SYLLABUS
FOR

THE CERTIFICATE COURSE
IN
ASTRONOMY AND ASTROPHYSICS

A dissertation-oriented programme for the students of undergraduate level and above

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1. Introduction to naked eye Astronomy
- The constellations and their identification
- Identification of some individual stars
- Identification of the instantaneous phenomena
- A sense of scale and time
- A historical perspective and Copernican revolution
- Earth's rotation and other motions
- Eclipses
- Changing night sky
- Interesting objects in the night sky
- Contents of the Universe: A general perspective
- The value of Astronomy

2. The celestial sphere and the coordinate systems
- Geometry of the sphere
- The alt-azimuth coordinate system
- The equatorial coordinate system
- The ecliptic coordinate system
- The galactic coordinate system
- Transformation of one coordinate system to another
- Sunset and sunrise
- Sidereal time
- Mean solar time
- Ephemeris time
- The seasons
- Twilight

3. Observing the stars

(i.) Optical Techniques
- Optical telescopes
- Light gathering power
- Observing in different spectral regions

- Magnifying power
- Resolving power
- Limiting magnitude
- Measurement of stellar distances
- Stellar magnitudes
- Stellar parallaxes
- Stellar photography
- Stellar photometry
- CCD and its uses
- Multicolor photometry
- Atmospheric disturbances
- Seeing and extinction: atmosphere
- Interstellar extinction
- Spectrophotometry

(ii.) Observing the Sun

- The coelostat
- The coronagraph

(iii.) Radio Techniques

- Radio telescopes
- Power
- Spectral power
- Brightness distribution
- Flux density
- Resolution
- Effective collecting area
- Minimum detectable flux density
- Minimum detectable brightness
- Radio galaxies and other astrophysical aspects

4. Stars

(i.) Ordinary stars
- Light from the stars
- The spectrum from the stars
- The colors of stars
- Planck's law and the black body
- Spectral types of the stars
- The hydrogen spectrum
- The continuous spectrum
- The Hertzsprung-Russel diagram

(ii.) Binary stars
- Visual binaries
- Eclipsing binaries
- Spectroscopic binaries
- Laws of motion
- Newton's laws
- Law of gravitation

- The two-body problem
- Stellar masses
- Stellar sizes

(iii.) Variable stars
- Intrinsic variables
- Extrinsic variables
- Long period variables
- Cepheid variables
- RR Lyrae variables
- Novae and Supernovae

(iv.) Star clusters
- Open clusters
- Globular clusters

5. Spectral line formation
- Formation of absorption and emission lines
- What do the spectral lines tell us?

6. Stellar evolution- formation and structure of stars
- Stars in formation
- Interstellar medium
- Stellar energy generation
- Stellar prime of life
- Stellar structure
- Dying stars
- Nebulae and supernovae remnants
- Pulsars, neutron stars and black holes

7. The Milky Way Galaxy
- Components of the Milky Way
- Spiral structure of the Galaxy

8. Cosmology and other galaxies
- Olber's paradox

- The Big Bang theory
- The Steady State theory
- The primordial background radiation
- The hierarchical Universe
- Types of galaxies –Hubble's classification
- The origin and evolution of galaxies
- Clusters of galaxies
- Quasars
- Active galactic nuclei
- The Hubble's law
- The creation of elements
- The boundaries of the knowable
- The future of the Universe

9. Sun and solar system
- Basic structure of the Sun
- The solar constant
- Solar energy for Earth
- Origin of the solar system
- The planets and their origins
- The Moon
- The planets Mercury, Venus and Mars
- The planets Jupiter, Saturn, Uranus, Neptune and Pluto
- Comets, meteors and asteroids

10. Astrobiology
- Life in the Universe

11. Space Astronomy
- Effects of the Earth's atmosphere on incident electromagnetic radiation
- Introduction to X-ray astronomy and related technique
- X-ray studies of the Sun
- Binary X-ray sources
- X-ray studies of supernova remnants
- X-rays from normal and active galaxies
- Diffuse X-ray background
- IR, UV, X-ray and Gamma ray satellites
- Gamma ray astronomy techniques
- IR, X-ray and Gamma ray studies of our Galaxy, pulsars and active galactic nuclei