications and demonstration.
UNIT 3 RADIOGRAPHIC METHODS 9 Hrs.
X-ray radiography principle, equipment and methodology. Applicability, types of radiations limitations. Interpretation of Radiographs, limitations of gamma-ray radiography –principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials and technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, scattering factor. Precautions against radiation hazards. Xero-Radiography, Digital Radiography,

Gamma ray Radiography, Safety in X- ray and Gamma ray radiography. Advantages of gammaray radiography over X-ray radiography.

UNIT 4 ULTRASONIC TESTING AND ACOUSTIC EMISSION TESTING 9 Hrs.

Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages& Limitations, Applications and demonstration.

UNIT 5 EDDY CURRENT TESTING AND THERMOGRAPHY 9 Hrs.

Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages and Limitations and applications. Thermography – Introduction, Principle, Contact and Non-Contact inspection methods, Active and Passive methods, Liquid Crystal – Concept, example, advantages and limitations. Electromagnetic spectrum, infrared thermography-approaches, IR detectors, Applications and demonstration.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recall the basic concepts of NDT.
CO2 - Interpret the quality of the components.
CO3 - Design the precautions against the radiation hazards.
CO4 - Apply the knowledge on Interpretation of results.
CO5 - Analyze products as production team member.
CO6 - Apply the knowledge on Electromagnetic spectrum.

TEXT / REFERENCE BOOKS

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park,
Ohio, USA, 200, Volume-17.
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic 2002.
3. Paul E Mix, “Introduction to non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.
4. Ravi Prakash, “Non-Destructive Testing Techniques”, New Age International Publishers, 1st Revised Edition, 2010.

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 of internal choice, each carrying 16 marks 80 Marks

- **REVISED COURSES**

SMRA1701 ROBOTICS AND MACHINE VISION SYSTEM

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVES

ÿ To introduce the robotic concepts, parts and various types of robots.
ÿ To make the students familiar with sensors, drive systems for robot and their applications in robots, programming of robots.
ÿ To understand the various applications of robots, justification, implementation and safety of robot.

UNIT 1 BASICS OF ROBOTICS 9 Hrs.

Introduction-Anatomy of Robot-Laws of robotics- Configurations of robot-work volume- -Spatial resolution-accuracy resolution –repeatability of robot-Drive Systems of Robot-Control system of Robot-: Robot motions Rotary to rotary motion, Rotary to linear motion, Harmonics Drives-Robotic sensors and actuators-control systems-Robot actuation and feedback components- Power transmission system.

UNIT 2 ROBOT END EFFECTORS 9 Hrs.

Robot End effectors: Types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers-Tools-Selection and design of Grippers.

UNIT 3 ROBOT MECHANICS 9 Hrs.

Robot kinematics: Introduction-Position representation- rigid motion & homogeneous transformation forward & inverse kinematics- trajectory planning-Wrist Orientation-Manipulator path control. Robot Dynamics: Robot Arm dynamics – Lagrange - Euler formulation- Newton - Euler formulation.

UNIT 4 MACHINE VISION SYSTEM 9 Hrs.

Machine vision:- Sensing and Digitizing-Imaging Devices-Lighting Techniques-AD Converter-Image Processing-Date reduction-segmentation- Thresholding-Region Growing-Edge Detection-Feature extraction-Object recognition-Applications Inspection-identification-visual servicing and navigation-Training the vision.

UNIT 5 ROBOT PROGRAMMING 9 Hrs.

Robot programming: Types-Methods of Defining Position-Motion Interpolation-Commands-Branching-Robot LanguagesClassification of robot language-Computer control and robot software-Val system and Languages-application of robots.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able

CO1 - Understand the basic concepts of Robotics.

CO2 - Educate the various types of End effectors used in robots for various applications.

CO3 - Introduce the position representation on work space.

CO4 - Understand machine vision system and its applications.

CO5 - Impart knowledge on robot programming language and to educate how to program a robot.

CO6 - Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of
robotics.

TEXT / REFERENCE BOOKS

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications"
Tata, McGraw-Hill Education Pvt Limited, 2010.
2. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" 6th Edition, Tata McGraw- Hill Publication, 2013.
3. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw- Hill Publication, 2009.
4. John.J.Craig, "Introduction to Robotics: Mechanics & Control", 2nd Edition, 2012.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010.

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

SMR1401 ROBOTICS AND MACHINE VISION SYSTEM

L T P Credits Total Marks

3 0 0 3 100

COURSE OBJECTIVE

 Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

UNIT 1 BASICS OF ROBOTICS 9 Hrs.

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space accuracy-resolution – repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives

UNIT 2 ROBOT END EFFECTORS 9 Hrs.

Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism-gripper force analysis- other types of gripper- special purpose grippers.

UNIT 3 ROBOT MECHANICS 9 Hrs.

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction – Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT 4 MACHINE VISION FUNDAMENTALS 9 Hrs.

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction- windowing technique- segmentation- Thresholding- edge detection- binary morphology – grey morphology

UNIT 5 ROBOT PROGRAMMING 9 Hrs.

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able
CO1 - To understand the basic concepts of Robotics.
CO2 - To educate the various types of End effectors used in robots for various applications.
CO3 - To introduce the position representation on work space.
CO4 - To understand machine vision system and its applications.
CO5 - To impart knowledge on robot programming language and to educate how to program a robot.
CO6 - Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics.

TEXT / REFERENCE BOOKS:
1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited, 2008
2. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Sixth edition, Tata McGraw- Hill Publication, 2003.
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B.E. / B. TechREGULAR 87 REGULATIONS 2018
3. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw- Hill Publication, 1987.
4. John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010
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

SMRA2701 ROBOTICS AND CAM LAB
L T P Credits Total Marks
0 0 4 2 100
COURSE OBJECTIVES
ÿ To introduce different types of robotics and demonstrate them to identify different parts and Components.
ÿ To write programming for simple operations like pick and place, rotoxim etc.
ÿ Use of Adam's software and MAT Lab software to model the different types of robots and calculate work volume for different robots.
ÿ To study the features of CNC Machine Tool.
ÿ To expose students to modern control systems (Fanuc).
ÿ To know the application of various CNC machines like CNC lathe, CNC Milling etc.

SUGGESTED LIST OF EXPERIMENTS – ROBOTICS LAB
1. Study of Robot anatomy and programming methods.
2. Study of sensor operations using LEGO kits.
3. Study of Actuators using LEGO kits.
4. Programming of basic motion commands using Teach pendant.
5. Programming for pick and place and palletizing operation in Robot.
6. Programming the robot for a drilling and Milling application.
7. Programming on operation for cutting and welding application.
8. Programming a parallel kinematic robot for a pick and place application.
9. Introduction to Matlab for Image processing.
10. Reduction and Noise and Grey levels using Mat lab.

SUGGESTED LIST OF EXPERIMENTS - CAM LAB
CNC LATHE
i) Part Programming for;
· Facing
· Turning
· Step Turning
· Taper Turning
· Chamfering
· Threading
· Grooving

· Boring
· Drilling
CNC MILLING
i) Part Programming for;
· Point to Point Motions
· Linear Motions
· Contour Motions
· Peck Drilling
· Rectangular Pocketing
· Circular Pocketing
· Mirroring

COURSE OUTCOMES
On completion of the course, student will be able
CO1 - Provide sufficient knowledge of industrial robot.
CO2 - Understand basic knowledge of robot programming.
CO3 - Understand the concepts of work volume, configuration of industrial robot.
CO4 - Understand the latest development in CNC system.
CO5 - Understand the basic concepts of CNC programming and machining.
CO6 - Prepare CNC Part Programming and preform manufacturing.

SPR4054 CAD /CAM LAB
(For Mech, Mech&Prod & Auto)
L T P Credits Total Marks
0 0 4 2 100

SUGGESTED LIST OF EXPERIMENTS
A.CAD LAB
CAD ANALYSIS USING ANALYSIS SOFTWARE
Exercises will be given on Analyzing of mechanical components using Suitable Software
1. Cantilever beam with Point load at the end
2. Simply supported beam with inclined load
3. Overhanging beam with Uniformly distributed load (UDL)
4. Determination of deflection for a Truss system
5. Determination of deflection in a Pressure vessel
6. Determination of deflection in a Bent tube
7. Determination of temperature distribution in a stepped bar
8. Analysis of a bicycle frame
9. Thermal - mixed boundary example
B.CAM LAB
1. CNC Milling
(i). Part Programming for: Point to point motions, Contour motions, Circular milling, Linear motions, Pocket milling, Mirroring Commands, Circular interpolations (both CW & CCW). Rectangular milling.
(ii). Part Programming involving fixed or canned cycles: Drilling, Peck drilling, Boring and Tapping. (iii). Part programming using: Do loops, Sub Routines.
2. CNC Lathe
(i). Part programming for: Turning, Facing, Chamfering, Grooving, Step Turning, Taper Turning, Circular Interpolation.
(ii). Part programming using standard fixed cycles: Turning, Facing, Taper Turning, Thread Cuttings.

COURSE OUTCOME
CO1 - Execute steps required for modeling 3D objects by using protrusion, cut, sweep, extrude commands
CO2 - Convert 3D solid models into 2D drawing-different views, sections
CO3 - Use isometric views and dimensioning of part models
CO4 - Machine simple components on CNC machines
CO5 - Use CAM software to generate NC code
CO6 - Implement CNC programs for milling and turning machining operations

SMR4052 ROBOTICS LAB
L T P Credits Total Marks
0 0 4 2 100

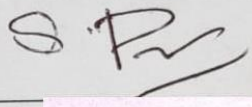
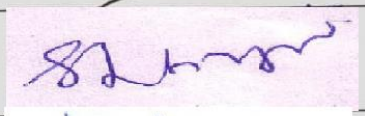
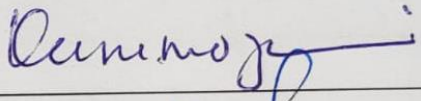
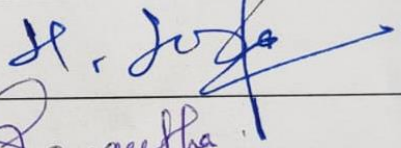
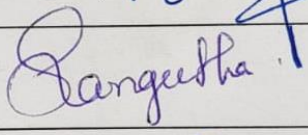
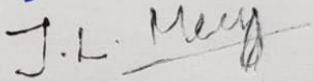
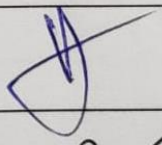
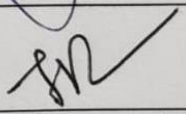
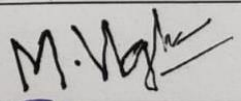
SUGGESTED LIST OF EXPERIMENTS
1. Study of Robot anatomy and programming methods
2. Study of sensor operations using LEGO kits
3. Study of Actuators using LEGO kits
4. Programming of basic motion commands using Teach pendant
5. Programming for pick and place operation in ROBOT
6. Programming the robot for a drilling application
7. Programming on palletizing operation
8. Programming a parallel kinematic robot for a pick and place application
9. Introduction to Matlab for Image processing
10. Reduction and Noise and Grey levels using Matlab

Course Outcome
After the successful completion of the course the students will be able to:
CO1 - Explain the fundamentals of robotics and its components
CO2 - Illustrate the Kinematics and Dynamics of robotics
CO3 - Elucidate the need and implementation of related Instrumentation & control in robotics
CO4 - Illustrate the movement of robotic joints with computers/microcontrollers.
CO5 - Explain sensors and instrumentation in robotics
CO6 - To learn about application of robot

Note:

- The Contents Highlighted in Green Colour are new inclusions
- The Contents Highlighted in Yellow Colour remains unchanged
- The Contents Highlighted in red colour are the portions being removed.

- 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	
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