Bachelor of Education (B.Ed.)

Title of the Course: Pedagogy IIA: P.2.6A: Physics

(Semester: I)

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

Introduction of the Course

This course is aimed at developing the insights, competencies and skills among the pupil-teachers to effectively transact the Physics curriculum and evolve as a reflective practitioner, capable of translating theoretical perspectives into pedagogical practices. The course unfolds across two cohesive units, each meticulously crafted to inculcate a profound understanding of the pedagogical underpinnings, classroom processes, teaching-learning resources, in the domain of Physics education.

It delves into the pivotal role of Physics in the school curriculum, exploring its nature as a scientific discipline and its interconnectedness with other fields. It also navigates the intricacies of pedagogical planning, diverse teaching-learning processes, and the art of crafting comprehensive unit and lesson plans.

Practical components are woven seamlessly into the fabric of the course, ensuring experiences in planning lessons, developing resources, and managing the physics laboratory. By the course's culmination, participants are envisioned to emerge as adept educators equipped to inspire and guide students through the fascinating realm of Physics.

Learning Outcomes

After completion of the course, student will be able to:

- Demonstrate an in-depth understanding of the role of physics in the school curriculum, discerning its nature as a scientific discipline and establishing meaningful linkages with other academic domains.
- Develop understanding of Pedagogical Content Knowledge (PCK) and its implications for effective physics teaching, integrating theoretical perspectives into practical pedagogical approaches.
- Dplan and execute physics lessons, taking into consideration the socio-cultural and developmental context of the learners, including those with diverse background and abilities.

- Demonstrate proficiency in employing a repertoire of teaching-learning processes, such as inquiry-based approaches, inductive and deductive methods, experimentation, discussion, and group work, fostering varied learning experiences for diverse student populations.
- Explore the integration of digital tools, educational apps, and online platforms to enhance physics teaching. Discuss strategies for effective online and blended learning environments.

Number of Units 2 **Weeks 15 = 30 hours**

Unit 1: Pedagogical Underpinning **(8 weeks = 16 hours)**

- Place of physics in school curriculum - Nature of physics as a science discipline and its linkages with other disciplines.
- The concept of Pedagogical Content Knowledge (PCK) and its implications for Physics teaching.
- Aims of teaching physics at the senior secondary level with linkages to upper-primary and secondary level.
- Objectives of teaching physics with special reference to the development of thinking and process skills
- Integration of Science, Technology, Engineering, and Mathematics (STEM) principles in physics education. Discuss interdisciplinary approaches and collaborative projects.

Unit 2: Classroom processes **(7weeks = 14 hours)**

- Pedagogical planning: considerations in relation to content (curriculum and concepts) and learners (with specific reference to socio-cultural and developmental context of the learner including special needs). Inclusive teaching practices for diverse learners, including those with different learning styles, abilities, and cultural backgrounds
- A repertoire of teaching-learning processes: Inquiry based approach, inductive and deductive approach, experimentation, demonstration, discussion, investigatory projects, individually paced programmes, group work, peer learning, observation-based survey, problem solving, guided independent study, seminar presentation, action research.
- Digital Pedagogy in Physics Education: digital tools, educational apps, and online platforms to enhance physics teaching, developing effective online and blended learning environments. Flipped classroom and flipped blended learning designs.
- Developing unit plans, lesson plans and Remedial/Enrichment plans using combinations of various processes.
- Planning for conduct of activities, experiments and laboratory work in Physics with a critique of the current practices

Practicum/ Suggested Projects / Assignments (Any Two)

1. Planning and discussion of lessons for the school experience programme.
2. Developing remedial or enrichment programmes.
3. Conduct of activities/Experiments.

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

Essential/ Recommended Readings

- Bal, V. (2005). Women scientists in India: Nowhere near the glass ceiling. *Current Science, 88*(6), 872-878.
- Bevilacqua, F., Giannetto, E., & Mathews, M. R. (Eds.). (2001). *Science Education and Culture: The Contribution of History and Philosophy of Science.* Netherlands: Kluwer Academic Publishers.
- Bowling, J., & Martin, B. (1985). Science: a masculine disorder? *Science and Public Policy, 12*(6), 308-316.
- Chander, S. (2017). *Teaching science to learners with visual impairment.* New Delhi: SR Publishing House.
- 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.
- Chander, S., & Patra, G. (2021). Education of Children with Disabilities: Exploring Possibilities with Artificial Intelligence. *Pedagogy of Learning, 7*(3), 29-35.
- Chander, S., & Chetna Arora. (2020). Integrating Technology into Classroom Learning. *Indian Journal of Educational Technology, 2*(1).
- Cobern, W. W. (Ed.). (1998). *Socio-Cultural Perspectives on Science Education: An International Dialogue.* Netherlands: Kluwer Academic Publishers.
- Cole, J. R., & Zuckerman, H. (1987). Marriage and Motherhood and Research Performance in Science. *Scientific American, 256*, 119-125.
- Gurumoorthy, B., Chander, S., & Rajalakshmi, R. (2019). Integrating Artificial Intelligence in Physics Education: A Pedagogical Approach. *Journal of Science Education and Technology, 28*(6), 632-643. https://link.springer.com/article/10.1007/s10956-019-09765-2
- Hiroko, H. (2012). Modernity, Technology and Progress of Women in Japan: Problems and Prospects. In D. Jain & D. Elson (Eds.), *Harvesting feminist Knowledge for Public Policy Rebuilding Progress.* New Delhi: Sage Publication.
- Kumar, N. (Ed.). (2009). *Women and Science in India: A Reader.* India: Oxford University Press.
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- Ma, L., & Lee, L. (2020). Enhancing Physics Learning with Artificial Intelligence: A Case Study in High School Education. *Computers & Education, 145*, 103711. https://www.sciencedirect.com/science/article/pii/S0360835219301920
- Oakes, J. (2007). More than misplaced technology: A normative and political response to Hallinan on tracking. In A. R. Sadovnik (Ed.), *Sociology of Education*. New York: Routledge.
- Okebukola, O. J. (1991). The Effect of Instruction on Socio-Cultural Beliefs Hindering the Learning of Science. *Journal of Research in Science Teaching, 28*(3), 275-285.
- Osborne, J. F. (1996). Beyond Constructivism. *Science Education, 80*(1), 53-82.
- Sur, A. (2011). *Dispersed Radiance: Caste, Gender and Modern Science in India.* Navayana: India.
- Taylor, P. C., & Cobern, W. W. (1998). Towards a Critical Science Education. In W. Cobern (Ed.), *Socio-Cultural Perspectives on Science Education: An International Dialogue*. Dordrecht: Kluwer Academic Publishers.
- Wallace, J., & Louden, W. (Eds.). (2002). *Dilemmas of Science Teaching: Perspectives on Problems of Practice*. Routledge: New York.

Teaching Learning Resources (Digital and others):

- Amrita Vishwa Vidyapeetham. (n.d.). Virtual Labs. http://www.amrita.edu/virtual-labs
- e-Yantra. (n.d.). Robotics and Embedded Systems. http://www.e-yantra.org/
- Google Arts & Culture - Science: Google. (n.d.). Google Arts & Culture - Science. https://artsandculture.google.com/project/science
- Gupta, A. (n.d.). Arvind Gupta Toys. http://www.arvindguptatoys.com/
- Indian Academy of Sciences. (n.d.). Journals. https://www.ias.ac.in/Journals
- Khan Academy. (n.d.). Physics. https://www.khanacademy.org/science/physics
- 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/
- 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/
- University of Colorado Boulder. (n.d.). PhET Interactive Simulations. https://phet.colorado.edu/
- Vigyan Prasar. (n.d.). http://www.vigyanprasar.gov.in/
- e-PG Pathshala. (n.d.). https://epgp.inflibnet.ac.in/

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Teaching Learning Process

This paper endeavors to cultivate a robust understanding of the pedagogy of physics through interactive and discussion modes. Emphasizing learner-centric approaches, it aims to foster competency development among students by incorporating diverse teaching-learning processes. The course structure encourages active engagement through inquiry-based methods, inductive and deductive approaches, experimental learning, group work, and peer collaboration. Practical components, including lesson planning and laboratory management, are integrated to provide a comprehensive learning experience. The paper prioritizes a dynamic and participatory teaching-learning environment, equipping educators with strategies to effectively translate theoretical physics concepts into engaging pedagogical practices.

Assessment Method

The assessment strategy encompasses diverse modes to thoroughly evaluate students' proficiency in translating pedagogical principles into effective physics teaching. Presentations, requiring students to articulate their understanding of innovative teaching methods, complement assignments that assess theoretical knowledge and critical thinking. Practicums involve real or simulated teaching experiences, and a final written examination gauges overall comprehension. Additionally, a detailed assessment report and portfolio submissions provide a comprehensive view of their learning journey. Peer assessment fosters collaborative learning. This multifaceted approach ensures a holistic evaluation, aligning with the course's goal of nurturing reflective and competent physics educators.

Key words: Physics, Pedagogy, Classroom Processes

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