Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

M.Sc. Physics

Sem	Subject	Title of the Paper	Ins.Hrs	Credits
I	MC	Mathematical Physics	5	4
	MC	Classical Mechanics and Statistical Mechanics	5	4
	MC	Quantum Mechanics-I	5	4
	MC	General Experiments	5	-
	MC	Electronic Experiments	6	-
	Elective	1. Electronic Devices and Applications 2. Energy & Environmental physics 3. Astrophysics	4	4
II	MC	Electromagnetic Theory	5	4
	MC	Quantum Mechanics-II	5	4
	MC	Electronic Instrumentation Techniques	5	4
	MC	General Experiments	6	6
	MC	Electronic Experiments	5	6
	Elective	1. Microprocessor 8085 and Microcontroller 8051 2. Geophysics 3. Bio Physics	4	4
	SSP	Ultrasonics	-	2*
III	MC	Solid State Physics	5	4
	MC	Atomic and Molecular Spectroscopy	5	4
	MC	C Programming and Research Methodology	5	4
	MC	Advanced General Experiments	5	-
	MC	Microprocessor and C Programming Experiments	5	-
	Elective	1. Nanoscience and Technology 2. Optical Physics 3. Quantum Computational Physics	4	4
	SSP	Communication Electronics	-	2*
	Core	Project	1	-
	MC	Materials Science	5	4
	MC	Nuclear and Particle Physics	5	4
	MC	Advanced General Experiments	5	6

IV	MC	Microprocessor and C Programming Experiments	5	6
	MC	Project	4	5
	Elective	1. Crystal Physics and Non-Linear Optics 2. Reactor Physics 3. Digital signal processing	4	4
		Human Rights	**2**	**1**
Total			**120**	**90+4***

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

Department: M.SC. PHYSICS

S. NO	COURSE CODE	COURSE NAME
1.	P915C	Elective: Quantum Computational Physics
2.	P1012B	Elective: Reactor Physics
3.	P916X	SSP- Communication Electronics

SYLLABUS

Elective: Quantum Computational Physics

Semester - III Hours/week: 4

Sub. Code: Credits: 4

Objectives:

To introduce modern methods of molecular modeling and culminating in electronic structure modeling.

To introduce formalism of quantum computation.

Learning Outcomes: After studying this course, the students will

Have a conceptual understanding of quantum mechanics necessary for the description of molecules and atoms.

Be able to choose an appropriate method to solve quantum computational problems.

Unit - I: Introduction to Computational Quantum Mechanics:

Schrödinger equation-Atomic orbital's - spectra of hydrogen-like (one electron) atoms and alkali atoms - variation theorem - Spin and spin wave functions-Many electron systems-

electrostatic Hamiltonian for many-electron systems-fixed nuclei (simplest Born-Oppenheimer) approximation- Pauli principle (antisymmetry of the many-electron wave function with respect to the interchange of electrons in the wavefunction)-Slater determinants.

Unit - II: Basic Methods of Molecular Modeling:

Force Field (Molecular Mechanics), semiempirical, ab initio and Density Functional methods. Applicability- comparison of accuracy - basics of electronic structure theory-Atomic units - qualitative role of kinetic and potential energy in shaping the orbitals-Bhorn- opphenier approximation-Geometric optimization.

Unit - III: Roothaan-Hall Hartree-Fock Method:

Energy expression- Slater determinantal wavefunction- Basis set expansion of the orbitals-Basis set types: atomic, plane wave and grid basis sets- Atomic basis sets: Slater-type and Gaussian functions The Self-Consistent Field (SCF) method- Fock's theorem - invariance of the total wavefunction with respect to linear combination of occupied spin-orbitals-Hund's theorem and its implications.

Unit - IV: Ab initio Calculation:

Basic principles of ab initio method – Hatree self consistent field method-Calculation of molecular energy- minimizing energy equation – Ab initio calculation using Roothaan – Hall equation (SCF procedure) - Application to Ab initio method.

Unit - V: Density Functional Theory (DFT):

Orbital energies, Koopmans' theorem, electrostatic properties - Canonical and localized molecular orbital's - molecular properties- Density functional theory-Major exchange-correlation function - calculation of equilibrium geometries- force constants- vibrational spectra- transition states.

Books for Study

F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2004.

Errol Lewars, Computational chemistry, Introduction to the theory and application of molecular and quantum mechanics, Springer publication, 2008.

M.B Smith and J. March, Advanced organic chemistry, John Wiley & Sons, 2001.

Books for Reference

C. J. Cramer Essentials of Computational Chemistry, John Wiley & Sons ,2002.

T. Clark A Handbook of Computational Chemistry, Wiley, New York, 1985.

R. Dronskowski Computational Chemistry of Solid State Materials, Wiley-VCH ,2005.

D. Rogers, Computational Chemistry Using the PC, 3rd Edition, John Wiley & Sons ,2003

Szabo, N.S. Ostlund, Modern Quantum Chemistry, McGraw-Hill, New Delhi, 1982.

Website References

https://en.wikipedia.org/wiki/Computational_chemistry

https://www.google.co.in/?gfe_rd=cr&ei=iihZWMRIILT8gfEmKmoCQ&gws_rd=ssl#q=introduction+to+quantum+computational+chemistry

http://www.ccl.net/cca/documents/dyoung/topics-orig/compchem.html

http://nptel.ac.in/courses/104101002/downloads/lecturenotes/module1/chapter1.pdf

Elective: Reactor Physics

Semester - IV Hours/week: 4

Sub. Code: Credits: 4

Objectives

To introduce the concepts of nuclear energy, neutron diffusion and neutron moderation.

To provide an understanding of construction, kinetics, fuel used, precautions to be taken and applications of reactors.

Learning outcomes: After completing this course, the students will be able to

Differentiate between chemical reaction and nuclear interaction

Demonstrate the importance of nuclear power other than the non-conventional energy sources

Apply the knowledge chain reaction and able to calculate the critical value for a typical nuclear reactor and understand the working concept of different reactors and their applications.

Unit – I: Chain Reactions

Slow neutron reactions-nuclear reaction cross section-neutron cross section-determination of neutron cross section-attenuation of neutrons-macroscopic cross section and mean free path- neutron flux and reaction rate-energy dependence of neutron cross sections-fission cross section-neutron flux and reaction rate-energy dependence of neutron cross sections-fission cross section.

Unit – II: Thermal Neutrons

Energy distribution of thermal neutrons-effective cross section for thermal neutrons-the slowing down of reactor neutrons-scattering angles in Laboratory system (L system) and Centre of mass system(CM system)-forward scattering in L system-transport mean free path and scattering cross section-average logarithmic energy decrement-slowing down power moderating ratio-slowing down time-resonance escape probability-the effective resonance intent

Unit – III: Neutron Diffusion

Diffusion – diffusion Equation- solution of diffusion equation for a point source in an infinite medium and for an infinite plane source in a finite medium -thermal diffusion Length- diffusion Length for a fuel-moderator mixture-fast neutron diffusion and Fermi age equation- Correction for neutron capture.

Unit – IV: Neutron Moderation and Critical Equation

Energy loss in elastic collision - moderation of neutrons in Hydrogen - Space dependent slowing down -Moderation with absorption-Diffusion equation applied to a thermal reactor- thermal neutron source as obtained from the Fermi age equation-critical equation and reactor buckling-the non-leakage factors-criticality of large thermal reactors-critical equation for reactors with heterogeneous moderators-critical size and geometrical buckling- extrapolation length correction-effect of reflector.

Unit – V: Nuclear Reactors

Classification of reactors-Heterogeneous reactors-Thermal neutron fission-requirements and limitations-possible alternative-properties of heterogeneous system-resonance capture and resonance escape probability-calculation of the thermal utilization-resonance escape probability and fast fission factor-Commercial reactors: Pressurized Water Reactor (PWR)-Boiling Water Reactor (BWR)- Heavy Water Reactor (HWR)- Water Moderated Enriched Reactors- The breeder reactor- future of nuclear fission power.

Text Books

John R. Lamarsh, Introduction to Nuclear Reactor Theory, Addison Wisley, 2002.

Samuel Glasstone, Milton C. Edlund, The Elements of Nuclear Reactor Theory, Van Nostrand, 1995.

Nuclear reactor analysis-James J Duderstadt ,Louis J Hamilton,Wiley India Pvt Ltd,2013

Books for Reference

Thayal D.C., Nuclear Physics, Himalaya Publishing house, Mumbai, 2007.

Goshal S. N., Nuclear Physics, S. Chand Publications, New Delhi, 2004.

Bannet D. J. and Thomson J. R, The elements of nuclear power, Longman Scientific and Technical, New York, 1989.

Murray R. L., Nuclear Physics, 5th edition Butterworth, Heineman, 2001.

Websites for Reference

http://faculty.ksu.edu.sa/adokhane

http://www.studymode.com/essays/Reactor-Physics

www.ans.org/PowerPlants

www.world-nuclear.org/info/inf53.html

npcil.nic.in/main/AllProjectOperationDisplay.as

Self-Study Paper: Communication Electronics

Sub. Code: Credits: 2

Objectives:

To familiarize the basic antenna parameters, radiated power, radiation resistance, radiation efficiency, radiation pattern and to review the fundamentals of antenna theory.

To enable the students to understand the different types of communications and make them appreciate the flavor of physics in communication and to understand the concepts and techniques involved in communication by satellites.

Learning Objectives: On successful completion of this paper, the students will be able to

Understand the function of antennas, different types of antennas and the radiation mechanism.

Demonstrate proficiency in the use of data and wireless communication networks, equipment and devices.

Analyze components associated with digital and analog electronic/communication systems.

Unit - I: Antennas & Wave Propagation

Radiation field and Radiation resistance of a short dipole antenna -Grounded λ/4 Antenna-Ungrounded λ/2 Antenna- Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas- Sky Wave Propagation-Ionosphere-Ecles&Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation.

Unit - II: Pulse Code and Digital Modulation Techniques

Sampling theorem – Low – Pass and Band – Pass signals, PAM, Channel BW for a PAM signal. Natural sampling. Flat–top sampling, Signal recovery through Holding, Quantization of signals, PCM transmission, quantization of noise.

Unit – III: Broad Band Communication

Multiplexing–Frequency division–Time division- Short and medium Haul systems: Coaxial cables – fibre optic link – Microwave link – Tropospheric Scatter links. Long Haul system: Submarine cables.

Unit - IV: Radar and Television

Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems- Radar Antennas-Duplexers-Radar Receivers and Indicators-Pulsed Systems-Other Radar Systems.

Components and Principle of operation: Cable TV, CCTV and DTH

Unit -V: Satellite Communication

Orbital Satellites, Geostationary Satellites, Orbital Patterns, satellite system link models, satellite system parameters, satellite system link equation, Link budget. INSAT communications satellites.

Books for Study:

Electronic Communication System-George Kennedy & Davis -Tata McGraw Hill 6th Edition, 2002.

Electronic Communications – Dennis Roddy&Coolen , Prentice Hall of India, IV Edition, 1995

3. Wayne Tomasi, "Advanced electronics communication Systems", fourth Edition, Prentice Hall, Inc., 2006.
4. M. Kulakarni, "Microwave and Radar Engineering", Umesh Publications, 1998.

Books for Reference:

Taub and schilling, "Principles of Communication Systems", Tata McGrawHill Second edition, 1991.

Robert J Schoenbeck-Electronic Communications, Prentice Hall of India, New Delhi, 2002.

Websites for Reference

http://www.ti.com/lit/ds/symlink/lm555.pdf

http://www.youtube.com/watch?v=nV_AtmUS7lE

http://en.wikipedia.org/wiki/Pulse-code_modulation

http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/