DSE (Open Elective)
PHY7E503 **Credits: 4**
ELEMENTARY ASTROPHYSICS **T-P: 4-0**
Course Instructor – Dr. Drisya K, Mobile - 8861825464

	Course Outcome: After completion of the full course the student should be able to	**Cognitive level**
CO1	Perform the observation of celestial objects	Apply
CO2	Estimate the physical properties of stars using photometric techniques	Apply, Analyse
CO3	Describe the evolutionary states of stars based on the masses	Understand
CO4	Explain the formation and evolution of galaxies	Understand
CO5	Describe the planetary system and explain the basic formation scenario of exoplanets	Understand

1. **COORDINATES AND OBSERVATION TECHNIQUES:** The celestial sphere, The horizontal system, The equatorial system, The Galactic coordinates , The sidereal time, Stellar distances – parallax method, Optical telescopes – Properties and aberrations, Radio telescopes, other wavelength regions**(12 hours)**
Section 2.3, 2.4, 2.8, 2.13, 3.2, 3.3, 3.4, 3.5 of Fundamental Astronomy by Karttunen et al

2. **PHOTOMETRIC CONCEPTS AND MAGNITUDES:** Intensity, Flux density, Luminosity, Apparent Magnitudes, Absolute magnitudes, Magnitude systems, Spectral formation, Saha and Boltzmann equation, Spectral classification: The Harvard spectral classification, The Yerkes Spectral Classification, Peculiar Spectra, The Hertzsprung-Russel Diagram **(12 hours)**
Sections 4.1 to 4.4 and Section 8.1 to 8.5 of Fundamental Astronomy by Karttunen et al
Sections 4.2 and 4.3 of Baidyanath Basu M : “An introduction to Astrophysics” (Prentice Hall of India)

3. **STELLAR EVOLUTION:** The contraction of stars towards the main-sequence , The main-sequence phase, The Giant phase, The final stages of evolution, White dwarfs, Neutron stars, Black holes (qualitative idea only) **(10 hours)**
Sections 11.2 to 11.5, 14.1 to 14.3 of of Fundamental Astronomy by Karttunen et al

4. **GALAXIES:** The Milky way Galaxy, Stellar luminosity function, The rotation of the Milky way, Structural components of the Milky way, The formation and

evolution of the Milky way, The classification of Galaxies, Luminosities and Masses, Galactic Structure, Dynamics of Galaxies, Systems of Galaxies , Active galaxies and quasars, The origin and Evolution of Galaxies **(14 hrs)**
Section 17.2 to 17.5 and Section 18.1 to 18.9 of Fundamental Astronomy by Karttunen et al

5. **THE SOLAR SYSTEM:** Planetary configurations, Orbit of the earth and visibility of Sun, Orbit of the moon, Eclipses and Occultations, The structure and surface of planets, Atmospheres and Magnetospheres, Photometry, polarimetry and spectroscopy, Thermal radiations of the planets, Minor bodies of the solar system, origin of the solar system **(12 hours)**
Section 7.1 to 7.9 and 7.17 and 7.18 of Fundamental Astronomy by Karttunen et al

Books and References

1. H. Karttunen, P. Kroger, H. Oja, M. Poutanen, K. J. Donner (Eds.): " Fundamental Astronomy"
2. Baidyanath Basu M : "An introduction to Astrophysics" (Prentice Hall of India)
3. B.W. Carroll & D.A. Ostille : "Modern Astrophysics", (Addison Wesley, 1996)
4. Frank H Shu: The Physical Universe: An Introduction to Astronomy

DSE (open elective)
PHY7E505 **Credits: 4**
IDEATION TO ENTREPRENEURSHIP: THE JOURNEY FROM CONCEPT TO MARKET READY ELECTRONICS **T-P: 4-0**
Course Instructor – Dr. Mohamed Shahin T , Mobile - 9961824725

	Course Outcome	Cognitive Level
CO1	Innovation and Problem-Solving Skills: Apply ideation techniques such as Design Thinking, Brainstorming, and SWOT analysis to identify real-world problems and develop innovative solutions leading to viable product concepts.	Apply
CO2	Embedded Systems Design and Programming: Design and program microcontroller-based circuits using Atmega32 and C programming, and interface embedded devices with computers to develop science application-oriented projects.	Create
CO3	Practical Circuit Design and Fabrication:	Analyze

	Simulate, design, and fabricate electronic circuits using tools like KICAD and LTSPICE, including the creation of PCB layouts and hands-on circuit building.	
CO4	Peripheral Device Integration and IoT Development: Design and implement systems that interface microcontrollers with peripheral devices using communication protocols (I2C, SPI, UART) to build IoT devices and control systems.	Create
CO5	Product Prototyping and Fabrication: Integrate electronics, PCBs, and 3D-printed mechanical components to fabricate functional prototypes, transforming a concept into a market-ready product.	Synthesize

1. Ideation and Concept Development: Introduction to Innovation and Entrepreneurship: Role of innovation in entrepreneurship; importance of creativity in problem-solving, Idea Generation Techniques: Brainstorming, Mind Mapping, SCAMPER, SWOT Analysis, Problem Identification and Solution Mapping: Identifying real-world problems, defining value propositions, and mapping out potential solutions, Design Thinking: Empathy mapping, user-centered design, ideation, prototyping, and testing, Case Studies: Examples of successful product ideas and how they were conceptualized.**(10 hours):**

2. Embedded device fundamentals: Introduction to microcontrollers (Atmega32): Overview of microcontroller architecture using KuttyPy Plus training platform, Programming Basics: Introduction to programming microcontrollers with C. Interpreting datasheets, shortlisting bill of materials for making circuit boards, interfacing embedded devices with computers. Creating a microcontroller based circuit on a breadboard. Creating science application oriented projects such as smart temperature control, basic input/output scheduled operation, and timers.
Lab Sessions: Hands-on experience with writing and uploading code using the IDE.**(12 hours):**

3. Circuit design fundamentals: Basic electronics training using SEELab, Signal processing circuits such as filters, and amplifiers, creating schematic diagrams, layouts, and PCBs with KICAD (with practical demo), introduction to device packages (through hole, SMD, various connectors), SMD soldering: creating scalable projects circuit testing, simulating circuits with circuit simulator built into SEELab software., Simulating circuits with LTSPICE.**(12 hours)**

4. Interfacing Peripheral Devices with Microcontroller: Interfacing Techniques: Working with sensors, actuators, and communication protocols (I2C, SPI, UART), practical Applications: connecting microcontrollers to various sensors and devices, focusing on real-time data acquisition and control, advanced projects: developing IoT devices, home automation systems, and simple robotic applications using KuttyPy Plus, Lab Sessions: Real-world projects where students design, program, and test systems that incorporate sensor data and device control, Interfacing scientific instruments with laptops using Python. Will cover communication protocols such as GPIB, USBTMC, and RS232, plotting datasets, and feature extraction (curve fitting) using scipy.**(14 hours)**

5. Fabrication of a Product: Prototyping and Design – Basics of 3D printing, laser cutting, mechanical design: designing enclosures and mechanical components for devices using 3D printing and laser cutting, integrated product fabrication: combining electronics, PCB, and mechanical components into a fully functional product, fabrication of projects: including designing, building, and testing a complete product from concept to final prototype.**(12 hours)**

TEXT BOOKS

1. The AVR Microcontroller and Embedded systems using Assemble and C by M.A. Mazidi, S Naimi and S. Naimi.

2. Design Thinking: New Product Development Essentials from the PDMA by Abbie Griffin, Charles H. Noble, and Serdar S. Durmusoglu.

3. **Embedded C Programming and the Atmel AVR**, by Richard H. Barnett, Larry O'Cull, and Sarah Cox.

4. The Art of Electronics, by Paul Horowitz and Winfield Hill.

REFERENCES:

1. **Kuttypy Documentation : https://kuttypy.readthedocs.io/en/latest/**
2. **Atmega32 Reference : https://www.microchip.com/en-us/product/atmega32**
3. **Atmega32: https://ww1.microchip.com/downloads/en/DeviceDoc/doc2503.pdf**
4. **KiCAD Handbook : https://docs.kicad.org/**