Bachelor of Education (B.Ed.)

Title of the Course: Pedagogy IA: P.1.2A: Science
(Semester: I)

Credits 2
MM: 50 (External: 35 Internal: 15)
Contact Week: 15

Introduction of the Course

This course would enable the pupil teachers to understand Science as a discipline through its philosophical and epistemological perspectives. The insights into the nature of science and how children construct knowledge of science would help in developing a critical understanding about science and how it unfolds through the transactional processes at the various levels of school education. This course also aims to develop an understanding about Indian Contributions to science from ancient to modern times and to develop insights about the evolution of scientific knowledge and methods of science. In this course, we will also explore the various factors that influence a science classroom as to develop a profound understanding of the pedagogical underpinnings in the domain of science education

Learning Outcomes:

After completion of the course, student will be able to

1. Develop understanding about the nature of science and establish its meaningful linkages with science as a discipline.
2. Critically study science within historical and philosophical contexts.
3. Apply principles of Science-Technology-Society-Environment (STSE) interface to real-world issues.
4. Critically analyze the Indian Contributions from ancient to modern times and their relevance in contemporary pedagogical practices.
5. Develop an understanding of a science classroom.
6. Foster scientific thinking among learners.

Number of Units 3 **Weeks 15 = 30 hours**

Unit I: Nature of Science and Science Education (7 weeks = 14 hours)

Head/Dean
विभागाध्यक्ष एवं संकाय अध्यक्ष
शिक्षा विभाग/Deptt. of Education
दिल्ली विश्वविद्यालय / University of Delhi, Delhi-110007

(31)

- The nature of science- science as a process and science as a body of knowledge, as a social enterprise;
- The development of science as a discipline; awareness of the contributions like Popper and Kuhn.
- Development of scientific temper and public understanding of science, ethics of science; Science-Technology-Society-Environment (STSE) Interface, Science for Sustainable Development

Unit II: Science in Indian context (4 weeks = 8 hours)

- Understanding the evolution of scientific knowledge and methods of science through Indigenous Knowledge Systems.
- Conceptualizing the development of scientific temper, critical thinking, and enquiry-based learning through the Indian Contributions from ancient to modern times in areas like medicine, agriculture, health and well-being, physics, chemistry, and other forms (Like Baudhayan Sulbha-Sutra, Aryabhat and Aryabhatika, Varahmihira, Sir J. C. Bose, Ramanujan, P.C. Ray, APJ Abdul Kalam, Anadibai Joshi etc.) *

  *The list is suggestive and can be expanded both for areas as well as contributors to science and technology, as per the context. For assessment purposes names are to be considered just examples.

Unit III: Understanding the Science Classroom (4 weeks = 8 hours)

- Understanding children's fear of science addressing their inability to correlate the observed phenomena with micro level processes and with their symbolic/mathematical representations.
- Role and limitation of language: its contribution towards expression, articulation and understanding of science
- Addressing Learner-diversity: gender issues, socio-cultural diversity, special need-learners, contextual factors.

Practicum/ Suggested Projects / Assignments (Any Two)

1. Reflect upon the tentative and revisionary nature of science
2. Research and develop a community-based project related to a specific local or global environmental issue. In what ways will this project contribute meaningfully towards understanding the STSE principles?

Head/Dean
विभागाध्यक्षा एवं संकाय अध्यक्ष
Head & Dean/Deptt. of Education
दिल्ली विश्वविद्यालय / University of Delhi-110007

3. Document and analyze contributions of any one of the Indian thinkers/scientists in any area. Reflect upon the role of systematic enquiry and evidence-based research that is fundamental for contributions in science

Note: On the basis of the above, the teacher may design his/her own relevant projects/assignments.

Essential/ Recommended Readings

- Aikenhead, W. W. (1998). Cultural aspects of learning science. Part one, pp 39-52. (B. F. Tobin, Ed.) Netherlands: Kluwer academic Publisher.
- Alavi, S. (2008). Medical culture in transition: Mughal gentleman physician and the native doctor in early colonial India. Modern Asian Studies, 42(5), 853-897.
- Chander, S. (2018). Developments in Information and Communication Technology for Inclusive Education: Issues of Access and Pedagogy. In V. Saxena & S. Kumar (Eds.), Psychological and Sociological Perspectives in Diversity and Inclusion: An Anthology for Researchers and Practitioners. Kanishka Publication.
- Chaudhari, P. (2022). *Teaching-Learning Resources for Science Teachers.* New Delhi: ABI.
- Chhabra, M., & Das, R. (2023). Students' understanding of electrostatic force as a vector quantity at the undergraduate level. Physics Education, 58(3), 035016.
- Cobern, W. W. (1998). Socio-Cultural Perspectives on Science Education. London: Kluwer Academic Publisher.
- D.M. Bose, S.N. Sen & B.V. Subbarayappa, eds, A Concise History of Science in India, Universities Press, Hyderabad, 2nd edn, 2009
- Deo, M.G. & Pawar, P.V. (2011), General Article: Nurturing Science Talent in Villages, In Current Science, Vol. 101, No. 12, pp1538-1543.
- Fabrizio Speziale. The Circulation of Ayurvedic knowledge in Indo-Persian Medical Literature. Ayurveda in Post-Classical and Pre-Colonial India, Jul 2009, Leiden, Netherlands.
- Hines, S. M. (Ed.). (2005). Multicultural science Education: Theory, Practice, and Promise (Vol.120). New York, U.S.A: Peter Lang.
- Jain, N. K. (1982). Science and Scientists in India: Vedic to Modern. Indian Book Gallery.
- Lee, E. & Luft, J. (2008), Experienced Secondary Science Teachers' Representation of Pedagogical Content Knowledge. International Journal of Science Education 30(10), 1343-1363(21), August

Head/Dean
विभागाध्यक्ष एवं संकाय अध्यक्ष
शिक्षा विभाग/Deptt. of Education
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007

- Lee, O. (2003). Equity for Linguistically and Culturally Diverse Students in Science Education. Teachers College Record, 105 (3), pp 465-489.
- Lynch, S. J. (2000). Equity and Science Education Reform. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Nath, B. K. (2018). *Pedagogy of Science at Secondary level.* New Delhi: Shipra Publications.
- National Curriculum Framework for School Education, (2023), NCERT: New Delhi
- National Curriculum Framework, (2005), NCERT: New Delhi
- National Education Policy, (2020).
- NCERT (2013). *Pedagogy of Science. Physical Science Part I: Textbook for B.Ed.* New Delhi: NCERT.
- NCERT (2013). *Pedagogy of Science. Physical Science Part II: Textbook for B.Ed.* New Delhi: NCERT.
- NCERT (2019). Vigyan Shiksha shastra (Bhautik Vigyan Bhag I). New Delhi: NCERT.
- NCERT (2019). Vigyan Shiksha shastra (Bhautik Vigyan Bhag II). New Delhi: NCERT.
- Newsome, J. G. & Lederman, N. G. (Eds.) (1999), Examining Pedagogical Content Knowledge: The Construct and its Implications for Science Education. Kluwer Academic Publishers, The Netherlands
- Parkinson, J. (2002). Chapter-1. Learning to Become an Effective Science Teacher. In Reflective Teaching of Science 11-18: Continuum Studies in Reflective Practice and Theory. New York: Continuum. pp. 1-12.
- Pedagogy of Science: Physical Science – (Part I & II) (2013). National Council of Educational Research and Training.
- Quigley, C. (2009). Globalization and Science Education: The Implications for Indigenous knowledge systems. International Educational Studies, 2 (1), pp 76-88.
- Rashtriya Madhyamik Shiksha Abhiyan (2005), MHRD: New Delhi
- Rivet, A.E. & Krajick, J.S. (2008), Contextualizing Instruction: Leveraging Students' Prior Knowledge and Experiences to Foster Understanding of Middle School Science, In Journal of Research in Science Teaching, Vol. 45, No. 1, pp 79-100.
- Sears, J. and Sorensen, P. (Eds.). (2000) Issues in Science Teaching. Routledge Falmer, The Netherlands.
- Sherman, S.J., & Sherman, R.S. (2004). Science and Science Teaching: Methods for Integrating Technology in Elementary and Middle School. USA: Wiley Student Edition

Head/Dean
विभागाध्यक्ष एवं संकाय अध्यक्ष
शिक्षा विभाग/Deptt. of Education
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007

34

- Tobin, K. (Ed.). (1993). The Practice of Constructivism Science Education. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc.
- Van Driel, J.H.V., Beijaard, D. & Verloop, N. (2001), Professional Development and Reform in Science Education: The Role of Teachers' Practical Knowledge. Journal of Research in Science Teaching, 38(2), 137-158, February
- Wallace J. and Louden W. (eds.). Dilemmas of Science Teaching: Perspectives on Problems of Practice. London: Routledge Falmer. pp. 191-204.
- Wang, H. A and Schmidt, W. H. (2001). - History, Philosophy and Sociology of Science in Science Education: Results from the Third International Mathematics and Science Study. In F. Bevilacqua, E. Giannetto, and M.R. Mathews, (eds.). Science Education and Culture: The Contribution of History and Philosophy of Science. The Netherlands: Kluwer Academic Publishers. pp.83-102.
- Wellington, J. (2018). Secondary Science: Contemporary Issues and Practical approaches. USA: Routledge
- Wellington, J., & Ireson, G. (2012). Science learning, Science Teaching (3rd ed.). London and New York: Routledge

Teaching Learning Resources (Digital):

- Amrita Vishwa Vidyapeetham. (n.d.). Virtual Labs. http://www.amrita.edu/virtual-labs
- e-PG Pathshala. (n.d.). https://epgp.inflibnet.ac.in/
- e-Yantra. (n.d.). Robotics and Embedded Systems. http://www.e-yantra.org/
- Gupta, A. (n.d.). Arvind Gupta Toys. http://www.arvindguptatoys.com/
  How Not to Tell the History of Science. https://www.bostonreview.net/articles/how-not-to-tell-the-history-of-science/
- Indian Academy of Sciences. (n.d.). Journals. https://www.ias.ac.in/Journals
- Ministry of Education, Government of India. (n.d.). National Digital Library of India (NDLI). https://ndl.iitkgp.ac.in/
- National Aeronautics and Space Administration. (n.d.). NASA's Education Resources. https://www.nasa.gov/audience/foreducators/index.html
- National Council of Educational Research and Training. (n.d.). Diksha. https://diksha.gov.in/

Head/Dean
विभागाध्यक्ष एवं संकाय अध्यक्ष
शिक्षा विभाग/Deptt. of Education
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007

- National Council of Educational Research and Training. (n.d.). National Repository of Open Educational Resources (NROER). https://nroer.gov.in/
- National Council of Educational Research and Training. (n.d.). NISHTHA. https://diksha.gov.in/nistha
- NPTEL. (n.d.). https://nptel.ac.in/
- OpenStax. (n.d.). https://openstax.org/
- Remembering Acharya Prafulla Chandra Ray, Father of Indian Chemistry. https://axial.acs.org/inorganic-chemistry/remembering-acharya-prafulla-chandra-ray-father-of-indian-chemistry
- Sanrachna. https://www.epicon.in/tv-shows/sanrachna/season-1
- University of Colorado Boulder. (n.d.). PhET Interactive Simulations. https://phet.colorado.edu/
- Vigyan Prasar. (n.d.). http://www.vigyanprasar.gov.in/

Teaching Learning Process:

The course will be taught through interactive pedagogic methods such as classroom discussions, debates, collaborative learning tasks and laboratory methods with the appropriate use of digital processes, so as to enhance reflective practices and critical analytical thought processes among learners. Self-learning, self-exploration, creative expression and comprehension & application of concepts will be encouraged.

Assessment Method:

The assessment will be formative in nature both in theory and practicum and will focus on rigorous student participation. Individual and group tasks will aim at developing scientific temper, social skills, and values among learners. Assessment will also be based on development of creative expressions, critical understanding, reflections, and ethics in science.

Key words: Nature of Science, Pedagogy of Science, Science in Indian Context

Head/Dean
विभागाध्यक्ष एवं संकाय अध्यक्ष
शिक्षा विभाग/Deptt. of Education
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007

(36)