

# Number Systems for Digital Signal Processing

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## Overview

The program consists in offering a course to under graduate students that is relatively new to the curriculum. Number systems as an enabling technique to implement and solve problems in engineering, whether it is in electrical engineering or in any other engineering has never been taught at the under graduate level. The novelty of the current proposal lies in attempting to educate under graduate students to see the power number systems in solving engineering problems. The effectiveness of the number theory has been exploited in computer architectures and in the implementation computing algorithms. However this important aspect of math has been taught only at the graduate level. Since math is fundamental to engineering it is of paramount importance that an initial introductory course is offered at the under graduate level. This will act as a precursor to advances topics at graduate level.

In this program it is envisaged that a brief introduction to number systems be given to students and to observe their reaction. Basic theory of residue number system which has been in existence for a long time will be introduced. This number system uses carry free arithmetic when basic operations are performed in this domain. It uses a number of parallel channels in implementing arithmetic operations.

It is efficient but there are some over heads associated in using this number system. These will be discussed. Implementation issues in using this system in hard ware will be discussed. Numerous examples will be discussed to deepen the understanding of the students. They will begin to appreciate the power of these systems when implanted practically. Students will be able see the advantages of designing an entire system using RNS. Efficient implementation of analog to digital converter will be discussed. Use of RNS reduces the over power of A/D converters and the reason for this the flexibility offered by these systems

Thermometer codes have been proposed for the first time in 2013. The power of these codes will fully unleashed when they are combined with residue numbers. This system enables modular addition and subtraction to be performed without the use of a conventional adder. The principles are simple and powerful and this will be taught for the first time in a university.

Use of these number systems to practically implement circuits in communication and signal processing will be taught giving a practical twist to the entire topic. Students will be able to implement these using field programmable gate arrays (FPGA) or implement them in software using Matlab. A fundamental of FPGA will be taught in the class.

<b>Modules</b>	Number Systems for Digital Signal Processing: <b>October 17-October 23</b> <b>Number of participants for the course will be limited to 60.</b>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"><li>4th Year B.Tech in Electronics and Communication Engineering, 1st and 2nd year M.Tech in Communication, Signal Processing, Image Processing, RF Microwave, research student in the relevant areas, and engineers from the industries.</li></ul>
<b>Fees</b>	The participation fees for taking the course is as follows: <b>Participants from abroad : US \$400</b> <b>Industry/ Research Organizations: Rs. 5000</b> <b>Academic Institutions: Rs.1000 (Student), Rs. 3000 (Faculty)</b> The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with single bedded accommodation on payment basis.

## The Faculty



**Dr. Benjamin Premkumar Annamalai** is a professor at the department of Electrical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia. He obtained PhD from University of Idaho, USA. Prof. Annamalai has served as Visiting Erskine Fellow, University of Canterbury, Christ Church, New Zealand in 2004 and Visiting Professor of University of Bedfordshire in 2012. Currently he is

authors and co-authors of several books including "RNS Number Systems: Theory and Implementation." Several undergraduate and postgraduate courses including Analysis and design of Telecommunication Networks and Satellite and mobile communications are taught by him. He has guided more than 20 PhD and Master thesis's. He has published more than 180 international peer-reviewed journal and conference papers. He has several patents including three U.S. patents. He is associate editor of Journal of Circuits, Systems and Signal Processing: Springer. Among several other recognitions he has been awarded with Tau Beta Pi, Life Member in 1990, member of Marquis, Who's Who in Science and Engineering in 1998 and membership of Institution of Electrical and Electronic Engineers (university) from 1992 to 2014.



**Dr. Sudhan Majhi** is presently working as a Assistant Professor jointly in the department of Mathematics and EE. He has obtained his PhD in wireless communications from the school of computer engineering, Nanyang Technological University (NTU) Singapore. He has done postdoc from university of Michigan-Dearborn, MI, USA,

Institute of Electronics and Telecommunications of Rennes, France, and NTU, Singapore. He received best academic NI ASEAN Graphical System Design Achievement awards in 2012. He received a young scientist start-up grant, DST, India. He is associate editor of Journal of Circuits, Systems and Signal Processing: Springer.



**Dr. Arijit Mondal** is an Assistant Professor in the Department of Computer Science and Engineering, Indian Institute of Technology, Patna. His research interest is in the area of CAD for VLSI, Analog EDA.

## Course Co-ordinator

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