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Preface

It is a well-known fact that 'Second', the unit of time, is the most accurately realizable among the seven base units of the international system of units (SI). This is mainly due to the availability of stable and accurate frequency standards and the well-established mechanism of maintenance and dissemination schemes of the reference of time, i.e. Coordinated Universal Time (UTC). The current time reference is realized by a large number of cesium frequency standards and hydrogen maser systems maintained and operated at a large number of National Metrology Institutes (NMI) all around the world, and in addition the dedicated time transfer network utilizing commercial communication satellites and Global Navigation Satellite Systems (GNSS). It has been reported that the current stability of the UTC has reached at the level of 3×10^{-16}. This unprecedented level of stability is still being continuously improved by a lot of efforts to develop better frequency standards and advanced time and frequency transfer techniques. Especially, the recent advancements of the optical frequency standards have been remarkable and the re-definition of the unit of second is being seriously considered under the Consultative Committee for Time and Frequency (CCTF) of International Committee for Weights and Measures (CIPM). The special issue of the MAPAN journal was proposed to focus on the recent situation and activities related with the rapid advancements of the time and frequency metrology field, and a call for papers for the Special Issue on Advanced Frequency Standards was circulated. In response to this call, eight outstanding papers covering the field of time and frequency metrology were contributed. The first and the second of these are comprehensive reviews on the current up-to-date situation of optical frequency standards. The two following review papers explain the fundamentals of the advanced time and frequency transfer methods using commercial communication satellites and Very Long Baseline Interferometry. These four reviews are then followed by four original papers discussing about the developments of Cesium Fountain frequency standard systems and various aspects of realization and maintenance of time scale. All of these papers should be valuable references for the readers aiming to understand the state of the art research and developments in the field of time and frequency metrology. We hope that this special issue will assist mutual understanding within the time and frequency metrology community and will stimulate further works towards more reliable and surpassing definition of the unit of the second. We wish to take this opportunity to sincerely thank all those who contributed their valuable papers to the journal and the many people who assisted us in the publication.

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Amitava Sen Gupta received the M. Sc. and Ph.D. degrees in Physics from the University of Delhi, India, in 1974 and 1980, respectively. Since 1979, he has been with the Time and Frequency Standards section of the National Physical Laboratory (NPL), New Delhi, India. In recent years his group has been mainly engaged with research on development of Cs Fountain atomic frequency standard at NPL, India and a new generation of microwave synthesizers for Cs frequency standards. Dr. Sen Gupta is a Fellow of the National Academy of Sciences, India, Fellow of the Institution of Electronic and Telecom Engineers, India and a Senior Member of the IEEE, USA.