



Phys 4310	QUNTUM ELECTRONICS	(CR3)
Preq.	Phys 3402, 3702	

Objective

Develop a basis for understanding the quantum mechanical aspects of modern electronics (lasers, quantized Hall effect, field effect transistors, optical tweezers, etc.)

Syllabus

Time-independent Schrodinger equation, quantum mechanical tunneling, bound states and scattering transmission electron microscopy, the energy spectrum of diatomic and aromatic molecules, the band structure of one-dimensional crystalline and disordered solids, the scattering time for electron transport in a crystal, the quantized and fractional Hall effect in a two-dimensional electron gas, perturbation theory and field quantization, two-state lasers, light pressure forces on atoms, quantization of LC circuits, Casimir forces, field effect transistors, optical tweezers, quantum devices, single electron transistor, Spontaneous and stimulated transitions, Einstein coefficients, coherence of stimulated emission, Light matter interaction, transition probability Spectral line shape, inhomogeneous and homogeneous broadening Absorption and amplification, gain medium, saturation Laser oscillations, feedback, lasing threshold, resonant conditions interaction of electromagnetic radiations with resonant atomic transitions, density matrix treatment, Rabi oscillations.

Recommended Books

1. *Quantum Theory Of The Optical And Electronic Properties Of Semiconductors (5Th Edition)*, H. Haug and S. W. Koch, World Scientific, (2009)
2. *Quantum Electronics*, by A. Yariv, Wiley, (2013)
3. *Principles of Quantum Electronics*, D. Marcuse, Academic Press, (2012).



Phys 4310	ASTROPHYSICS	(CR3)
Preq.	Phys 3402, 3702	

Objective

To give an introduction to theory of star formation and to understand large scale structure of the universe.

Syllabus

Astronomy as an observational science, measuring time, angle, and distance, luminosity, brightness and telescope, temperature, colour and spectral properties of stars, basic physics of stars, The interstellar medium and the birth of stars; protostars and evolution to the main sequence; star clusters, The death of stars - white dwarfs, the late evolution of massive stars, supernovae and supernova remnants Neutron stars, pulsars and black holes, Galaxies: the Milky Way galaxy, rotation curves and dark matter, other galaxies and the Hubble classification scheme, Galaxies: active galaxies, galaxy environments and large scale structure, galaxy clusters and dark matter, galaxy formation, Cosmology: Hubble's law, the Big Bang, the cosmic microwave background, Expanding Universe, Hubbles law, red shift, Big Bang and Inflation, Cosmic Microwave Background, Nucleosynthesis, Dark Matter and Dark Energy.

Recommended Books

1. *An Introduction to Modern Astrophysics* by B. W. Carroll and D. A. Ostlie, (2nd Edition), Cambridge (2017)
2. *Introduction to Astrophysics: The Stars* by J. Dufay and O. Gingerich, Dover (2012)
3. *An Introduction to Stellar Astrophysics* by F. LeBlanc (1st Edition), Wiley (2010)



Phys 4310	MEDICAL PHYSICS	(CR3)
Preq.	Phys 3402, 3702	

Objective

To give an introduction to various applications of physics in medical sciences and health care sector.

Syllabus

Interactions of Ionising Radiation with Matter: Introduction; Beta-rays, range-energy relationship, mechanism of energy loss, Ionization and excitation, Bremsstrahlung, Alpha-rays, Range-energy relation – ship, Energy transfer, Gamma-rays, exponential absorption, interaction mechanisms, Pair production, Compton scattering, photoelectric absorption, photodisintegration, Combined effect, Neutrons, Production classification, interaction, Scattering, Absorption. Radiotherapy, development of radiotherapy, Radiotherapeutic aims, External beam therapy, Brachytherapy, Unsealed source therapy, Requirements for accuracy and precision, Quality assurance, The role of medical physics. Medical Imaging, Diagnostic X-rays, Production of X-rays, Absorption of x-ray to other planes, Partial volume effect, Artifacts, Contrast agents in conventional radiography and CT, Diagnostic Ultrasound, Doppler effect, Radionuclide imaging, positron emission tomography (PET), Magnetic resonance imaging (MRI), Contrast agents for MRI.

Recommended Books

1. *Introduction to Health Physics* by H. Cember. 3rd Ed. McGraw Hill, (1996).
2. *Diagnostic Imaging*, by Peter Armstrong and Martin L. 4th Ed., Blackwell, (1998).
3. *Radiologic Science of Technologists* by S. C. Bushong, 5th Ed. Mosby, (1993).
4. *Fundamentals of Radiation Dosimetry*, by J. R. Greening, 2nd Ed. Adam Hilger, (1985).
5. *Radiation Detection and Measurement*, by Knoll G.F., 2nd Ed. Willey, (1980).
6. *Physics of Medical Imaging*, by Edwin G. A. Aird, Heinemann, (1988).