Minutes of the meeting of the Senate held on 20.11.2008 (Thursday) at 3.30 p.m. in the Conference Room of the Institute.

Following members were present:

1. Prof. A B Samaddar	Chairman
2. Prof. B. D. Chaudhary	Member
3. Prof. Satish Chand	"
4. Prof. S. K. Agrawal	"
5. Prof. Satya Sheel	"
6. Prof. T.N. Sharma	"
7. Prof. R.K. Srivastava, CED	"
8. Prof. P.R. Agarwal	"
9. Prof. Raghuvir Kumar	"
10. Prof. R.C. Mehta	"
11. Prof. P.K. Mishra	"
12. Prof. Sudarshan Tiwari	"
13. Prof. Nirjhar Roy	"
14. Prof. Rakesh Mathur	"
15. Prof. S.K. Duggal	"
16. Prof. K.M. Gupta	"
17. Prof. Dinesh Chandra	"
18. Prof. Vineeta Agarwal	"
19. Prof. R. K. Srivastava, MED	"
20. Prof. Peetam Singh	"
21. Prof. Rajeev Tripathi	"
22. Prof. M.M. Gore	"
23. Prof. K.K. Shukla	"
24. Prof. Rakesh Narain	"
25. Prof. Anuj Jain	"
26. Prof. N.D. Pandey	"
27. Prof. Geetika	"
28. Prof. Suneeta Agrawal	"
29. Prof. R.P. Tewari	"
30. Prof. H. N. Kar	"
31. Prof. Vinod Yadav	"
32. Prof. P. P. Sahay	"
33. Dr. Sanjay Chaubey	"
34. Dr. S S Narvi	"
35. Dr. Neeroj Banerji	"
36. Sri Sarvesh K Tiwari	Registrar/ Secretary

Special Invitee

1. Dr. R. K. Tripathi	Dy Dean (A.A.)

The Chairman extended welcome to the members of the Senate.

Following resolutions were passed by the Senate on the basis of the agenda items and other points raised by members with the permission of the chair.

1. The Senate confirmed the minutes of its meeting held on 22.09.2008 without any observation.
2. The Senate deferred the discussion on the fixation of procedure for award of Gold Medals amongst the students having a tie vide **Resolution No. 6 (iv)** of the Senate meeting held on 22.09.2008. The Senate after deliberations of the members, desired that the committee, formed for such purpose, may acquire adequate information from IITs and other NITs for the award of Gold Medals in similar cases. The Senate recommends that the Committee may submit its finding to the Chairman Senate for his consideration and approval.

   The Senate desired that any action taken report, which is not presented in the Senate Meeting due to various reasons, may be placed in the subsequent meeting of the Senate.
3. The Senate considered and approved the names of degree recipients of B.Tech., M.Tech., MCA, MBA and Ph.D. programmes for the award of degree in the Fifth Convocation – 2008 of the Institute to be held on November 29th 2008.

   The Senate further desired that a statistical analysis of degrees awarded in last two Convocations and the current Convocation be done. This analysis may be published in the web page of MNNIT subsequently.
4. The Senate considered and approved the course structure and syllabi of courses for Ph.D. programme of the Department of Physics with the permission of the Chairman Senate. The course structure and syllabi as approved by the Senate is enclosed here as **Annexure – 1**.

The meeting concluded with a vote of thanks to the Chair.

Approved

30/01/09

(A B Samaddar)
Director/ Chairman

30/01/09

(Sarvesh K Tiwari)
Registrar/Secretary

Confirmed

10/02/9

(Chairman, Senate)

(6)

Senate Agenda Item No. ... Dated ... 19-11-08

ANNEXURE No. ...1...

18.11.08

To
The Head,
Dept. of AMD/Chemistry/CE/CSE/EE/ECE/HSS/SMS/Maths/ME
MNNIT, Allahabad

Sub. : Course Structure and Syllabi for PhD Programme of Physics Department

Through : The Head, Department of Physics

Dear Sir,

In the last Senate meeting held on 22.09.08, the Dept. of Physics had put forward the course structure and syllabi for its PhD Programme. In this meeting the Senate had suggested certain modifications in it, which have been incorporated now. A copy of the modified course structure and syllabi for PhD Programme of Physics Dept. is enclosed herewith for your kind consideration.

It is mentioned that all these courses are specialized ones, which are quite necessary for preparing ground work of the students willing to carry out research in the following areas, for which expertise are available in the department.

- ☐ Carrier Transport in Thin Films
- ☐ Solid State Gas Sensors
- ☐ Physics of the Early Universe
- ☐ Black Hole Physics
- ☐ String Theory
- ☐ Non-linear Dynamics and Chaos
- ☐ Non-linear Fiber Optics
- ☐ Optical Properties of Nanostructures
- ☐ Biophysics and Quantum Chemistry
- ☐ Photo-voltaic Solar cells

Senate meeting held on 22/11/08

Sincerely yours,

18.11.08

Convener, DPGC,
Department of Physics,
MNNIT

Forwarded
18/11/08

Copy forwarded for information and necessary action to :

1. Dean, Academic Affairs, MNNIT
2. Chairman, SGPC, MNNIT
3. Registrar & Secretary, Senate, MNNIT.

Department of Physics, MNNIT

Course Structure and Syllabi for Even Semester 2009

Summary

Code	Name	L	T	P	C
PH 976	Advanced Characterization Techniques	4	0	0	4
PH 977	Science and Technology of Thin Films	4	0	0	4
PH 978	Gas-sensors Materials	4	0	0	4
PH 979	General Relativity and Black Hole Physics	4	0	0	4
PH 980	Physics of the Early Universe	4	0	0	4
PH 981	Introduction to Quantum Field Theory	4	0	0	4
PH 982	Introduction to String Theory	4	0	0	4
PH 983	Non-linear Dynamics and Chaos	4	0	0	4
PH 984	Non-linear Fiber Optics	4	0	0	4
PH 985	Synthesis and Optical Properties of Nanostructures	4	0	0	4
PH 986	Biophysics and Quantum Chemistry	4	0	0	4
PH 987	Advanced Solid State Physics	4	0	0	4

PH 976 Advanced Characterization Techniques
4 credits (4-0-0)

Need of Characterization, Physical Parameters for Characterization, Basic Principles and Description of such techniques as Diffraction (X-ray, electron and neutron), Spectroscopy (UV, VIS, IR and Raman), Thermal (DTA, TGA, DSC), Electronic (resistivity, Hall effect and TEP),.Resonance (NMR, EPR and Massbauer) and Electron and Ion Spectroscopy (AES, ESCA, SIMS and RBS). Electron Microscopy – SEM and TEM.

References

1. P.R.Vaya, ed., *Semiconductor Materials: Characterization Techniques*, Narosa Publishing House
2. J. B. Wachtman, Zwi H. Kalman, *Characterization of Materials*, Boston : Butterworth-Heinemann
3. Elton N. Kaufmann, *Characterization of Materials*, Wiley-Interscience
4. W.R.Runyan, *Semiconductor Measurements and Instrumentation*, McGraw-Hill Kogakusha, Ltd. Tokyo
5. S.C.Kashyap, ed., *Advanced Techniques for Characterization of Materials*, IIT Delhi.

PH 977 Science and Technology of Thin Films
4 credits (4-0-0)

Nucleation, growth, kinetics and thermodynamics of materials; Physical vapor deposition, Chemical vapor deposition, Plasma / Ion beam deposition, Epitaxial thin films: LPE, MBE, MOCVD; Film formation, Thin film characterization, Inter-diffusion and reaction in thin films, Film formation, structural and physical properties: thickness, composition, morphology, mechanical properties, uniformity, grain size etc., Electrical, Optical and Magnetic properties of thin films, Electrical conduction in thin films- size effects, interface properties.

References

1. L.I.Maissel and R.Glang, eds., *Handbook of Thin Film Technology*, Mc Graw-Hill, New
   York.
2. K.L.Chopra, *Thin Film Phenomena*, Mc Graw-Hill, New York
3. J.George, *Preparation of Thin Films*, Marcel Dekker, Inc., New York.
4. A.Goswami, *Thin Film fundamentals*, New Age International Publishers, New Delhi.
5. S.M.Sze, *VLSI Technology*, Mc Graw-Hill, New York.

PH 978 Gas-Sensor Materials
4 credits (4-0-0)

Gas sensor materials: Criteria for the choice of materials, Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity and selectivity, response time, LEL & UEL; Gas sensors based on semiconductor devices, thin films and sintered pellets, Gas sensors for detection of hydrogen, hydrocarbon, nitrogen oxides, carbon monoxide, oxygen and carbon dioxide in a variety of ambient gas conditions and temperatures.

References

1. C.N.R.Rao, A.R.Raju and K.Vijaymohan, "*Gas-Sensor Materials*", in *New Materials*, (eds.) S.K.Joshi, T.Tsurute, C.N.R.Rao and S.Nagakura, Narosa Publishing House
2. M.J.Madou and S.Roy Morrison, *Chemical Sensing with Solid state Devices*, Academic Press, Inc.
3. D.Patranabis, *Sensors and Transducers*, Prentice Hall of India.
4. P.T.Moseley and A.J.Krocker, *Sensor Materials*, CRC Press.

PH 979 General Relativity and Black Hole Physics
4 credits(4-0-0)

Brief review of Special Relativity, manifolds and analysis on manifolds, affine conection, curvature and torsion, Cartan's structure equations, Levi-Civita connection, principle of equivalence, gravitation as spacetime curvature, physics in curved spacetime, Einstein equations, Einstein-Hilbert action, Lie derivatives, isometries and Killing vectors, vierbeins, coupling of fermion to gravitational field, Palatini form, Post-Newtonian formalism, Schwarzschild solution and Black holes, Birkoff theorem, charged black holes(Reissner-Nordstrom), rotating black holes(Kerr solution), ADM energy, Black hole thermodynamics, Hawking Radiation, Black holes in higher dimensional spacetime.

References

1. Sean Carroll, *Lecture Notes on General Relativity*, available online at http://arXiv.org/abs/gr-qc/9712019.
2. S. Weinberg, *General Relativity and Cosmology : Principles and applications*, John Wiley and sons (1972).
3. Sean Carroll, *Spacetime and Geometry : An introduction to General Relativity*, Benjamin Cummings (September 28, 2003)
4. P.K. Townsend, *Black Holes: Lecture notes*, available online at http://arXiv.org/abs/gr-qc/9707012.

5. L. Susskind and J. Lindesay, *An Introduction to Black Holes, Information And The String Theory Revolution: The Holographic Universe*, World Scientific Publishing Company (December 31, 2004).

PH 980 Physics of the Early Universe
4 credits(4-0-0)

Prerequisites : PH 979

Expanding Universe, large scale isotropy and homogeneity, cosmic microwave background radiation, matter density, dark matter, dark energy, Robertson-Walker metric, Friedmann equation, horizons, phase transitions in Early Universe, Big-bang nucleosynthesis, problem with standard hot big-bang cosmology, inflationary paradigm, inflation and scalar fields, modeling the inflaton field, the amount of inflation, observational tests of inflation. Cosmological perturbation theory and large scale structure formation.

References

1. E.W. Kolb and M. S. Turner, *The Early Universe*, Westview Press (1994).
2. A.R. Liddle and D.H. Lyth, *Cosmological Inflation and Large Scale Structure,* Cambridge University Press (2000).
3. J. A. Peacock, *Cosmological Physics,* Cambridge University Press (2000).
4. P. Coles and F. Lucchin, *Cosmology : The Origin and Evolution of Cosmic Structure*, John Wiley & Son Ltd. (2002).

PH 981 Introduction to Quantum Field Theory
4 credits(4-0-0)

Quantum mechanics of many particle systems, necessity of the concept of fields, classical field theory, principle of least action, symmetries and conservation laws, energy-momentum tensor, internal symmetries, Noethers's theorem, Poincare group and its irreducible representation, spin zero particle and Klein-Gordon equation, Green function. Free scalar fields and canonical quantization, propagators. Interacting fields and perturbation theory, interaction picture, time-evolution operator, S-matrix, Wick's theorem, Dyson's formula, Feynman rules and Feynman diagrams, Feynman Rules for Phi4 theory and scattering amplitudes. Path-integral quantization : application to QED and non-Abelian gauge theory. Sample Feynman diagram calculation in gauge theory.

References

1. M. Peskin and D. Schroder, *An Introduction to Quantum Field Theory*, Levant Books, India.
2. P. Ramond, *Field Theory : A Modern Primer*, Levant Books, India.

3. L. Ryder, *Quantum Field Theory*, Levant Books, India.
4. W. Greiner and J. Reinhardt, *Field Quantization*, Springer-Verlag (1993).

PH 982 Introduction to String Theory

4 credits (4-0-0)

Prerequisites : PH 981

Basic ideas, types of strings, bosonic strings, worldsheet, string interactions, critical dimension. Quantization of closed bosonic string, Nambu-Goto and Polyakov action, Light-cone quantization and string spectra. Light-cone quantization of open string, Neumann and Dirichlet boundary conditions, string spectra. D-branes , perturbative description of D-branes in terms of open string, Chan-Paton factors.
Path-integral quantization of bosonic strings. Strings in presence of background fields and quantization. Conformal field theory(CFT), commutators in CFT and radial ordering, operator product expansion, correlation functions, Wick's theorem, operator-state correspondence. String interaction, topology of string worldsheets, Riemann surfaces. Tree level bosonic string interaction and computation of the simplest string scattering amplitudes. Superstring theory : Type I, IIA, IIB, Heterotic SO(32) and E8xE8. Superstring interactions. String theory in curved spaces, idea of compactification, simplest compactification : Orbifolds. Calabi-Yau manifolds and compactification. Low-energy theory, Supergravity in various dimensions, overview of string theory beyond perturbation theory, non-perturbative states, p-branes. String dualities.

References :

1. J. Polchisnki, *String Theory, Vol. 1 and 2*, Cambridge University Press(Paperback, 2005).
2. M.B. Green, J. Schwarz and E. Witten, String Theory, Vol. 1 & 2, Cambridge University Press(1988).
3. E. Kiritsis, *String Theory in a Nut-shell*, Princeton University Press(March 19, 2007).[Also the free lecture notes by the same author, available online at http://arxiv.org/abs/hep-th/9709062]
4. D. Lust and S. Theisen, *Lectures on String Theory*, Springer(December 1989).
5. A. Sen, *An Introduction to Non-perturbative String Theory*. Available online free of cost at http://arxiv.org/abs/hep-th/9802051.

PH 983 Non-linear Dynamics and Chaos

4 credits(4-0-0)

Dynamical systems: Linear and nonlinear forces; Mathematical implications of Nonlinearity, Linear oscillators and predictability; nonlinear oscillations and bifurcations. Autonomous and nonautonomous systems; dynamical systems a s coupled first-order differential equations: equilibrium points; phase space/ phase plane and phase trajectories: stability, attractors and repellers; limit cycle motion-periodic attractors: Poincare-Bendison theorem; Higher dimensional systems: dissipative and conservative systems: Hamiltonian systems; Bifurcation and Chaos; onset of chaos: sensitive dependence on initial conditions-Lyapunov exponent, Henon map. Chaos in Nonlinear Electronic Circuits: Chaotic Dynamics of the simplest dissipative nonautonomous circuit; Murali-Lakshmanan-Chua (MLC) circuit: Experimental realization, stability analysis, explicit analytical solutions, experimental and numerical studies.

References

1. H. Goldstein: *Classical Mechanics*, Narosa, New Delhi, 1990.
2. E. A. Jackson: *Perspectives of nonlinear Dynamics: Vol. I and II*, Cambridge University Press, 1990.
3. M. Lakshmanan and S. Rajasekar: *Nonlinear Dynamics: Integrability, Chaos and Patterns*, Speringer-Verlag, New York 2003.
4. M. Lakshmanan and K. Murali: *Chaos in Nonlinear Oscillators: Controlling and Synchronization*, World Scientific, Singapore, 1996.
5. N. Minorsky: *Nonlinear Oscillations*, Van Nostrand, New Jersey, 1962.
6. A. H. Nayfeh and D. T. Mook: *Nonlinear Oscillations*, Wiley, New York, 1979.
7. J. Gleick: Chaos: *Making a new science*, Viking, New York, 1987.
8. R. J. Field and L. Gyorgyi (Eds.): *Chaos in Chemistry and Biochemistry*, World Scientific, Singapore 1993.
9. P. Hagedorn: *Nonlinear Oscillations*, Oxford Sci. Publ., Oxford, 1988.
10. P. Gladdening: *Stability, Instability and Chaos*, Cambridge Univ. Press, Cambridge 1994.
11. M. Tabor: *Chaos and Integrability in Nonlinear Dynamical Systems: An Introduction*, John-Wiley, New York 1989.

PH 984 Nonlinear Fiber Optics

4 credits(4-0-0)

1. Linear and Nonlinear Dispersive Waves; Nonlinear Dispersive Systems: An Illustration of the Wave of Permanence, John Scott Russel's Great Wave of Translation, Cnoidal and Solitary Waves. Pulse Propagation in Fibers: Nonlinear Pulse Propagation; Higher-Order Nonlinear Effects; Numerical Methods: Split-Step Fourier Method, Finite-Difference Methods.; Group-Velocity Dispersion; Fibre Grating: Bragg Diffraction, Photosensitivity; Fabrication Techniques: Single-Beam Internal technique, Dual-beam holographic technique, Phase mask technique, Point-by-point fabrication technique; Grating Characteristics:

Coupled-Mode Equations, CW Solution in the Linear Case, Photonic Band gap or Stop band, Grating as an optical filter; Experimental verification.

References:

1. M. Lakshmanan and S. Rajasekar, *Nonlinear Dynamics: Integrability, Chaos and Patterns*, Springer-Verlag, New York 2003.
2. Govind P. Agrawal, *Nonlinear Fiber Optics*, Third Edition, Academic Press, California 2001.
3. Govind P. Agrawal, *Fiber-Optic Communication Systems, Second Edition*, Wiley, New York 1987.
4. P. Diamet, *Wave Transmission and Fiber Optics*, Macmillan, New York 1990.
5. S. A. Akhmanov, V. A. Vysloukh and A. S. Chirkin, *Optics of Femptosecond Laser Pulses*, American Institute of Physics, New York 1992.

PH 985 Synthesis and Optical Properties of Nano Structures

4 credits(4-0-0)

Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. Physical, Chemical and Bio-routes for Synthesis of Nanomaterials, Experimental Techniques for Characterization of Nanomaterials, Metal Nanoparticles, Some applications of Nano Materials, Bulk to Nano Transitions. Nature of Carbon Clusters, Discovery of C60 Structures of C 60. Carbon Nanotubes: Synthesis, Structure, Electrical and Mechanical Properties. Preparation of Quantum Nanostructures, Size Effects, Conduction Electrons and Dimensionality, Properties Dependent on Density States. Scanning Probe Microscopes (SPM), Diffraction Techniques, Spectroscopic Techniques.

References

1. Poole and Owens , *Introduction to Nanotechnology*: Wiley-Interscience (May 30, 2003).
2. Jacak, Hawrylak and Wojs , *Quantum Dots*, Springer; 1 edition (March 20, 1998).
3. Nalva (Ed.), *Handbook of Nanostrcture Materials and Nanotechnology*, Academic Press, 2002 .
4. S.K. Kulkarni, *Nano Technology: Principles and Practices*, ISBN: 81-85589-29-1 / 8185589291, Delhi, 2006.
5. C. Kittel, *Introduction to Solid State Physics,* Wiley; 8th. edition (November 11, 2004).

6. C.M. Niemeyer and C.A. Mikin(Eds.), *Nanobiotechnology : Concepts, Applications and Perspectives*, John Wiley & Sons, 2004.

PH 986 Biophysics and Quantum Chemistry

4 credits(4-0-0)

Elementary ideas about the DNA structure, sugar-phosphate backbone, nucleosides and nucleotides, three-dimensional DNA structure, RNA. Proteins: primary, secondary, tertiary and quaternary structures, enzymes and their catalytic activity, DNA and protein folding, DNA denaturation, replication, mutation, intercalation, neurotransmitters, membranes. Forces stabilizing DNA and protein structure, Theoretical quantum chemical and molecular mechanical methods, Treatment of intermolecular interactions, conformations, hydrogen bonding, stacking and hydrophobic interactions, importance of electrostatic interactions, biomolecular recognition, drug design. Application of experimental techniques of light scattering, absorption and fluorescence spectroscopy, Nuclear magnetic resonance, Interaction of UV radiation with DNA, Photodimerization, Photodynamic action.

References

1. P. Narayanan , *Essentials of Biophysics*, New Age Publishers(2003).
2. Price, *Basic Molecular Biology*, John Wiley & Sons Inc (April 1979).
3. Pullman (Ed.), Quantum Mechanics of Molecular Conformations, John Wiley and Sons Ltd (January 1, 1976).
4. Yakushevich , *Non-linear Physics of DNA*, Wiley (February 25, 1998).
5. Nelson, *Biological Physics*, W. H. Freeman; First Edition (June 15, 2007).

PH 987 Advanced Solid State Physics

4 credits(4-0-0)

Crystalline properties of solids: Periodicity in crystals, crystal lattice and systems, unit cell, Bravais lattice, symmetry elements, point groups, space groups, Miller indices, packing factor.

Bonding and structure: Electronic structure of atoms, structure of atoms with many electrons, ionic, covalent, mixed, metallic and secondary bonds, energy bands.

Thermal properties of crystals: Specific heat of solids, Einstein's and Debye model, density of states, thermal conductivity of solids, thermal conductivity due to electrons and

phonons, phonon-phonon interaction, scattering of phonons by grain boundaries, scattering by impurities and imperfections.

Magnetic properties: Exchange interactions, Antiferro-magnetism, Ferri-magnetism, Magnetic resonance.

Optical properties: Absorption process, photovoltaic effect, photoluminescence, colour centers.

Dielectric properties: Piezo-, pyro- and ferro-electric properties of crystals.

Low dimensional quantum structures: Density of states calculations, two-, one-, and zero-dimensional quantum structures (quantum wells, quantum wires and quantum dots), their optical properties and their examples.

References

1. M. Rajeghi, *Fundamentals of Solid State Engineering*, Springer International Edn.
2. H. V. Keer, *Principles of Solid State*, Wiley Eastern Limited.
3. M. A. Wahab, *Solid State Engineering*: Structure and Properties of Materials, Narosa Publishing House.
4. Azaroff, *Introduction to Solids*, Tata McGraw Publishing Company Limited.

Motilal Nehru National Institute of Technology
Allahabad

No. 257 /AOS/18th BOG meeting January 27,2009

Dean (Academic Affairs)

The Board of Governors in its 18th meeting held on 28.11.2008, the Board of Governors has noted the decision taken in the meeting of the Senate held on 22.09.2008.

Kindly ensure necessary action as per the decision of the Senate meeting held on 22.09.2008.

(A.B. Samaddar) 24/01/9
Director