**Government of India**

**Department of Science & Technology**

**(Interdisciplinary Cyber Physical System Division)**

**Special Call for proposals under Scheduled Castes (SC) and Scheduled Tribes (ST) Category under ICPS programme**

**The Scheme:** Proposals are invited from SC and ST categories only for conducting the following

1. Conduction of national level Conferences/workshops/Seminars/brain storming sessions etc of three days duration.
2. Training programmes: In-house Short term training/FDP Programmes for Faculty/UG/PG/Doctoral students of two weeks duration.
3. Building awareness at School level and at ITI, Polytechnic, Advanced Training Institutes (ATI).

**The above are to be conducted under broader indicative topics like**

1. Cyber-Physical Systems (CPS) and Applications
2. Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL)
3. Data Science and Big Data Analytics
4. Quantum Science & Technology
5. Cyber Security, crypt analysis and security for physical infrastructure
6. Block chain Technology
7. Sensor Networks, Internet of Things (IoT) and Internet of Everything
8. Robotics and advanced Manufacturing

**Who can Apply**: Academicians, Scientists, Technologists and other practicing researchers from recognised academic, research institutions and registered scientific societies/NGO’s, State S&T Councils etc Who belong to SC/ST categories.

**Approval mechanism:** As per standard DST Rules and Regulations.

**How to apply**: All proposals are to be submitted on-line at [www.onlinedst.gov.in](http://www.onlinedst.gov.in/) and one hard copy by post. For more information or queries, visit [www.dst.gov.in](http://www.dst.gov.in/), contact Dr Rajeev Sharma, Scientist-E, ICPS Division, DST, New Delhi Ph:26590310 and e-mail: [rajeevsharma@nic.in](mailto:rajeevsharma@nic.in).

**Last date for submission:** The last date for receipt of electronic and physical copy with all attachments, signatures etc is **15th February, 2019**. No proposals shall be entertained after the last date. **Hard copy of the proposal be addressed to:**

**Dr K R Murali Mohan**

**Scientist-G & Head, ICPS**

**Room No:1, Hall-C**

**Department of Science & Technology**

**Technology Bhavan, S J Marg,**

**New Delhi-110 016.**

**Indicative list of topics for short term training programmes:**

**1 . Data Science & Predictive analytics**

* 1. Data pre-processing
  2. Data visualisation
  3. Descriptive Statistics
  4. Dimensionality Reduction
  5. Data Mining
     1. Association Analysis
     2. Classification
     3. Time Series Analysis
     4. Text Mining
     5. Cluster Analysis
     6. Anomaly Detection

**Sub-themes:**

* Industrial Data Collection - Arduino and Raspberry Pi
* Open Source Programming Techniques – Python, MAT LAB and R Programming
* Introduction to Data Analytics – ML Algorithms
* Build predictive models using ML Techniques
* Image Processing – Introduction and Neural Networks
* Deep Learning with MATLAB - Learn the theory and practice of building deep neural networks with real-life image and sequence data
* Optimization Techniques – Python & Mat lab Tool box

**Suggested reference Books:**

* Predictive Analytics and Data Mining: Concepts and Practice with Rapid Miner by Vijay Kotu, Bala Deshpande
* Data Science and Predictive Analytics: Biomedical and Health Applications using R by Ivo D. Dinov
* Data Mining and Predictive Analytics by Daniel T. Larose

1. **Internet of Things (IoT)**
   1. Information Theory and Computation
   2. M2M communications
   3. Sensors
   4. Actuators
   5. Cloud and Data platforms
   6. IoT architectures
   7. Embedded Systems
   8. Communication Models
   9. Network Protocols
   10. Data Analytics
   11. Security

**Suggested reference Books:**

* The Technical Foundations of IoT by Boris Adryan, Dominik Obermaier, Paul Fremantle
* IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry

1. **Machine Learning (ML)**
   1. Lazy Learning
   2. Probabilistic Learning
   3. Decision trees and random forests
   4. Regression Analysis
   5. Neural Networks
   6. Support Vector Machines
   7. Clustering
   8. Optimization

**Suggested reference Books:**

* Pattern Recognition and Machine Learning by Christopher M. Bishop
* Machine Learning by Tom Mitchell

1. **Deep Learning (DL)**
   1. Perceptrons
   2. Deep Feedforward Networks
   3. Convolutional Networks
   4. Recursive Networks
   5. Recurrent networks
   6. Autoencoders
   7. Representation Learning
   8. Pre-trained models
      1. LeNet
      2. AlexNet
      3. ImageNet
      4. GoogleNet
      5. ResNet

**Suggested reference Books:**

* Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville
* Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms by Nikhil Buduma, Nicholas Locascio

1. **Big Data Analytics**

**Data Science basics**

1. Data Preparations and processing
2. Introduction to R and visualization
3. Basics of Matrices and Linear Algebra
4. Basics of Probability and Statistics

**Basic data models**

1. Linear regression modelling and diagnostics
2. Multiple linear regression modelling
3. Logistic regression and binary classification
4. Decision tree modelling

**Advanced data models**

1. Model evaluation and improvement
2. Nonlinear classification methods
3. Dimensionality reduction methods
4. Matrix decomposition methods

**Finding structures in data**

1. Clustering methods
2. Outlier analysis
3. Association analysis
4. Network analysis and optimization

**MapReduce and Hadoop**

1. MapReduce basics
2. Hadoop MapReduce
3. HDFS basics
4. Hadoop Ecosystem

**Distributed and parallel computing using R**

1. Integrating R and Hadoop
2. RHIPE and RHadoop
3. Applications on large data
4. High-Performance and Parallel R

**Analyzing data in motion**

1. Real time data streams
2. Stream data basics
3. Data Stream analysis platforms
4. R based stream analysis

**Databases and operationalizing Big Data**

1. Relational and Non-relational databases
2. R interface to databases
3. Managing data security and variety
4. Cloud in the context of Big Data

**Big Data case studies**

(practical lesions)

**Theme areas:**

* 1. Challenges in Big Data
  2. Paradigm Shifts
  3. Big Data Storage and Retrieval
  4. Applications of Big Data
  5. MapReduce
  6. Apache Hadoop
     1. Pig
     2. Hive
     3. HBase
     4. HDFS
  7. Cloud Computing
  8. Spark
  9. Data Analytics

**Suggested reference Books:**

* Big Data Analytics: Tools and Technology for Effective Planning edited by Arun K. Somani, Ganesh Chandra Deka
* Handbook of Big Data Analytics edited by Wolfgang Karl Härdle, Henry Horng-Shing Lu, Xiaotong Shen

1. **Robotics**
   1. Perception
   2. Mechanics and Planning
   3. Assembly and Control
      1. Kinematics and Dynamics
      2. The whole Iguana
   4. Actuation Design

**Suggested reference Books:**

* Robotics Science edited by Michael Brady
* Handbook of Industrial Robotics edited by Shimon Y. Nof

1. **Self-Monitoring, Analysis & Reporting Technology (SMART)**
   1. SMART technology
   2. SMART attributes
   3. Self-tests
2. **Advanced materials**
   1. Polymer Composites
   2. Ceramic materials
   3. Nickel and Nickel Alloy
   4. Titanium Alloys
   5. Aluminium and Aluminium Alloys
   6. Functionally Graded Materials

**Suggested reference Books:**

* Handbook of advanced materials enabling new designs by James K. Wessel

1. **Sensor Networks**
   1. Sensing and sensors
   2. Architectures
      1. Single Node
      2. Network architecture
   3. Communication Protocols
      1. MAC protocols
      2. Link layer protocols
      3. Routing protocols
   4. Node and network management
   5. Security

**Suggested reference Books:**

* Protocols and Architectures for Wireless Sensor Networks by Holger Karl and Andreas Willig
* Fundamentals of Wireless Sensor Networks: Theory and Practice by Waltenegus Dargie, Christian Poellabauer

1. **Quantum Computing**
   1. Quantum Computation
   2. Quantum Mechanics
   3. Devices for computation
      1. Classical models
      2. Quantum information
      3. Circuits
   4. Fast Factorization
      1. Quantum Fourier transform
      2. Shor’s algorithm
   5. Finding hidden subgroup
      1. Generalized Simon’s algorithm
   6. Grover’s Search algorithm

**Suggested reference Books:**

* Quantum Computing by Mika Hirvensalo
* An Introduction to Quantum Computing by Phillip Kaye, Raymond Laflamme, Michele Mosca

1. **Quantum Communication**
   1. Fundamentals
      1. Vector and Hilbert spaces
      2. Quantum mechanics
   2. Classical and Quantum communication systems
   3. Poisson processes
   4. Quantum Decision Theory
      1. Analysis and Optimization
      2. Sub-optimization
   5. Quantum Communication systems
   6. Quantum Information

**Suggested reference Books:**

* Quantum Communications by Gianfranco Cariolaro
* An Introduction to Quantum Communication by Vinod K. Mishra

1. **Quantum encryption (Quantum Key Distribution)**
   1. Classical Cryptograpty
   2. Information Theory
      1. Source coding
      2. Channel coding
   3. Quantum Information Theory
      1. Qubits
      2. Entropies and coding
      3. Quantum optics
   4. Quantum key distribution
   5. Secret key distillation
   6. Privacy amplification
   7. Reconciliation

**Suggested reference Books:**

* Quantum Cryptography and Secret-Key Distillation by Gilles van Assche

1. **Cyber Security and security for physical infrastructure** 
   1. History and Impact
   2. Fundamentals rights in cyber security
   3. Ethical issues
   4. Cyber security technology
      1. Clustering-Based Protocol Classification
      2. Timing and Side Channel Attacks
   5. Cyber Security and Automation
      1. Protection of ICS Systems

**Suggested reference Books:**

* Cyber Security: Analytics, Technology and Automation by Martti Lehto • Pekka Neittaanmäki

**Blockchain Technology**

* 1. Blockchain basics
  2. Blockchain client
  3. Regulator
  4. Blockchain developer
  5. Blockchain network administrator
  6. Blockchain creation
  7. Blockchain validation
  8. Block chaining
  9. Understanding cryptocurrency

**Suggested reference Books:**

* Blockchain, A guide to understanding blockchain by Sean Benett
* Blockchain Technology by Stephen Fleming

1. **Artificial Intelligence (AI)**
2. State space search
3. Uninformed Search techniques
   1. Breadth first search
   2. Depth first search
   3. Depth Limited Search
   4. Iterative Deepening Search
   5. Iterative Broadening Search
   6. Uniform Cost Search
4. Informed Search Techniques
   1. Heuristics
   2. Types of Heuristics
5. Heuristic Search Techniques
   1. Generate-and-Test
   2. Greedy Search
   3. Best First Search
6. Heuristic Search Strategies
   1. Iterative Improvement Search

* Hill Climbing
* Simulated annealing
  1. A\* Search
  2. Iterative Deepening A\*
  3. AO\* Search

1. Adversarial Search
2. Iterative Improvement Search
   1. Beam search
3. Branch and Bound
4. Adversarial Search

**Suggested reference Books:**

* Artificial Intelligence by Christopher Thornton
* Artificial Intelligence, A Modern Approach by Stuart J. Russell and Peter Norvig

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**Format for Submitting proposals for organizing short –term training courses/workshops/conferences/awareness programs**

* + - 1. Name, Designation, Category and address of the PI (Category belongs to SC/ST)
      2. Title of the training course
      3. Duration and dates of the course/workshops/conferences
      4. No. of participants
      5. Brief justification of proposal i.e. need for conducting the course
      6. Objectives of course
      7. Nature of course (Theoretical/Practical)
      8. Financial assistance required for conducting the course (Travel cost, Boarding & Lodging, Working Lunch & Dinner, Training material/kit/Certificate Printing, Stationary, Contingency, Honorarium, Faculty Fees, Administrative support/institutional overheads)
      9. Other information, if any

**Note: the proposal should be forwarded with all endorsements, Certificates Registration etc. by an Executive Authority of the institute with seal.**