Annexure 'A' of Agenda Item No. AC/41.01
(Total Page A-01 to A-18) 41.01/A-01

# GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

Sector – 16C Dwarka, New Delhi – 110078

F.No. IPU/JR(C)/40th AC/2016/ 47 Dated: 05.03.2016

**Subject- Proceedings of the 40th meeting of Academic Council.**

Please find enclosed herewith the proceedings of the 40th meeting of Academic Council of Guru Gobind Singh Indraprsatha University held on Tuesday, 1st March 2016 at 11.30 a.m. in the Conference Hall of the University, Administrative Block-'A' wing, Dwarka Campus, New Delhi-110078 for approval.

Observations, if any may kindly be communicated to the office of the undersigned within week, consequent to no observation(s), communicated, the proceedings will be assumed as deemed approved.

Jt. Registrar (Coordination)
coordination112@gmail.com
09868527302/011-25302135

F.No. IPU/JR(C)/40th AC /2016 /47 Dated: 05.03.2016

1) All Deans and Directors of Guru Gobind Singh Indraprastha University
2) Prof.P.K.Julka, Dept. of Clinical Oncology, AIIMS, New Delhi.
3) Prof.M.C.Sharma, School of Education, (IGNOU), New Delhi.
4) Prof.M.P.Gupta, Department of Management Studies, IIT, Delhi.
5) Prof.A.K.Maitra, Former Director, School of Planning & Architecture, Delhi.
6) Prof.Karmeshu, School of Computer & System Sciences, JNU, New Delhi.
7) Prof. Surender kumar, Deptt. of Chemical Technology, IIT Roorkee, Uttarakhand.
8) Prof.J.P.Khurana, Dept. of Plant Molecular Biology, Faculty of Interdisciplinary & Applied Sciences, University of Delhi, South Campus.
9) Prof. Lallan Prasad, Retired Head and Dean of Dept. of Business Economics, Faculty of Applied Social Sciences, University of Delhi, South Campus.
10) Shri Arvind Misra, Former Dean, Faculty of Law, Dr. B.R. Ambedkar University, Agra, Ex.Direcotor /Head, Post Graduate Deptt. of Law Agra College, Agra Former OSD (Law) to H.E. the Governor of UP, Lucknow.
11) Shri Sandeep Gupta, CEO,Academy of Embedded Technology, Delhi.
12) Prof. J.K. Garg, Professor, University School of Environment Management
13) Dr.Amar Pal Singh,Professor,University School of Law & Legal Stuides.
14) Dr. Manpreet Kang, Associate Professor, University School of Humanities & Social Sciences
15) Dr. Meenu Kapoor, Associate Professor, University School of Biotechnology
16) Dr. Vaishali Singh, Associate Professor, University School of Basic and Applied Sciences

**Copy for kind information of the Competent Authority:**

(i) AR to the Vice Chancellor GGSIP University
(ii) SO to the Pro-Vice Chancellor GGSIP University
(iii) AR to the Registrar GGSIP University

Jt. Registrar (Coordination)
coordination112@gmail.com
09868527302/011-25302135

24.01/A-02

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

# GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

## FORTIETH MEETING

OF THE

## ACADEMIC COUNCIL

*DATE* : *01st March, 2016 (Tuesday)*

*TIME* : *11:30 a.m. onwards*

*VENUE* : *CONFERENCE ROOM*

# PROCEEDINGS

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SECTOR – 16C, DWARKA, NEW DELHI.

## INDEX OF AGENDA ITEMS

41.04/A-04

| AGENDA No. | AGENDA ITEM(S) | Page No. |
|---|---|---|
| AC40.21 | To consider and approve the implementation of the minor modification(s) in the existing scheme and syllabus of Master of Technology (M.Tech.) in the following programmes approved by the Board of Studies of the University School of Information and Communication Technology (USICT), from the academic session 2015-2016:-<br>M.Tech.(Regular Programme):-(i)Information Technology, (ii) Computer Science & Engineering,(iii) Information Security , (iv)Electronics & Communication Engineering, (v)Digital Communication, (vi)Signal Processing, (vii) RF & Microwave Engineering and (viii)VLSI Design<br>M.Tech.(Weekend Programme):- (i) Computer Science & Engineering (ii) Information Technology (iii) Electronics & Communication Engineering | 15-16 |
| AC40.22 | To ratify the Admission Brochure of the University for the Academic Session 2016-2017. | 16 |
| AC40.23 | To consider and approve the institution of an Award (Gold Medal) in the name of Late Dr. Bhaskar Prakash Joshi (Ex-Registrar, Guru Gobind Singh Indraprastha University). | 16 |
| | Table Agenda | |
| AC40.24 | To ratify the extension of last date of submitting eligibility proof by November 2, 2015 for result awaited students of Engineering, B. Arch. & Professional Programmes (Except MBBS / BDS / PGMC / SSMC), admitted during Academic Session 2015-2016. | 17 |

The course curriculum and scheme of examinations for the above programmes have been revised as per the UGC guidelines, merging some old papers and including important aspects like wetland. The revised scheme and syllabus has been implemented with the approval of Competent Authority from Academic Session 2015-2016. The Academic Council after consideration ratified the revised course curriculum and scheme of examinations for the above programmes offered by University School of Environment Management as implemented from academic session 2015-2016.

{Annexed as Annexure 'N' of Agenda Item No.AC40.16} (Page N-01 to N-1C

**Agenda Item No. AC40.17: To ratify the implementation of revised scheme and syllabus of Ph.D. course work of University School of Education (USE), from the academic session 2015-2016.**

In pursuance of the provision of regulations of the University Ordinance 12 for programmes leading to the degree of Doctor of Philosophy (Ph.D.), the University School of Education on the recommendation of sub-committee of the Academic Council (15th December 2015) has updated and revised scheme and syllabus for Ph.D. coursework. The revised scheme and syllabus has been implemented with the approval of Competent Authority from Academic Session 2015-2016. The Academic Council after consideration ratified the revised scheme and syllabus for Ph.D. coursework implemented from Academic Session 2015-2016.

{Annexed as Annexare 'O' of Agenda Item No. AC40.17}
(Page N-01 to N-10)

**Agenda Item No. AC40.18: To ratify the implementation of revised course curriculum and scheme of examinations for Ph.D. courses in the discipline of (i)Physics (ii) Chemistry (iii) Mathematics offered by the University School of Basic & Applied Sciences (USBAS) from the academic session 2015-2016.**

In pursuance of the provision of Regulations of the University Ordinance 12 for programmes leading to the degree of Doctor of Philosophy (Ph.D.), the University School of Basic & Applied Sciences has revised the course curriculum and scheme of examinations for Ph.D. courses as approved by the sub-committee of Academic Council (17th September, 2015) in the following disciplines:

(i) Physics
(ii) Chemistry
(iii) Mathematics

The revised curriculum and scheme of examinations for Ph.D. programme has been implemented with the approval of Competent Authority from academic session 2015-2016.

The Academic Council after consideration ratified revised course curriculum and scheme of examinations for the above programmes as implemented from Academic Session 2015-2016.

{Annexed as Annexure 'P' of Agenda Item No. AC 40.18}
(Page- P-01 to P-33).

# University School of Basic &Applied Sciences
# Guru Gobind Singh Indraprastha University

# Scheme and Syllabus for Ph.D. Directed Course Work in the Discipline of Physics

## 2015 – onwards

Entrepreneurship | Employability | Skill Development

Approved in the 40th meeting of the Academic Council held on 01-03-2016 vide agenda item 40.18 w.e.f. 2015

## Scheme of Ph. D. Directed Course Work in Physics

| S. No. | Code | Paper | L | P | Credits |
|---|---|---|---|---|---|
| **1.** | PES 101 | Research Methodology for Science & Technology | 3 | 0 | 3 |
| **Elective (Choose at leastone)** | | | | | |
| **2.** | CWP 102 | Fundamentals of Nanoelectronics | 3 | 0 | 3 |
| **3.** | CWP 103 | Radiation Detection Techniques | 3 | 0 | 3 |
| **4.** | CWP 104 | Characterization of Bulk and Nanomaterials | 3 | 0 | 3 |
| **5.** | CWP 105 | Nanostructured Thermoelectric Materials | 3 | 0 | 3 |
| **6.** | CWP 106 | Magnetism in Low Dimensional System | 3 | 0 | 3 |
| **7.** | CWP 107 | Solar Radiation and Solar Photovoltaic Science and Engineering | 3 | 0 | 3 |
| **8.** | CWP 108 | Thermoluminescence Dosimetry | 3 | 0 | 3 |
| **9.** | CWP 109 | Quantum & Statistical Physics | 3 | 0 | 3 |
| **10.** | CWP 110 | Elementary Neutron Physics | 3 | 0 | 3 |
| **11.** | CWP 111 | A Course of High Energy Physics | 3 | 0 | 3 |
| **12.** | CWP 112 | Radiation Physics and Protection | 3 | 0 | 3 |
| **13.** | CWP 113 | Introduction to MATLAB and Computational methods | 2 | 1 | 3 |

**Paper Name: Research Methodology for Science & Technology Credit: 3 Lectures: 40**
**Paper Code: PES – 101**

**Unit – I**

Definition, motivation & significance of research, types of research, research process and steps in conducting research; Planning research Problem identification and formulation; Research design; Application of Research scenario in India.

**Unit – II**

Review of the publisher research in the relevant field; Re-viewing literature; Report Preparation, Structure of Report, Report Writing Skills, Citations, Research Papers,; formulation of research projects proposal; Types of reports, bibliography.

**Unit – III**

Values, standards & practices; scientific misconduct; human participants & animal subjects, authorship allocation of credit, competing interests, commitments & values. Definition, types of plagiarism, unintentional plagiarism, mechanisms for avoiding plagiarism.

**Unit – IV**

Understanding of invention & innovation and its role in economic development; patents & copyrights, importance &basic knowledge of Intellectual Property Right (IPR); what can and cannot be protected.

**SUGGESTED REFERENCES**


1. Research Methodology Methods and Techniquest - C.R. Kothari, New Age Intl. Pub. (2004)
2. Business Statistics for contemporary decision making- Ken Black, John Wiley and Sons, Inc. 2010.
3. Research Methodology (Concept and Cases)-Deepak Chawla & NeenaSodhi, Vikas Publication House (P) Ltd. (2011)
4. Research Methodology- DebashisChokarvaty, Surbhi (P) Ltd. (2010)
5. Research Methodology-Navin Sharma, Deep & Deep (P) Ltd. (2007)
6. Research Methodology -Ranjit Kumar, Delhi Pearson Education (2006)
7. "The Role of Invention, Innovation and The Industrial Property System in EconomicDevelopment", www.wipo.int/cdocs/mdocs/innovation/en/.../wipo_inn_cai_97_1.doc
8. MLA Handbook for Writers of Research Papes- Joseph Gibaldi, New Delhi, Affiliated East West Press (1999 15th edition).

**Paper Name: Fundamentals of nanoelectronics** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 102**

This course provides the concepts required for the description of current flow through a nanostructure. For the devices with dimensionality in nanometer scale, an atomistic approach is required to describe the current flow. This course introduces the bottom-up approach for the current transport and provides the fundamental concepts required for the design and analysis of the modern nanoscale devices.

**(10)**

**Unit I:**

Electronic structure and properties of a given device : Hamiltonian matrix for a given device structure : converting schrodinger equation into a matrix equation by the use of finite difference method and obtaining the energy eigenvalues structure, Bandstructure of common semiconductors, Subbands: Quantum wells, wires, dots, Density of states, Electron density/density matrix

**(10)**

**Unit II:**

Current transport : Ballistic and diffusive transport, mobility, Landauer model, scattering theory of transport, Landauer-Büttikerformalism, semiclassical dynamics, coherent transport, correlation function/current, NEGF(non equilibrium green function) equations, self energy, conductance quantization, transverse modes

**(10)**

**Unit III:**

Energy transport: thermoelectricity, electrical conductivity, thermal conductivity, Seebeck coefficient, figure of merit for 1-dimensional, 2-dimensional and 3-dimentional systems.

**(10)**

**Text/Reference:**

S. Datta, Quantum Transport: Atom to Transistor, Cambridge (2005),
Ferry D. K. and Goodnick S. M., Transport in nanostructures, Cambridge University Press(1997)
Mark Lundstorm, Fundamentals of Carrier Transport,Cambridge University Press(2000)
Dimensionality and Thermoelectric Devices, http://arxiv.org/pdf/0811.3632., Lectures 4A,B: http://www.nanohub.org/resources/5279.

**Paper Name: Radiation Detection Techniques** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 103**

**Unit – I**

**(12Hrs)**

Introduction of SSNTD, General description of heavy ion energy deposit in solides (Crystal, Glasses and Polymers), Unrealistic mechanism (direct atomic displacement, thermal spike and the total energy loss rate); Realistic mechanisms; Ion Explosion spike (Criterion for Track Formation, Quantitative etching rate relation), Othe ionization based models (Secondary energy loss, restricted Energy loss, Primary and Secondary Damage), Mecham+nism of formation of charged particle track in solids; Environmental effects on tracks (Thermal effect, Chemical, Electrical effects, Photo-chemical effects and irradiation effects, Temporal effects).

**Unit – II**

**(8Hrs)**

Track etching methodology and geometry, Track recipes, Track etching geometry for constant track etch rate $V_T$, Determination of Track Parameters (range R and track etch rate $V_T$), Etching Efficiencies for internal and external track sources, prolonged etching factor,. Some special technique of track parameter measurements.

**Unit – III**

**(12Hrs)**

A Comparative study of various nuclear detectors such as gas counter, scintillation counters, semi-conductor detectors, $HPG_c$ detector or $SSNTD_s$ Various kinds of $SSNTD_s$ their relative, position viz-a-viz the lowest ionizing particle detection ability. Pulse shaping and data acquisition systems.

**Unit – IV**

**(10Hrs)**

Source of radon and nature of radon, radon and lung cancer, doses from internal and external sources and calculations, radiation exposure of man in the indoor environment, radon daughter equilibrium in dwellings, radon and its daughter products in human environment, long term exposure to radon and daughter products. Potential Alpha Energy (PAE), Working Level (WL).

**References:**


1. R. I. Fleiescher, P. B. Price and R. M. Walker: Nuclear tracks in Solids: Principles an Applications, University of California, Berkeley, 1975.
2. Nuclear Radiation Detectros by S.S. Kapoor and V S Ramamurthy, 1993
3. S. A. Durrani and R. K. Bull: Solid State Nuclear Track Detectros; Principles, Methods and Applications, Pergamon press. Oxford and New York, 1987.
4. Radiation Detection and Measurements by G. F. Knoll, 2010.

**Paper Name: Characterization of Bulk and Nanomaterials Credit: 3 Lectures: 40**
**Paper Code: CWP - 104**

**Unit – I: Fabrication of Nano Materials**

**[14]**

Synthesis method and strategies, Top-down and bottom up approaches, Chemical vapour deposit Laser Ablation, Electric Arc, Sol-Gel Processing and Lithography.

**Unit – II: Structural Characterization Techniques**

**[14]**

Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), EDAX, X-ray, diffreaction (XRD), Atomic Force Microscope (AFM) and Scanning Tunnelling Microscope.

**Unit – III: Spectroscopy**

**[12]**

Ultraviolet/visible absorption spectroscopy, Photoluminescence, Infrared spectroscopy, Fourier Transform Infrared (FT-IR) spectroscopy, Raman Spectroscopy, Atomic Absorption Spectroscopy, Inductive Coupled Plasma emission spectroscopy (IC-AES).

**Reference Books:**


1. Introduction to Nanotechnology by C P Poole
2. Hand book of Nanotechnology edited by B Bushan
3. ASM Hand Book Volume 10 – Material Characterization

**Paper Name: Nanostructured Thermoelectric Materials Credit: 3 Lectures: 40**
**Paper Code: CWP – 105**

**Unit – I**

**Electronic structure of material**

Overview of statistical equilibrium of free electrons: density of states for bulk and low dimensional system, distribution: Maxwell Boltzmann, Fermi Dirac, carries concentration, impurity semiconductors.

**(10)**

**Unit – II**

**Static and dynamic properties of nano particles**

Specific heat of metals and semiconductors, thermionic emission

**Transport properties of materials**

Boltzmann transport equation, particle diffusion, electrical and thermal conductivity, isothermal Hall effect.

**(10)**

**Unit – III**

**Thermo electric materials (TEM):**

Seeback coefficient, Peltier effect, Figure of merit, Selection of the material for TEM, Different types of TEM and recent development in low dimensional TEM, doping, alloying and size effects and its applications, Environmental TEM.

**(10)**

**Unit – IV**

**Thermoelectric module and device**

Introduction, Segment thermoelectric model, Modelling and optimization of Segmented Thermoelectric Uni couples, Optimum Conversion Efficiency, Summary.

**(10)**

**References:**


1. Statistical physics: Patheria (Butterworth-Heinemann, Oxford, 1972)
2. Statistical physics: K. Huang (Wiley Eastern, New Delhi, 1975)
3. B. K. Aggarwal & Melvin Eisner: Statistical physics (Wiley Eastern, New Delhi)
4. CRC handbook of Thermoelectrics, Ed. CR Rowe, 1955.

**Paper Name: Magnetism in Low Dimensional System** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 106**

**Unit – I**
**Brief Review:**

**[8]**

Overview of magnetic materials, Dia, Ferro, Anti ferro and Ferri magnetism.

**Unit – II**
**Different types of magnetic behaviors**

**[8]**

Super para magnetic materials, spin glass and giant and colossal magneto-resistance, super fluidity and superconductivity.

**Unit – III**
**Magnetism in Nano structures**

**[12]**

Single- Domain vs Multi-Domain behavior, Coercivity of Fine Particles, Super Para magnetism in Fine particles, Super Para magnetism in alloys, ferro magnetism in semi-conduction quantum dots and its applications.

**Unit – IV**
**Measurement techniques**

**[12]**

The susceptibility balance, faraday method, vibrating sample magnetometer, SQUID magnetometer.

**References:**


1. Physics of Magnetism- S. Chikazumi and S. H. Charap
2. Physical Theory of Magnetic Domains-C. Kittel
3. Introduction to magnetic materials-B D Cullity and C D Grham

**Paper Name: Solar Radiation and Solar Photovoltaic Science and Engineering**

**Credit: 3 Lectures:40**

**Paper Code: CWP - 107**

This course will give an overview about the status, recent trends and future scope of solar energy in general and solar photovoltaic in particular. Recent research and engineering technologies is specially emphasized in the course. Some basic knowledge of semiconductor Physics, thermal radiation and heat transfer shell be helpful for better understanding of the subject.

**Unit – I**

Current energy scenario and importance of renewable energy in general and solar energy in particular, Solar radiation, usefulness of radiation data for solar engineers, designers and architects. Sun-Earth relations, Thermal radiation, Extra-terrestrial Solar Radiation, Interaction of Solar radiation with atmosphere, various scattering, absorption and reflection processes, Terrestrial Solar Radiation, radiation data from satellite, Solar radiation measuring instruments: Pyranometer, Pyrheliometer, sun shine recorder etc., hourly global, beam and diffuse radiation, estimation of global radiation on horizontal surface, importance of radiation data for modelling of devices and simulations.

**(14)**

**Unit – II**

Status, Trends, Challenges and the future scope of Solar photovoltaics: What is photovoltaics, history, goals of today's PV research, global trends, motivation for photovoltaic application and development, crystalline Silicon technology, progress and challenges, Physics of solar cell: fundamental properties of semiconductors, pn junction diode electrostatics, solar cell fundamentals, spectral response, theoretical limits of photovoltaic conversion, V-I characteristics of solar cell, properties of efficient solar cells.

**(14)**

**Unit – III**

Emerging PV Technologies and their future: Dye sensitized solar cell, other variants of Dye Sensitized solar cells, Perovskite solar cell, CNT based solar cells, organic solar cell and other emerging technologies in solar photovoltaics.

**(12)**

**References:**


1. Solar Energy: Fundamentals, design, Modeling and Applications: G. N. Tiwari, 2002, Narosa Publishing house.
2. Understanding renewable energy systems, Volker Quaschning, 2006, Replika Press Pvt. Ltd. India.
3. Alternative Energy, Vol 1-3, Neil Schlager and Jayne weisblatt, 2006, Thompson Gale Generating electricity from the sun, Fred C Treble, 1991, Pergramon Press.
4. Solar Cells: Operating principles, technology and system Applications, Martin A. Green.
5. Physics of solar cells, Peter Wurfel, Wiley VCH Verlag GmbH & Co. KGaA.
6. Terrestrial solar photovoltaics, Tapan Bhattacharya, Narosa Publishing House.
7. Solar Cell Devices: Fonash (Academic Press, New York)(1981)

8. Solar Energy: S. P. Sukhatme (Tata McGraw-Hill, New Delhi)(1990)
9. Internet resources and journals of the field.

**Paper Name: Thermoluminescence Dosimetry** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 108**

## 1. Introduction

Definition of radiation and its types, Ionizing and non ionizing radiation, Quantities and units, Interaction of radiation with matter, Sources of radiation: Natural and Artificial. Radioactive sources: beta, alpha, gamma and X ray sources, Measurement of radiation: different type of dosimeters, Occupational Exposure Limits, Dose limits to Public, General safety of radiation sources, Radiation Measuring instruments, Radiation Hazard evaluation and control, Regulatory requirements: National Regulatory Body, safety standards.

**(11)**

## 2. Thermoluminescence Theory

Luminescence mechanism, Principle of Thermoluminescence, Application of Thermoluminescence: Personnel monitoring, environmental monitoring, radio diagnostics or radiotherapy, food processing, Models of Thermoluminescence: traps and recombination centres, simple model; alternate model; Thermoluminescence glow curve analysis: Evaluate of TL parameters E and s, Peak shape method, curve fitting, computerised glow curve deconvolution. TL properties: glow curve structure, dose response, energy response, annealing procedures, fading, reproducibility.

**(12)**

## 3. TLD Phosphor and their preparation

Various type of TLD phosphor; tissue equivalent and non tissue equivalent phosphor. Method of preparation, melting method, co precipitation method and crystal growth method: edge defined film fed growth technique: Advantage of EFG technique for preparing phosphor in the form of sheet: Growth procedure.

**(9)**

## 4. Application of TL dosimeters

Applicability for TL dosimeter for personnel monitoring and Radiotherapy Treatment; Patient skin dose distribution; treatment planning and quality assurance in radiation therapy, environmental monitoring.

**(8)**

**Suggested Reading and Reference:**


1. The physics of radiation therapy, Faiz M., Khan, 4th edition (2010). Lippincott, Williams and Wilkins. USA.
2. Fundamental of X-ray and Radium Physics – Joseph Selman, (1970). Charles C. Thomas Publisher.
3. Basic Medical Radiation Physics – Stanton, (1969). New York: Appleton-Century-Crofts.
4. Radiation Detection and Measurement, 3rd Edition, Wiley, New York (2000), G. T. Knoll.
5. Introduction to Radiological Physics and Radiation Dosimetry, Wiley, New York (1986). F. H. Attix.
6. Thermoluminescence of solid, Cambridge Solid State Science Series (1988), S.W.S. McKeever.

**Paper Name: Quantum & Statistical Physics** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 109**

(The course is intended as a review course of essential topics for students intending to pursue research work in related areas of theoretical Physics with a focus on concepts and problem-solving.)

**Unit – I**

Introduction to Quantum Mechanics (review of historical development of quantum mechanics), the Schrodinger equation and simple quantum systems. The quantum-classical correspondence, the quantum measurement problem, quantum coherence and decoherence. Applications of quantum mechanics in bulk & nanostructures: quantum confinement & energy spectra.

**(12)**

**Unit – II**

The matrix formulation of quantum mechanics, Dirac notation, state vectors, superpositions, unitary operators, Hermitian operators, Hamiltonian evolution, the concept of quantum measurement, two level systems: the spin half problem and properties of Pauli spin matrices: quantum information: the concept of qubits, quantum registers and quantum gates.

**(14)**

**Unit – III**

Statistical distributions: Maxwell-Boltzmann statistics, Quantum Statistics: Fermi Dirac & Bose Einstein statistics. Application of the formalism to (a) Ideal Bose gas, Debye theory of specific heat, Black-body radiation; (b) Ideal Fermi gas, properties of simple metals, electronic specific heat; thermionic emission; Fermi degeneracy: white dwarf stars.

**(14)**

**References:**


1. C. Cohen-Tannoudji, B. Diu and F. Laloe, Quantum Mechanics (Volume I)
2. L. I. Schiff, Quantum Mechanics.
3. E. Merzbacher, Quantum Mechanics.
4. R. P. Feynman, Feynman Lectures on Physics (Volume 3).
5. Reif: Fundamentals of Statistical and Thermal Physics
6. K. Huang: Statistical Mechanics

**Paper Name: Elementary Neutron Physics** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 110**

**(Emphasis should be given on solving numerical problems)**

**Unit – I: Sources of Neutrons:**

Radioactive nuclides and induced activity. Attenuation coefficient, stopping of radiation, Bremsstrahlung intensity, (g,n) reaction, (n, alpha) reaction, neutron production reactions, evaporation, pre-equilibrium and spallation neutrons using accelerators, radiative capture reaction, cold, slow, intermediate and fast neutrons. Interaction cross section and macroscopic cross section. Elastic and inelastic interaction of neutrons, Maxwell Boltzmann distribution.

**(07 Hours)**

**Unit – II: Interaction of Neutrons:**

Interaction cross section and macroscopic cross section. Elastic and inelastic interaction of neutrons, reaction rates. Variation of cross section with neutron energy. Discussions of resonance reaction cross sections. Neutron multiplication processes.

**(05 Hours)**

**Unit – III: Neutron Transport:**

Diffusion Theory – One speed neutron conservation, neutron leakage, diffusion equation, coefficient and diffusion length, solution of diffusion equation, boundary conditions, diffusion of mono energetic, Multi group neutrons in non-multiplying media, case of point source and infinite plane source.

Diffusion in multiplying media, Geometric Buckling and spatial flux distribution, non-leakage probability, one group and Bare reactor.

**(15 Hours)**

**Unit – IV: Slowing Down**

Elastic scattering, change in energy, empirical law, Average logarithmic energy decrement, lethargy, neutron moderation with and without absorption, Resonance absorption in heterogeneous system, thermalization, spatial distribution of slowed down neutrons, Fermi Age Model, Migration length, two group critical equation, reflection and four factor formula. Relation with reactors (discussion in respect of shielding, fissile and fertile medium).

**(13 Hours)**

**References:**


1. **Samuel Glasstone and Alexander Sesonske, Nuclear Reactor Engineering vol. 1, Edition 4 (1998), CBS publishers and Distributors**
2. **Nuclear Reactor Physics, W. M. Stacey, John Wiley and Sons (2001)**

**Paper Name: A Course of High Energy Physics** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 111**

**Unit – I: Introduction of Particles and Symmetries**

Introduction: Elementary particles, quantum numbers, spin, parity and mean life., Iso-spin, Space parity, Charge conjugation and Time symmetry, Strangeness etc. Kaon and theta-tau puzzle, CP – violation, $K^o$ – Meson regeneration, CPT theorem. Baryon octets and meson nonets. Introduction of SU (2) and SU(3) symmetries. Pion-nucleon interaction and production of deltas.

**(10 Hours)**

**Unit – II: Quark Model**

Quark Model, flavours and color quantum numbers. Discovery of J/ψ particles and introduction of fifth and sixth flavours. Discovery of $W^+$ and $Z_o$ bosons. Six leptons, Energy density and Energy density and concept of Quark Gluon Plasma.

**(08 Hours)**

**Unit – III: Standard Models and Beyond**

Standard Model: Gauge Symmetry, Electroweak interaction, Weingberg Salam Model, Grand Unification, Higgs, Super symmetry, Recent international facilities.

**(10 Hours)**

**Unit – IV: Detector Systems and Instruments**

Ionization chambers for fast high energy particles. Multi wire Proportional Chambers (MWPC), Gamma detection and measurement. Nal, HPGe and High Resolution X-ray detectors, their, resolution, calibration and maintenance. Basics of Gamma spectrometry, Charge particle beam monitor reactions, neutron dose measurements-$BF_3$ and other high density detectors like BC-501, Measurement of neutron flux, Cerenkov detectors, calorimetry of high flux events.

**(12 Hours)**

**References:**


1. **Experimental Nuclear Physics- K. N. Mukhin, Vol.2 Mir Publication, Moscow, 1987**
2. **Quarks and Leptons; Halzon and Martin, 1984.**
3. **Radiation Detection and Measurements by G F Knoll, 2010.**
4. **Introduction of High Energy Physics by D. Perkins, 2000.**
5. **Detectors and Particle Radiation, KonardKleinknecht, Cambridge University Press, 1999.**

**Paper Name: Radiation Physics and Protection** **Credit: 3** **Lectures: 40**
**Paper Code: CWP - 112**

**Unit – I: Radiation Damage and Measurement**

Radiation damage by neutrons, charged and e.m. particles and radiation. Measurements, Monte Carlo simulation, strength of material, change in physical properties like resistance, conductivity etc. Radiation damage, modification of materials, gems etc. Introduction of various Analytical techniques and combination of techniques. Application in the field of medical science, PET, SPET, etc.

**(10 Hours)**

**Unit – II: Radiation Effects**

Radiation units, flux and fluence, different kinds of doses. Biological effects of radiation, fluence/flux to dose standards, stochastic effects. ALLARA, dose standards for professional and non professional radiation workers. Dose &Kerma calculations.

Shielding design, attenuation calculations, reactor shield analysis-radiation transport in core and shield, experimental measurements, ducts and voids, shieldingmaterials, radiation damage and measurements, strength of materials, creep, defects, corrosion, erosion, swelling.

**(10 Hours)**

**Unit – III: Radiation Protection**

External and internal radiation sources, radiation dose and its units, biological effects of radiation- somatic genetic. Cell damage and survival, effects of radiation on DNA etc., dose from nuclear power operations, monitoring radiation, medical remedies of radiation affected. Reduction of consumed closes (decay & Biological reduction).

**(10 Hours)**

**Unit – IV: Monte Carlo Simulations and Available Codes**

Random number generation, interaction cross sections of n, charged particles and gammas, event generation, Characteristics of events, Analysis of data and plotting, Statistical weight, codes like SRIM and TRIM and introduction of MCNP. Calculation of dose in case of election as an example.

**(10 Hours)**

**References:**


1. **Samuel Glasstone and Alexander Sesonske, Nuclear Reactor Engineering vol. 1, Edition 4 (1998), CBS publishers and Distributors**
2. **Introduction to Medical Physics by A. H. Khan, 2008**
3. **Nuclear Reactor Physics, W. M. Stacey, John Wiley and Sons (2001)**

**Paper Name: Introduction to MATLAB and Computational Methods**

**LAB COURSE (6 Hours), Credit: 3 Lectures: 40**

**Exam will be Lab based**

**Paper Code: CWP - 113**

Introduction to the MATLAB programming language, Operations in MATLAB: basic mathematical operations with matrices, arrays, etc. Plotting with MATLAB: line plots, 1-D, 2-D, 3-D, mesh grid, labeling axes, legends, importing and plotting data files in MATLAB: Numerical methods for Solving Ordinary Differential Equations (ODEs) : The Euler method, Programming in MATLAB to solve $1^{st}$ Order and $2^{nd}$ Order ODEs by Euler method; Solving ODEs using inbuilt MATLAB solvers; Using direct MATLAB solvers for root finding; Using direct MATLAB solvers for integration; Introduction to Monte Carlo methods-random numbers, Mote Carlo Integration;

Example Applications [This list may be updated/modified to include related application from time to time]

**Physics & Mathematics**

1. **Plotting** (a) Eigenvalues & Eigenfunctions for Particle in a Box – ID & 2D; (b) Hydrogen atom wavefunctions.
2. **ODE's – examples** – (a) Simple, damped and driven Harmonic Oscillator; (b) Van der Pol Oscillator; (c) Radioactive Decay; (d) LCR Circuit; (e) Schrodinger equation in 1D (f) Coupled ODEs – The Lorenz Equations
3. **Mote Carlo methods** (a) Simulate coin toss, die roll etc. using MATLAB's inbuilt commands; (b) Estimating the value of "pi" using random numbers on a circle & sphere; (c) Monte Carlo Integration
4. (a) Some examples from linear algebra and matrices; (b) root finding (c) Simple Fractals (d) polynomial fit & exponential fit.

**Chemistry**

1. **Plotting** (a) Eigenvalues & Eigenfunctions for Particle in a Box – 1D & 2D; (b) Hydrogen atom wavefunctions.
2. **ODE's – examples**-(a) Schrodinger equation in 1D; (b) Kinetics of Oscillatory reaction.
3. **Calculation of π**- electron Huckel Molecular orbitals of molecules Butadiene, Benzene, Allyl radial, Pyridine, Aniline, Anilinium ion, toluene. HUMO, LUMO calculation of molecules (Linear, Cyclic, effect of Hetero atom, N, O, Cl, Br).
4. Application of eigenvalues like Fast Reaction kinetics, HUMO calculation, normal coordinate analysis for finding normal modes of vibrations of simple molecules.
5. Curve fitting of data points, Analysis of UV-Vis-NIR spectra (like detection, peak area, differential plots for detection of peaks)

**References:**

1. Rudra Pratap: Getting started with Matlab [Oxford University Press], 2006

2. Stephen J. Champman: for engineers, 2004
3. Balaguruswamy, Numerical Methods [Tata McGraw Hill], 1999.