

## Concept Note

### Capacity Building Programme on STEM

#### (Science, Technology, Engineering, and Mathematics)

#### Background

Stressing the importance of Science, Technology, Engineering, and Mathematics (STEM) education will drive India's global competitiveness. The world is changing rapidly and the importance of science and technology is increasing in every aspect of life. India's education system therefore must keep pace with global standards when it comes to STEM education. The significance of education in scientific fields, must instil a scientific temper in the young minds of India, preparing them for global leadership in science and technology. The goal is not just to train teachers but to nurture future scientists, researchers, and innovators through the empowerment of faculty. It is emphasized that Innovation is the key to progress, and our education system should nurture innovators, especially in the fields of STEM.

MoE has identified 8 Sector-Specific Groups (SSGs) based on their relevance to the changing world such as Agriculture, Health & Bio-electronics, Banking, Financial Services & Insurance (BFSI), Energy, Logistics, Digital & Creative Economy, AI in Engineering and Manufacturing & Industry 4.0 to identify the emerging needs of the respective sectors and to facilitate corresponding upgrades in academic and the corresponding capacity building programs. Designing STEM modules in a manner that effectively equip faculty with knowledge of eight key subjects relevant to the future of work, addressing the needs of the emerging workforce is the need of the hour.

The Department of Higher Education in its 5 year action plan has targeted to increase the number of patents filed by educational institutes from current 19,430 to 50,000, number of start-ups incubated by HEIs from 4,600 to 15, 000, and number of technology transfers from 25 to 1000. Capitalizing the Human Capital and Research India targets to attain within top 5 countries in the Global Innovation Index (GNI) global ranking.

Strengthening capacity of college teachers/ faculty in the area of STEM subjects is crucial to ensure enhanced output in Science, Engineering and Mathematics. Focus in these areas of capacity building is essential for maintaining and improving the quality of education by providing educators with updated knowledge, innovative teaching strategies, and professional development opportunities. This initiative is aligned with Ministry of Education commitment to improving educational standards and fostering excellence in STEM .

#### Introduction

The National Education Policy (NEP) 2020 aims to transform India into a global knowledge superpower, with a focus on fostering innovation, critical thinking, and

leadership through the promotion of STEM (Science, Technology, Engineering, Mathematics) education. The Hon'ble Prime Minister has frequently emphasized the need for quality education and skill development, particularly in the fields of science and technology, to drive the nation's progress.

The National Education Policy (NEP) 2020 emphasizes the importance of STEM education and training of faculty in STEM in following ways:

- i. **Interdisciplinary Approach:** Encourages an interdisciplinary approach, allowing students to integrate STEM education with the arts and humanities.
- ii. **Skill Development:** Equip students with essential skills in STEM fields, fostering critical thinking and problem-solving abilities.
- iii. **Research and Innovation:** Encouraging research is crucial for driving innovation and addressing societal challenges.
- iv. **Global Competitiveness:** A strong emphasis on STEM education is vital for enhancing the nation's global competitiveness and economic growth.
- v. **Experiential Learning:** Experiential learning including in STEM, enabling students to engage in hands-on projects and real-world problem-solving.

These points capture the essence of NEP 2020 commitment to advancing STEM education as a cornerstone for developing a skilled and innovative workforce.

Accordingly, Capacity Building Program for college teacher / faculty in STEM subjects, have been conceptualized under the aegis of Malaviya Mission Teacher Training Programme (MMTTP) to address the key elements of NEP 2020. These proposals aim to provide cutting-edge, subject-specific training that aligns with both the educational reforms envisaged by NEP 2020 and the goal of promoting India's scientific temper.

### **Capacity Building Program on STEM**

A Capacity Building Program on STEM is designed to enhance the conceptual understanding and pedagogical skills and competencies of educators, institutions, and communities in delivering effective STEM education. The goal is to refresh and enhance the teaching methodologies in Physics, Chemistry, Mathematics, and Biology of college teacher by incorporating practical lab sessions, innovative teaching methods, and exposure to cutting-edge research. Each training program will cover fundamental and advanced topics, aiming to foster a deeper understanding and effective delivery of STEM subjects. Following are the objectives of this program:

#### **Objectives**

- (i) Provide training for college teacher / faculty on effective STEM teaching methodologies, integrating technology into the classroom, and promoting inquiry-based learning.
- (ii) Support the development of innovative STEM curricula that align with national standards and incorporate real-world applications.

- (iii) Equip college teacher / faculty with access to quality teaching resources, laboratory equipment, and digital tools for STEM education.
- (iv) Enable college teacher / faculty to create culture of research and innovation that can be imbibed by the students.
- (v) Involve parents, local industries, and community members in STEM initiatives to create a supportive ecosystem for students.
- (vi) Promote inclusive practices to encourage participation in STEM among underrepresented groups, including girls and marginalized communities.

### **Expected Outputs & Outcomes of Capacity Building Program on STEM:**

- (i) **Enhanced Teaching Effectiveness:** Improved pedagogical skills among college teacher/faculty, resulting in more engaging and effective teaching practices in STEM subjects.
- (ii) **Increased Student Learning Outcomes:** Higher student performance in STEM courses, reflected in grades, assessments, and course completion rates.
- (iii) **Motivated, energised and capable faculty:** Happy, enthusiastic, engaged and motivated college teacher / faculty towards students, institutions and profession with professional development opportunities and a supportive teaching environment.
- (vii) **Research and Innovation:** Enable college teacher / faculty to create culture of research and innovation that can be imbibed by the students.
- (iv) **Strengthened Academic Community:** A collaborative culture among college teacher / faculty, promoting continuous improvement and innovation in teaching practices.
- (v) **Improved Student Engagement:** Enhanced student interest in STEM fields, leading to higher enrolment in STEM courses and programs.
- (vi) **Diversity and Inclusion:** Increased efforts to promote diversity and inclusion in STEM fields, reflected in student demographics and participation rates.

A well-structured Capacity Building Program on STEM can significantly contribute to developing a strong foundation in STEM education and preparing students for future challenges.

### **Host Institutions/ Implementing agency for Capacity Building Programs on STEM**

Initially, IIT Madras, IIT Ropar and IISc Bengaluru have been identified for conducting **Capacity Building Program on STEM** based on their institutional core strength and proposals to conduct Training of Trainers (ToT) programs that specifically target UG-level college teacher / faculty in Physics, Chemistry, Mathematics, and Biology. These programs are intended to empower educators with the conceptual understanding and pedagogical skills and knowledge necessary to cultivate innovation and inquiry in their students.

Other eminent Institutions may also be identified for conducting these Capacity Building Program, if required, subject to approval of PAB.

### Implementation Framework for Capacity Building Programs on STEM

All host institutes can exercise autonomy in assigning facilitators, setting syllabi, and developing pedagogical approaches in accordance with the following standardised programme modalities:

- (i) **Participants** - Regular teacher / faculty from Public funded colleges. Up to 6 participants can also be allowed from private colleges.
- (ii) **Target Audience** - college teachers/ faculty teaching STEM subjects like Physics, Chemistry, Mathematics, Biology, and Biotechnology
- (iii) **Batch size** - 30 participants per batch
- (iv) **No. of programs** - Minimum 8 in a year by each implementing Institution
- (v) **Mode of delivery & duration** - 9 days (residential)
- (vi) **Modules** - Host institutions will have full autonomy to design curriculum and pedagogy of the programme relevance to theme
- (vii) **Assessment and certificate of participation** - The host institution shall assess the learning outcomes of the participants. Upon successful completion of the programme, Host Institution shall award a certificate of completion under the aegis of Malaviya Mission Teacher Training Programme (MMTTP). Assessment is primarily to see effectiveness of the delivery and feedback to the participants.
- (viii) **Feedback Mechanism** - Participants are required to fill in the feedback form after each programme.

### Financial Norms

S. No.	Component	Unit Cost*	Physical (2 years)		Financial (2 years)	Number of Institutions	Host Institution
			No. of training program	No. of beneficiaries/ faculty to be	(Amount in Rs.)		
1	Capacity Building Program on STEM (Physics, Chemistry, Math, Biology/ Biotechnology)	9,00,000	48	1240	4,32,00,000	3	IIT Madras; IIT Ropar & IISc Bengaluru

\* cost includes all expenses and taxes, if any

### Impact

These training programs by IIT Madras, IIT Ropar and IISc Bengaluru represent a significant contribution to improving the quality of STEM education in India. By empowering teachers, the proposals directly support NEP 2020's objective of making India a global leader in education and innovation. The Hon'ble Prime Minister's call for advancing technology and nurturing talent through skill development finds strong resonance in these initiatives.