Indian Institute of Technology, Kanpur
Proposal for a New Course

1. Course No: SPA661

2. Course Title: Stars and Stellar Evolution

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

4. Proposing Department: Space Science & Astronomy

5. Proposing Instructor: Pankaj Jain and Amitesh Omar

6. Course Description

   (A) Objectives: The course aims to introduce students to basic principles of stellar structure and evolution. It will start with a detailed description of different kinds of stars, classification of stars based on the observed spectrum, and the Hertzsprung-Russell (HR) diagram. It will describe the basic equations of stellar structure and evolution. The different nuclear fusion reactions which contribute at different stages will be discussed in detail. The course will also provide detailed description of stellar evolution from birth to the formation of compact star or a black hole. The Physics of compact stars, i.e. white dwarfs, neutron stars and black holes will be discussed along with explosive transient phenomenon, such as the supernovas.

   (B) Contents (preferably in the form of 5 to 10 broad titles):

S. no.	Broad Title	Topics	No. of lectures
1.	Overview	Introduction to Stars, length and mass scales, interstellar medium, Photometry, Blackbody radiation magnitude scale, color index	4
2.	Stellar Spectra & classification	Stellar spectra, Saha equation, Hertzsprung-Russell (HR) diagram, Star clusters and Associations, Stellar	8
3.	Stellar Structure	Stellar structure equations, pressure temperature gradient equations energy production, Rosseland mean opacity, equation of state, radiative pressure,	8
4.	Stellar nuclear reactions	stellar nuclear reactions, nuclear reaction rate, standard solar model,	6
5.	Stellar evolution	formation of stars, pre-main sequence stars, Hayashi track, main sequence and evolution beyond the, main sequence, last stages of stellar evolution	6
6.	Compact Stars	white dwarfs, neutron stars and black holes, supernova explosion	6
7.	Binary stars	Kinematics of binary star system, Classification of binary stars, Mass Determination	4

(C) Pre-requisites, if any: N/A

(D) Short summary for including in the Courses of Study Booklet: Introduction to Stars and interstellar medium, Stellar spectra and classification, Hertzsprung-Russell diagram, Stellar structure equations, Rosseland mean opacity, radiative pressure, stellar nuclear reaction, formation of stars, evolution on the main sequence and beyond, the end stages of stellar evolution, formation of compact stars, white dwarfs, neutron stars, black holes, supernova explosions, Binary stars

7. Recommended Books:

   - An Introduction to Astronomy and Astrophysics, P. Jain
   - An Introduction to Modern Astrophysics, Bradley W. Carroll and Dale A. Ostlie

- Stellar Structure and Evolution, A. Weigert and Rudolf Kippenhahn
- Black Holes, White Dwarfs, and Neutron Stars: The Physics of Compact Objects, S. L. Shapiro and S. A. Teukolsky
- The Physical Universe, Frank Shu

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: