

# EMBEDDED SYSTEMS



**Dr. ANIKET S. KOTHAWALE**

**Prof. (Dr.) JAGDISH D. DESHPANDE**

**Prof. (Dr.) ASHOK E. KALANGE**

**Prof. DHANANJAY V. BANSODE**

# **EMBEDDED SYSTEMS**

**FIRST EDITION**

## **Authors**

**DR. ANIKET S. KOTHAWALE**

**PROF. (DR.) JAGDISH. D. DESHPANDE**

**PROF. (DR.) ASHOK E. KALANGE**

**PROF. DHANANJAY V. BANSODE**

**QIP**

**Title of the Book:** Embedded Systems

**Edition:** First - 2023

**Copyrights © Authors**

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

### **Disclaimer**

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN:** 978-93-5762-133-5

**MRP:** Rs. 600/-

**PUBLISHER & PRINTER:** Alpha International Publication (AIP),  
3/725/2, Kammangudi, Adichapuram,  
Thiruvarur District, Tamilnadu- 614717, INDIA

**Email:** [editoraippublications@gmail.com](mailto:editoraippublications@gmail.com)

**Website:** [www.alphainternationalpublication.com](http://www.alphainternationalpublication.com)

# SYLLABUS

**UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN**  
Complex systems and microprocessors- Embedded system design process -Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis - Specifications- System analysis and architecture design - Quality Assurance- techniques - Designing with computing platforms - consumer electronics architecture - platform-level performance analysis.

**UNIT II ARM PROCESSOR AND PERIPHERALS**  
ARM Architecture Versions - ARM Architecture - Instruction Set - Stacks and Subroutines - Features of the LPC 214X Family - Peripherals - The Timer Unit - Pulse Width Modulation Unit - UART - Block Diagram of ARM9 and ARM Cortex M3 MCU.

**UNIT III EMBEDDED PROGRAMMING**  
Components for embedded programs- Models of programs- Assembly, linking and loading - compilation techniques- Program level performance analysis - Software performance optimization - Program level energy and power analysis and optimization - Analysis and optimization of program size- Program validation and testing.

**UNIT IV REAL TIME SYSTEMS**  
Structure of a Real Time System -- Estimating program run times - Task Assignment and Scheduling - Fault Tolerance Techniques - Reliability, Evaluation - Clock Synchronization.

**UNIT V PROCESSES AND OPERATING SYSTEMS**  
Introduction - Multiple tasks and multiple processes - Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms - Evaluating operating system performance- power optimization strategies for processes - Example Real time operating systems-POSIX-Windows CE. Distributed embedded systems - MPSoCs and shared memory multiprocessors. - Design Example - Audio player, Engine control unit - Video accelerator.

## Author's Profile



**Dr. Aniket S. Kothawale** is currently working as Assistant Professor in Electronics Department at Tuljaram Chaturchand College of Arts, Science and Commerce, (Autonomous), Baramati, affiliated to Savitribai Phule Pune University, Pune. He has more than 11 years of teaching experience. He obtained his Bachelor of Science degree in Electronic Science in Tuljaram chaturchand College, Baramati, & Master degree from Modern College Pune. He obtained his Ph.D degree in Electronics from J.J.T University Rajasthan, India. He published a book entitled "Wireless Sensor Network". He has been granted one patent. He published more than 10 research paper in national & international journals. He has a strong passion for WSN, IOT, Embedded System. Moreover, He taught different courses like Microcontroller and Embedded system, Analog & Digital Electronics, Microwave and Antenna, Verilog, Optical fiber Communication, Microprocessor Architecture & Programming, Basics of Computer organisation, Control system, Digital Communication & Networking, Wireless communication & IoT etc. to post graduate and under graduate classes. His area of interests are internet of things (IoT) & WSN, embedded system, sensor to name but few.



**Prof.(Dr.) Jagdish D. Deshpande** is currently the Head of the department of Electronics in Tuljaram Chaturchand College of Arts, Science and Commerce, (Autonomous), Baramati, affiliated to Savitribai Phule Pune University, Pune. He obtained his Ph.D degree from Pune University, Pune, Maharashtra, India. His area of interest is embedded technology and sensor development. He participated in many national and international seminars and conferences and wrote papers which published in many national and international journals. He has been granted one patent. Under his guidance one scholar has completed his doctoral degree and two are pursuing their research.



**Prof. (Dr.) Ashok E. Kalange** is Professor of Physics in Tuljaram Chaturchand College of Arts, Science and Commerce, (Autonomous), Baramati, affiliated to Savitribai Phule Pune University, Pune. He obtained Ph. D degree from Savitribai Phule Pune University, Pune. He participated in many national and international seminars and conferences and wrote papers which published in many national and international journals. He has been granted two patents. Currently, he is Vice Principal of the college. His areas of research are sensors, biomedical instrumentation and material science.



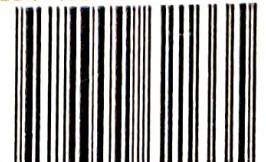
**Prof. Dhananjay V. Bansode** is working as Head of the department of Electronic Science at Someshwar Science College, Someshwarnagar. He obtained his Bachelor of Science degree in Electronic Science in Tuljaram chaturchand College, Baramati, and Master degree in year 2009 from Savitribai Phule Pune University. He qualified UGC-NET examination in Electronic Science in 2009. He also qualified State Eligibility Test in 2020. He has fourteen years of teaching experience. He is pursuing his doctoral research from Savitribai Phule Pune University. He taught different courses like Analog & Digital Electronics, Power Electronics, MATLAB, Optical fiber Communication, Microprocessor Architecture & Programming, Basics of Computer organisation, Microcontroller and embedded systems, Digital Signal Processing, Digital Communication & Networking, Wireless communication & IoT etc. to undergraduate programmes. His research interests are solar cells, noise pollution, healthcare ,internet of things (IoT) & WBN.

**AIP**

Alpha International Publication (AIP)

www.alphainternationalpublication.com | editor@ippublications@gmail.com

ISBN 978-93-5762-133-5



9 789357 621335