Indian Institute of Technology, Kanpur
Proposal for a New Course

1. Course No: IDC6XX

2. Course Title: Introduction to Space Weather

3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits (3*L+2*T+P+A): 9, Duration of Course: Full-Semester

4. Proposing Departments: dept. of SPASE & Physics dept.

5. Proposing Instructors: Rohit Sharma & Gopal Hazra

6. Course Description

   (A) Objectives: The objective of this course is to provide an introductory understanding of space weather by connecting the fundamental physics of the Sun to its far-reaching effects on the heliosphere and near-Earth environment. The course seeks to introduce the principles and challenges of space weather, enabling students to model, interpret, and anticipate various aspects of solar-terrestrial interactions.

   (B) Contents (40 lectures):

   1. Solar Interior and Magnetic fields (8 lectures):
      - Solar Structure - Internal Structure, Convection Zone, Solar dynamo, Helioseismology
      - Solar Atmosphere, Surface features, eruptive phenomena - Photosphere, Chromosphere, Corona
      - Role of Magnetic Fields in the Solar Atmosphere- Geometry, Sunspots, Active regions, Magnetic field extrapolation models
   2. Magnetic Reconnection & Eruptive Events (8 lectures)
      - Magnetic Reconnection - Sweet-Parker model, 2-D reconnection, 3-D reconnection, collisionless reconnection
      - Eruptive phenomena: solar flares, coronal mass ejections (CME), jets, spicules etc..
   3. Interplanetary Propagation of Solar Disturbances (5 lectures)
      - Solar Wind: Propagation of the electromagnetic and charged particles
      - Parker Spirals
   4. Earth's Atmosphere Response to Solar Disturbances (8 Lectures):
      - Radiation Interaction in the interplanetary space with planetary atmosphere
      - Dynamics of Earth's magnetosphere, ionosphere and thermosphere: interaction with solar wind, CME and solar energetic particles
      - Variations in neutral density, driven by space weather,
   5. Space Debris - Models & Risk Analysis (4 Lectures)
      - Modeling of the Current Space Debris Environment
      - Operational Collision Avoidance with Regard to Catalog Objects
   6. Geomagnetic Storms & Forecast of space weather events (4 Lectures)
      - Ring Currents Probes
      - Geomagnetic Storm Dynamics
   7. Overview of the current space weather missions & future missions (3 Lectures).

   (C) Pre-requisites, if any:

   (D) Short summary for including in the Courses of Study Booklet:

7. Recommended Books:
   - The Sun and Space Weather, Arnold Hanslmeier, 2nd Edition, Springer

- Reconnection of magnetic fields, Magnetohydrodynamics and Collisionless Theory and Observations, J. Birn & E. R. Priest
- An Introduction to Space Weather, Mark Moldwin, Cambridge Press
- Space Debris - Models and Risk Analysis, Heiner Klinkrad, Springer
- Handbook of the Solar-Terrestrial Environment, Y. Kamide A.Chian, Springer

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: