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International Conference on
Challenges and Opportunities in Mechanical Engineering,
Industrial Engineering and Management Studies**

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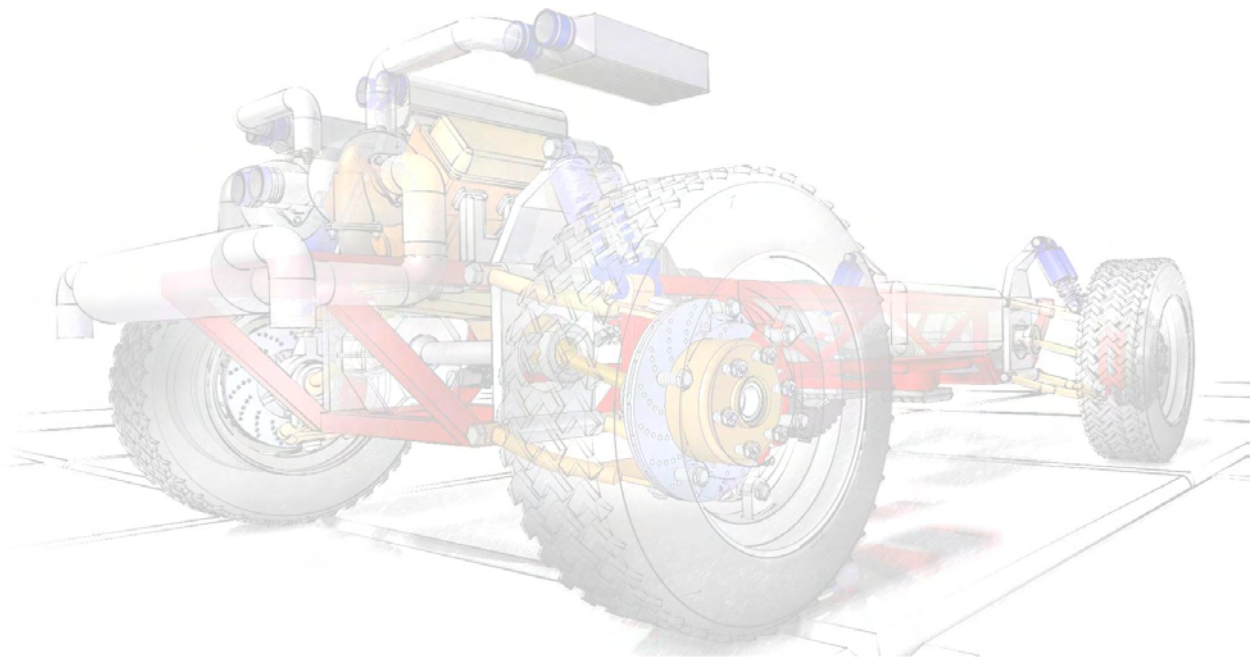
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*This book is dedicated to our beloved Founder Chairman
Dr. M.S. Ramaiah*

Preface

The “International Conference on Challenges and Opportunities in Mechanical Engineering, Industrial Engineering and Management Studies” is jointly organized by the Departments of Mechanical Engineering, Industrial Engineering and Management Studies, M.S. Ramaiah Institute of Technology, Bangalore and supported by Visvesvaraya Technological University, Belgaum and several other leading industries engaged in design and manufacturing activities. ICCOMIM 2012 is organized as a part of Golden Jubilee Celebrations of M. S. Ramaiah Institute of Technology and is a tribute to the visionary, philanthropist and our Founder Chairman Late Dr. M. S. Ramaiah.

The main objective of this conference is to bring academicians, researchers, policy makers and practicing engineers in the areas of Production Engineering, Thermal Engineering, Design Engineering and Nanotechnology on a common platform for sharing their innovative ideas and experiences for enriching the field of Mechanical Engineering.

Over 350 plus papers were received from across the globe out of which around 150 papers have been finally selected. The areas covered by these papers include the latest research in materials, nanomaterials and composites, vibration, FEM, thermal engineering, fluid mechanics, biofuels, energy engineering, fracture mechanics, TQM and OR to name a few. In the conference, these papers were presented over a period of three days in parallel sessions under the categories of thermal engineering and energy, production engineering, design engineering and general and nanomaterials. The contents of this volume reflect the latest trends in various research areas of mechanical engineering and should serve as an excellent reference material for future investigators and researchers.

As part of the conference, leading luminaries in various fields have been invited to deliver plenary and invited talks for the benefit of participants. The conference also allows for exchange of research ideas and sharing of scientific expertise among the participating researchers and academicians and also help network the research community for mutual benefits.

Acknowledgements

We are thankful to our Management for their constant support and guidance in all our academic endeavours including this International Conference on “Challenges and Opportunities in Mechanical Engineering, Industrial Engineering, and Management Studies” conducted as part of the Golden Jubilee celebrations of M.S. Ramaiah Institute of Technology, Bangalore. Magnanimous financial and infrastructure facilities provided by the management of MSRIT are duly acknowledged.

We have great pleasure in expressing our deep sense of gratitude to our Honorable Chairman - Gokula Education Foundation (GEF) Dr. M. R. Jayaram, for his keen interest and constant support. We are immensely grateful and indebted to our Honorable Vice-Chairman – GEF, Director-MSRIT and Member of Karnataka Legislative Council Sri M. R. Seetharam for his constant encouragement and support. We are grateful to our Honorable Secretary – GEF and Director-MSRIT Sri M. R. Ramaiah for his support. We are grateful to Sri. S. M. Acharya, Chief Executive – GEF for his guidance. We are grateful to Dr. S. Y. Kulkarni, Principal –MSRIT and Dr. N. V. R. Naidu, Vice-Principal for their continuous encouragement.

We are thankful to Dr. G K Ramaiah, Registrar- Academics and Mr. Ramesh Naik, Registrar-Administration for their support.

We would like to thank all the contributing authors for their scholarly work. We sincerely acknowledge all our sponsors and associates of the International Conference. We thank the faculty, staff, and students of M.S. Ramaiah Institute of Technology for their cooperation at every step. We also thank each and every individual who has been directly or indirectly involved in this project.

Last but not the least, we are thankful to BONFRING, for their whole hearted support in this venture and for publishing this book in the shortest time possible.

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