Title: **Introduction to STME research**
Credits: **4 (~44 hours, about 2 contact session per week of 2 hours)**
Semester 1: **August 14 to December 29**

Objectives:

1. Motivation for STME research (Why STME research is necessary?)
2. Exposure to research in STME and research at HBCSE
3. Overview of issues (central themes) in science, technology and mathematics education research

Concepts/ Issues/ Skills/ Questions:

- Ability to search research materials in STME (article, chapter, etc.)
- Recognise the context of research (broad areas of research, and issues addressed by the article)
- Develop ability to follow cross references of interest, and identify those that are significant or have broad reviews
- Conduct literature review
- Identify some of the central themes in STME research,
    - eg. Student conceptions, Teacher education, Students' /Teachers' attitudes to STME, Classroom interaction and assessment, Application to real-world contexts, STME and society

Classroom sessions:
The course will cover themes in STME and there will be 2 or more sessions per theme. The instructor/invited speaker will discuss a paper in a theme and students have to select a paper in that theme for presentation in the next session. Each student will have 15 minutes for presentation of the paper where the highlights of the paper are to be discussed. A short write-up written in ones own words is expected to be submitted on the day of the presentation.

Some selected readings (more to added by students themselves and instructors):

1. **Introductory Session:** *Anderson, C. (2007). Perspectives on science learning. In S. Abell & N. Lederman (Eds.). Handbook of Research on Science Education, pp.3-30. Taylor & Francis.*

2. **Theme 1: Education and Society**

   i) K. Krishna (2010). Culture, state and girls: An educational perspective. *Economic and Political Weekly,* Vol 45, Issue No. 17, April 24, 2010.

   ii) Fennema, E. H., & Sherman, J. A. (1978). Sex-related differences in mathematics achievement and related factors: A further study. *Journal for Research in Mathematics Education*, 189-203.

   iii) Reiss, M. (2008). Should science educators deal with the science/religion issue? *Studies in Science Education*, 44 (2). pp. 157-186.

   iv) Greer, B. (2011). What is Mathematics Education for? In K. Subramaniam & A. Majumdar (Eds.) epiSTEME 3 – *Proceedings of the International Conference to Review Research in Science, Technology and Mathematics Education*. MacMillan.

   v) George, A. (2013). Illustrating social studies in textbooks. *Contemporary Education Dialogue.* 10(1), pp.147–153.

vi) Mohite, S. (2014). Critical thinking on caste among school children in Maharashtra : Case study of two schools in Chiplun. *Economic and Political Weekly*. Vol. XLIX, Issue 22. May 31, 2014.

vii)Aikenhead, G. & Jegede, O. (1999). Cross-cultural science education: A cognitive explanation of a Cultural Phenomenon. *Journal of Research in Science Teaching*, 36(3), pp. 269–287.

viii) Hodson, D. (2003) Time for action: Science education for an alternative future. *International Journal of Science Education,* Vol. 25, Issue 6. pages 645-670.

3. **Theme 2: Out-of-school and connections to real world**

i) Rennie, L. (2007). Learning science outside of school. *In S. Abell & N. Lederman (Eds.). Handbook of Research on Science Education, pp. 125-167, Taylor & Francis.*

ii) Bose, A. & Kantha, V. (2014). Influence of socio-economic background and cultural practices on mathematics education in India: A contemporary overview in historical perspective, *ZDM Mathematics Education*, DOI 10.1007/2014-0607

iii) Tunnicliffe, S. D., Lucas, A. M. and Osborne, J. F. (1997). School visits to zoos and museums: a missed educational opportunity?, *International Journal of Science Education*19(9), 1039-1056.

iv) Braund, M. & Reiss, M. (2006). Towards a more authentic science curriculum: The contribution of out-of-school learning, *International Journal of Science Education*, 28(12), 1373-1388.

(v) Milne, C. (1998). Philosophically correct science stories? Examining the implications of heroic science stories for school science. *Journal of Research in Science Teaching*, *35*(2), 175-187.

(vi) Falk, J. & Dierking, L. (2012). Lifelong Science Learning for Adults: The Role of Free-Choice Experiences, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 1063-1079. Springer.

(vii) Allchin, D. (1999). Values in Science: An educational perspective, *Science & Education,* 8, 1-12.

4. **Theme 3: Teacher Education**

i) Wallace, J. & Loughran, J. (2012). Science Teacher Learning, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 295-306. Springer.

ii) Batra, P. (2013). Teacher Education and Classroom Practice in India: A Critique and Propositions. In S. Chunawala & M. Kharatmal (Eds.). *The epiSTEME Reviews --- Research Trends in Science, Technology and Mathematics Education, Volume 4*. India: Narosa.

(iii) Brown, P., Friedrichsen, P. & Abell, S. (2013). The development of prospective secondary biology teachers PCK. *Journal of Science Teacher Education*, 24(1), pp. 133-155.

(iv) Kang, E., Bianchini, J. & Kelly, G. (2013). Crossing the border from science student to science teacher: Preservice teachers' views and experiences learning to teach inquiry. *Journal of Science Teacher Education,* 24(3), pp. 427-227

(v) Crippen, K. (2012). Argument as professional development: Impacting teacher knowledge and beliefs about science. *Journal of Science Teacher Education*, 23(8), pp. 847-866.

(vi) Lumpe, A., Czerniak, C., Haney, J., & Beltyukova, S. (2012). Beliefs about teaching science: The relationship between elementary teachers' participation in professional development and student achievement. *International Journal of Science Education*, 34(2), 153-166.

vii) J. Stigler & J. Hiebert. (2009). Images of teaching, In, The teaching gap: Best ideas from the world's teachers for improving education in the classroom, Published by Simon and Schuster.

5. **Theme 4: Student conceptions**

i) Mahajan, B. S. & Chunawala, S. (1999). Indian secondary students' understanding of different aspects of health. *International Journal of Science Education,* 21(11), 1155-1168.

ii) Rowell, P. (2004). Developing technological stance: Children's learning in technology education, *International Journal of Technology and Design Education*, 14, 45–59.

iii) Duit R. & Treagust D. (2012) : How can conceptual change contribute to theory and practice in science education ?, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 107-118. Springer.

iv) Mintzes, J., Wandersee, J. & Novak, J. (2001) Assessing understanding in biology. *Journal of Biological Education*, 35:3, 118-124

v) Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education, 66, pp.* 211-227.

vi) Eilks, I., Moellering, J., Valanides, N. (2007) Seventh-grade students' understanding of chemical reactions: Reflections from an action research interview study. *Eurasia Journal of Mathematics, Science & Technology Education*, 2007, 3(4), 271-286

vii) Vosniadou, S. (2012). Reframing the Classical Approach to Conceptual Change: Preconceptions, Misconceptions and Synthetic Models, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 119-130. Springer.

6. **Theme 5: Classroom Interaction and Assessment**

i) Ramadas, J. & Kulkarni, V. (1982). Pupil participation and curriculum relevance, *Journal of Research in Science Teaching*, 19 (5), 357-365, 1982

ii) Jones, A. (2012). Technology in Science Education: Context, Contestation and Connection, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 811-822. Springer.

(iii) Spendlove, D. (2008). Creativity in education: a review. *Design and Technology Education: An International Journal,* 10(2).

iv) Larson, J. (1995). Fatima's Rules and Other Elements of an Unintended Chemistry Curriculum. Paper presented at *American Education Research Association (AERA)*, San Francisco.

v) Kawalkar, A. & Vijapurkar J. (2013)., Scaffolding Science talk: The role of teachers' questions in the Inquiry Classroom, *International Journal of Science Education*, 35(12) 2004-2027.

vi) Osborne, J. (2012). The Role of Argument: Learning How to Learn in School Science. In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 933-949. Springer.

vii) Sadler, T. & Dawson, V. (2012). Socio-Scientific Issues in Science Education: Contexts for the Promotion of Key Learning Outcomes, In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook of Science Education,* Part 1, pp. 799-810. Springer.

Activities:

1) A literature review on one of the themes
2) List questions or statements of problems in STME that can be researched
3) For one of the questions, frame the research study

Assessment:

Students will be assessed based on their presentations,(40%) writeups (40%) and peer assessment (20%).

Handbooks:

- *Abell, S. & Lederman, N. (Eds.). (2007). Handbook of Research on Science Education. Taylor & Francis.*
- *Fraser, B., Tobin, K. & McRobbie, C. (Eds.) (2012). Second International Handbook of Science Education, Springer.*

Journals:

- Contemporary Education Dialogue.
- Design and Technology education : An International Journal.
- Economic and political Weekly.
- Eurasia journal of Mathematics, Science and Technology Education.
- International journal of Science Education.
- International journal of Technology and Design Education.
- Journal for Research in Mathematics Education.
- Journal of Biological Education.
- Journal of Research in Science Teaching.
- Journal of Science Teacher Education.
- Science and Education.
- Science Education.
- Studies in Science Education.
- ZDM Mathematics Education.