MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Phil. Physics

M.Phil Physics Examination Semester-I, Semester-II

2011–12 से प्रभावी(w.e.f.)

सत्र 2013–14

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

NOTICE

1. Change in Statutes/Ordinances/Rules/Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.**The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुन: निर्माण कर परिनियमों /अध्यादेशों / नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

Ordinance 123 (V) relating to M. Phil Examination

According to Minimum standards and procedure for awards of M. Phil degree as per the guidelines of U.G.C. Regulation, 2009

Scheme of Examination

1. For starting or continuing M. Phil course in the University and its affiliated colleges, it must be ensured that at least two qualified teachers are available in that subject. A teacher who possesses Ph.D. Degree shall be eligible to teach M. Phil classes. A teacher who possesses Ph.D. Degree and three years P.G. teaching experience shall be eligible to supervise M. Phil dissertation.
2. A candidate for admission to the courses of study for the Degree of M.Phil must have obtained a Master's Degree in the concerned subject with at least 55% marks at the post graduate Examination of this University or of any other University/ Institution . A candidate with second division at post graduate examination (with less than 55% marks) shall be eligible for the M.Phil. if he/she has second division at the graduate examination. Relaxation in the eligibility will be given to SC/ ST/OBC/PH etc as per rules of the University/State Government.
3. **Admission to M. Phil Programme**
   (i) University shall issue notification regarding Eligibility test for admission to M.Phil Programme. Research Eligibility Test (RET-M.Phil) in the National/Regional news papers etc.
   (ii) University shall conduct RET-M.Phil on the date notified once every year.
   (iii) Candidates who have qualified the UGC/CSIR(JRF)/NET/SET/ GATE/or any equivalent examination conducted by the State/ Central government/Teacher Fellowship holder are exempted from RET.
   (iv) The University shall prepare a merit list of the eligible candidates.
4. **Procedure for Admission to M.Phil Programme**

A merit list shall be prepared of the eligible candidates based on the weightage of percentage of the academic record such as Sr. Secondary, Graduation, Post Graduation, publication in the peer reviewed journal, presentation of paper in National/International Conference/Seminar/ Workshop shall be as follows:

1.	Sr. Secondary	10% of the percentage obtained
2.	Graduation	20% of the percentage obtained
3.	Post graduation	60% of the percentage obtained
4.	Publication	05*
5.	Conference/seminar	05**

(*2.5 marks for each publication with maximum 5 Marks,
**** 2.5 marks for each conference/seminar with maximum 5 marks)**

The number of candidates called for interview shall be twice the availability of seats. Allocation for the candidates for the University and colleges shall be faculty wise and centralized at the University campus.

Students allotment Committee

The Composition of the Committee shall be as follows:

(i) Dean P.G.Studies
(ii) Dean Concerning Faculty
(iii) Head of the Deparment/Incharge/Director of the concerning teaching Department of the University/College
(iv) Principal or his/her nominee (in the case of College)
(v) Director Research (Member Secretary)

6. Research Eligibility Test (RET-M.Phil)

A. Procedure

There shall be a Research Eligibility Test for M.Phil. of 200 marks comprising of two papers of 100 marks of two hours duration each. Both the papers will be held on the same day with a gap of one hour. A candidate who does not appear in paper I shall not be allowed to appear in paper II. First paper shall be of Research aptitude and the second paper shall be subject paper based on the concerned subject.

B. Syllabus

Syllabus of paper First shall be based on research aptitude and the Second paper shall be based on the common papers of syllabus of M.D.S. University, Ajmer of their post graduation of the concerned subject. (Except special/optional papers)

Paper I –Research Aptitude

The questions shall be of general nature, intended to assess the research aptitude of the candidate. It will primarily be designed to test reasoning ability, comprehension, divergent thinking, computer skills, elementary statistical methods and general awareness of the candidate. A total of 50 multiple choice questions (MCQ's) will be set. Each question shall carry 2 marks. There will be no negative marking.

Paper II – Subject Paper

There shall be only one subject paper based on the syllabus of the common papers candidate has studied at the post graduation. There will be three sections in this paper.

Section A: 20 question of multiple choice	2 marks each	= 40
Section B: 10 question of short answers	3 marks each	= 30
Section C: 2 question of long answers	15 marks each	= 30

(All Question in Section A and B shall be compulsory. In section C there will be four questions out of which candidate shall be required to attempt any two questions.)

7. The candidate after getting admission in the M.Phil. programme will carry out the M.Phil. studies as per the scheme mentioned below.

Semester Scheme for M.Phil Courses

(i) M.Phil. course shall be of one academic session to be run under semester scheme and credit system. There will be two semesters in the academic session. Each semester will be of about 20 weeks duration having a minimum of 90 days (16 weeks) of actual teaching, one week for preparatory leave and remaining days for the conduction of examination and other activities.
The tentative schedule is as below:
First semester : July to November
Internship: >2 weeks (December)
Second semester: January to May

(ii) There will be six (6) theory papers in one academic session divided equally into two semesters. The dissertation is in lieu of IV and VIII theory papers in Semester I and II, respectively.

(iii) The M.Phil. Course shall be of 32 credit hours, i.e. 16 credits per semester.

(iv) Each theory credit hour shall be designated as 1L that shall be equal to 1 hour of instruction and one dissertation credit hour shall be designated as 1 D credit that shall be equal to 1.5 hour per week. (L = Lecture; D=Dissertation)

(v) Each theory paper shall be of 4L credits per semester with total 64 hrs of instructions. The semester shall be of about 16 weeks, 4 hrs instructions shall be given to each theory paper per week.

(vi) The dissertation shall carry 4 D in each semester with total 96 hours of instruction hours per semester. Since a semester shall be of about 16 weeks, 6 hrs instruction per week shall be given to dissertation.

(vii) Each theory paper shall be of 50 marks and dissertation shall be of 50 marks. There shall be no evaluation of the dissertation at the end of first semester because the work carried out during the first semester shall be continued in the second semester. Evaluation of the dissertation shall be done at the end of the second semester.

(viii) The distribution of credits and the examination scheme are as below:

Paper	Title	Max. Marks	Credits	Minimum hours of instruction		Minimum hours of self study	
				Per week	Per semester	Per week	Per semester
Semester I							
I	Research	50	4	4	64	4	64
	Methodology						
II	Optional Paper	50	4	4	64	4	64
III	Optional Paper	50	4	4	64	4	64
IV	Dissertation*	—	4	6	96	12	192
Semester I Total		150	16	18	288	24	384
Semester II							
V	Advance	50	4	4	64	4	64
	Research						
	Methodology						
VI	Optional Paper	50	4	4	64	4	64
VII	Optional Paper	50	4	4	64	4	64
VIII	Dissertation*	100	4	6	96	12	192
Semester II Total		250	16	18	288	24	384
Grand total of Semester I & II		400	32		576		768

There will be internship of two to three weeks between two semesters

*Dissertation will begin from semester I and shall complete at the end of the second semester.

(ix) The total maximum marks for evaluation in M.Phil. shall be 400.

(x) The time allotted for self study is the minimum time expected to be spent on various activities like practical, field work, library reference work, use of computer and internet and such other facilities.

(xi) There shall be one paper-on Research Methodology (Paper-I) in Semester I and one on Advance Research Methodology in Semester II.

(xii) Papers II, III shall be optional paper in Semester I and paper VI and VII shall be optional in II Semester.

(xiii) Out of a maximum of 50 marks in each theory paper 15 marks (30%) shall be for the continuous sessional assessment to be done internally based on assignments (5 marks), written test (5 marks) and seminar/ group discussion (5 marks). The internal assessment marks should be sent to the University by the various Departments/Affiliated Colleges of the University before the commencement of theory examination. The theory examination will be held at the end of each semester. Each theory paper shall be assessed out of a maximum of 35 marks

(xiv) All paper setters and examiners for the external assessment shall be external persons (i.e. those who are not working either in the M.D.S University or in any of its affiliated colleges). The Board of studies shall prepare a separate panel of Examiners for M. Phil. theory papers as well as dissertation. Appointment of the paper setters and examiners shall be made on the recommendations of the committee for selection of the examiners.

(xv) The answer books of theory papers of external examination shall be evaluated by single examiner. After declaration of the result the student concerned if desires shall be entitled for re-evaluation in accordance with the provisions of the university. Dissertation shall be evaluated by two examiners.

(xvi) The student will have to carry out the work of dissertation in both the semesters and shall submit the thesis for evaluation within two weeks after the last theory examination of II Semester.

(xvii) Dissertation work shall be conducted by the candidate under the supervision of any teacher who is registered as M.Phil. Supervisor with the teaching department concerned. An M.Phil. Supervisor can normally guide five dissertations at a time. However, the maximum limit may be relaxed by the Vice-chancellor on the recommendation of the Head. The work load for dissertation shall be six hours per week per class.

(xviii) For dissertation work the placement of every candidate under a supervisor shall be decided within one month from the last date of admission.

(xix) The dissertation will be divided into two parts. Part I of Semester I will constitute preparation of plan of work that should be presented by the student in front of the faculty of the department, who will assess the feasibility and recommend suggestions, if any, for the improvement. The student must suitably incorporate the changes, if any, in the synopsis in consultation with the supervisor. Following this he/she must write and submit type written draft of chapters on review of literature and methodology to the supervisor. He/she may also conduct some preliminary work/experiments to understand the techniques. The supervisor shall submit a report of satisfactory progress to the Head of the Department before beginning of the theory examination. The latter shall forward it to the university along with marks for internal assessment. The dissertation shall be of 100 marks to be evaluated out of 70 marks by an external examiner. The marks obtained, shall be added to the marks obtained in the viva voce examination to be held subsequently.

(xx) In the second part of dissertation in Semester II, the student will have to complete the work as per the aims and objectives of the study and submit a dissertation. Prior to final submission of the dissertation, the student shall make a pre- M. Phil. presentation in the department in the presence of all the faculty chaired by the Head of the Department . Suggestions, if any, may be suitably incorporated into the dissertation.

(xxi) The candidate must give a certificate that (1) the dissertation incorporates his/her own work, (2) the work incorporated in the dissertation is not a repetition of earlier work, (3) any part of the dissertation containing information from other sources has been properly cited or has been printed after having obtained due permission from the original author, and (4) any kind of assistance or help taken during the course of work has been properly acknowledged. This certificate must be attached immediately after the title page of the dissertation. Supervisor shall give a certificate according to the prescribed format ((Annexure-I)

(xxii) The dissertation must be hard bound and type written dissertation on A-4 size paper. Four hard copies and four soft copies in non-editable PDF format must be submitted to the Head of the Department through the Supervisor. The colour of the cover page of dissertation shall be faculty wise (Annexure-II).

(xxiii) On receipt of satisfactory evaluation report of dissertation, i.e., minimum 50% marks M. Phil. students shall undergo a viva voce examination of 30 marks which shall also be openly defended. There will be an examination committee comprising one external examiner and one internal examiner; the later may be the supervisor of the candidate or the Head of the Department in the absence of the supervisor.

(xxiv) Every student shall be required to undertake a compulsory internship of 2-3 weeks in between the two semesters. The internship schedule shall be decided by the concerning Head of the Department. The teaching institution may decide for the provision of stipend for the students taking internship. The students will be required to submit and present a report of the internship. The participating organization/institution will give the performance appraisal of the student's work. The concerning supervisor of the Department shall certify the satisfactory performance of the students during internship and submit the same to the examination section through the Head of the Department of the university.

(xxv) Every candidate shall be required to attend a minimum of 75% of the lectures, tutorials, seminars and practical (taken together) held in each paper.

(xxvi) Every student of semester I shall be promoted to the next semester at her/his own risk in case he/she qualifies in 50% of papers (2 theory papers of semester I) .

(xxvii) The student who fails in any paper of Semester Ist or IInd shall appear in the due paper in the next year along with the concerned Semester.

(xxviii) The award list should show both, total marks of the continuous internal assessment as well as external assessment in the theory papers separately and the third column must have the aggregate marks of the two. The candidate will be considered pass on the basis of the combined total marks secured in each paper.

(8) For a pass, a student will have to obtain (a) at least 40% marks in each paper separately and (b) a minimum of 50% marks in the aggregate of all the papers prescribed for the examination. In the marksheet, successful candidates shall be classified as under:

Pass	50% or more but less than 55% marks in the aggregate
Second Division	55% or more but less than 65% marks in the aggregate
First Division	65% or more but less than 75% marks in the aggregate
First Division with Distinction	75% or more marks in the aggregate

A candidate who fails at the examination even in one paper/dissertation shall be required to reappear at the examination in a subsequent year in all the papers/dissertation prescribed for the examination, provided that a candidate who obtains at least 50% marks in dissertation shall be exempted from submitting a fresh dissertation and the marks obtained by him shall be carried forward for working out his result.

9. **Depository with UGC**

(i) Following the successful completion of the evaluation process and announcements of the award of M.Phil the University shall submit a soft copy of the M.Phil dissertation obtained from the candidate to the UGC, for hosting the same in INFLIBNET accessible to all Institution/ Universities.

(ii) Along with the Degree, the University, shall issue a Provisional Certificate certifying to the effect that the Degree has been awarded in accordance with the provisions to these Regulations of the UGC.

M.Phil Physics Examination w.e.f. 2011

PAPER I RESEARCH METHODOLOGY

Time 3 Hrs Max. Marks 35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1. Principles of Scientific Research

Identification of the problem - Determining the mode of attack, Literature survey, References, Awareness of current status, Abstraction of a research paper, Possible ways of getting oneself abreast of current literature, internet and its applications, - E mail, Web browsing, Assessing status of the problem, Guidance from the supervisor - Actual investigation, Preparation of manuscript. Presenting a paper in scientific seminar, Thesis writing.

2. Numerical Methods

Curve fitting, Least square method, Solutions of equations, Graphical methods, Newton-Raphson Method, Predictor and Corrector Method, Numerical integration, Trapezoidal method, Simpson's method, Runge- Kutta, method Second order, Third order and Fourth order Tailor's series solutions.

3. Computer Programming

C language : Operations and expression Unary operators, Relations and logical operators, assignment operators, Conditional operators, Library functions, data input, Output, Getehar, Seanf Print, Gets and Puts function, Control statements While, Do-While, For, Bobs, If-else, Switch, Break, Continue, Comma operator, Goto statements.

4. Function, Defining a function, Accessing for Passing arguments to a function, Specifying argument data types, Program structure, Automatic Passing arrays to a function, Multidimensional arrays, arrays and strings. Data files opening, closing a data file, Creating a data file Processing a data file, unformatted data files.

Reference Books :

1. Anderson, J., Durstan. B.H. and Poole, M. Thesis and assignment writing, wiley Eastern (1977)
2. Rajammal P., and Devadas, S.R.K.,A Hand book of methodology of research. Vidyalaya press (1976)
3. Metheous, J., and R.L. Walker, Mathematical method of physics, Inc (1975)
4. Stark, P.A. Introduction to Numerical methods, Macmillan (1970)

PAPER II A -QUANTUM SOLID STATE PHYSICS

Time 3 Hrs Max. Marks 35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1. Mathematical Introduction

Basic Hamiltonian and Hartrce -Fock approximation,

2. Acoustic Phonons

Discrete elastic line Quantum theory of the continuous line. Long wavelength acoustic mode phonons in isotropic crystals. Super fluidity, Second sound in crystals. Frequency distribution for phonons.

3. Plasmons

Optical phonons and polarization waves. Plasmons. Long wavelength optical phonons in isotropic crystals. Ineraction of optical phonons with phonons.

4. Magnons

Ferromagnetic Magnons. Helstein-Primakeff transformation Hamiltonian in spin-wave-variabie. Magnon heat capacity. Magnons interaction magnatisation reversal. Anti ferromagnetic magnon. Zero point sub energy, lattice magnetization. Microsopic magnon theory.

5. Fermion field and the Hartree Fock Approximation

Particle field equation of motion method for the Hartree Fock equation. Koopman's theorem. Fermion Quasi particles. Electron gas in the Hartree and HartreeFock-Approximations,:Modified Hartree model. Two electron correlation functions. Coulomb's interactions and the formation.

6. Polarons

Current carrier spectum, renormalization and effective. Mass of polarons,Strong coupling polarons. Landan and Pekar theory. Theory of small radius polarons.

7. Superconductivity

Indirect-electrons.Electron interaction via phonons: Bound electron pairs in a Fermi gas. Superconductivity ground state. Solution of the CS equation spin-Analog method. Solution of the CS equation. Equation of motion method. Ground state wave function.Electrodynamics of superconductors. Coherennce length. Matrix elements coherence effects. High temperature super conductivity (Basic Ideas) Fullerence superconductors (Basic Ideas) Organic superconductors (Basic Ideas).

8. Super-fluidity

Basic properties of Super-fluidity 4 He. Elementary excitation in He-II and their interaction. Elementary excitation spectrum of supeffluid-3 He. Helium-II: the two fluid model. The fountain effect and heat transport in Helium-II. Superconductivity in Liquid 3 He.

Text and References Books:

1. Quantum Solid State Physics : Vensovsky (springer verlag) and Kalsnelson.
2. High-T superconductivity : R.P Sinha & S.L. Kakani Nova Sc.
3. Superconductivity Current problems: S.L. Kakani Arihant Jaipur
4. Condensed-Matter Physics : Stephen W. Levessy Benjamin Dynamic Correlations 2nd ed.
5. Superfluidity and superconductivity : D.R. Tilley and J. Cilley Adam Highler 1986-2nd ed.
6. Quantum theory of solids : C. Kittel.

PAPER II (B) PHYSICS OF AMORPHOUS SOLIDS

Time 3 hrs. Max.Marks.35

Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1, Preparation

Basic definitions,preparation of amorphous materials-Thermal evaporation sputtering,Glow discharge decomposition, Chemical vapour deposition, Kinetics of nucleation and growth, Melt quenching techniques.

2. Glass - transition

Survey of experimental characteristics of glass-transition, variation of first order extensive thermodynamical variables, Discontinuities in second order thermodynamical quantities,glass transition temperature, thermal hysteresis. Viscosity, strong and fragile liquids.Thermogynamical phase transition, Entophy in glass transition, Kauzmann parbox.

3. Theories of glass transition and microscopic structure

Adam-Gibbs theory of glass transition, Patential energy surfaces in configurations space, free volume theory (Cohen-Model).

Factors determining glass transition temperature, glass forming system and ease of glass formation.

Microsopic structure - radial distribution function,, experimental determination by x-ray diffraction, overview of other experimental tequniques like x-ray absorption spectroscopy Mossbauer spectroscopy.

'I. Amorphous semiconductors

Universal feature of crystalline state and effect of disorder on band structure, chemical bond description of covalent non crystalline semiconductors, dangling bond.

General models for states in gap of covalent amorphous semiconductors, CFO model, Davis -Mott model, dc conduction in amorrphous semiconductors(on the basis of Davis-Mott model), Conduction in extended states, Conduction in band tails, Conduction in localized states at the Fermi energy. Small poloran model for dc conduction.Thermo electric power,ac conduction.Transit time (Driff Mobilty, dispersive transport in amorphous semiconductors), photoconductivity in amorphous semi-conductors.

2. Application s

Electronic application - Electrophotographic application, Thin film transistors, solar cells, Electro chemical application - solid state batteries, electrochemical/sensors. Electro chromatic optical devise.

Optical application - Optical filters, Laser materials, light emitting diodes.

Magnetic application - Transformer cores.

Text and References Books:

1. Mott and Davis - Electronic process in Non crystalline materials.
2. Elliot - Physics of amorphous materials.
3. March, Street and Tosi - Amrophous Solid and Liquid state. (Plenum Press,1985, New York)
4. Material science vol. 9 (Edited by W. Kalin etal.)
5. Amrophous semi conductor by Jai Singh, Hama Kawa.

PAPER III (A) ENERGY

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1. Solar Energy

Basic ideas of black body absorption and radiation, Solar radiation, Solar radiation data, Solar radiation geometry, Empirical relation for predicting the availability of solar radiation. Solar energy collectors : Flat plate solar collector and Evacuated solar collector. Application of solar collector ; 1) Solar water heating system - introduction; heat exchanger and heat collector, 2) Solar air heater - Introduction; performance analysis of conventional air heater; testing procedure, 3) Concentrating collector - Flat Plate collector; Cylindrical parabolic collector; compound parabolic collector; parabolic dish collector; Thermal energy storage; introduction, sensible heat storagejatent heat storage, thermo chemical storage.

2.Hydrogen Energy

Introduction, Hydrogen Production: electrolysis, thermo chemical methods, fossil fuel methods, solar energy methods, bio hydrogen production. Storage: Gaseous Storage, Liquid Storage, solid state storage, New ways of hydrogen storage. Hydrogen utilization, Hydrogen as an alternative for motor vehicles, safety.

3. Wind Geothermal Ocean and other Energies

Basic Principles: The nature of wind, power in wind, forces on blades, wind energy conversion; Components of wind energy conversion systems, classification of WECS, Advantages and Disadvantages of wind energy.

Inroduction, Geothermal sources, Prime movers of geothermal energy conversion, Advantages and disadvantages, Applications of geothermal energy.

Tidal Energy - Introduction, Basic principle, Tidal power plants, Advantages and disadvantages of tidal energy.

Wave Energy - Introduction, Energy and power from waves, Wave energy conversion devices, Advantages and disadvantages.

Elementary idea about other energies.

4. Atomic Energy : Basic considerations

Slowing down of neutrons, elastic scattering and energy change in scattering, estimation of number of collisions, logarithmic energy decrement (lethargy), Macroscopic cross section, moderation of neutrons by bulk, water, graphite and heavy water. Fermi age, slow down length. Attenuation of neutrons, capture of neutrons, 1/E law resonances, fission cross section in case of Th, U^{238} and U^{235} evaluation of flat and spectrum average cross sections, ENDF library of cross sections. Fission energy, prompt neutrons and delayed neutrons.

5.Critical and Sub critical Reactors and nuclear waste

Four factor formula, Criticality, Neutrons multiplication in a reactor and its relation with power, kinds of critical reactors(based on fuel,moderator

and heat exchange), Fast breeder reactors,Heat exchange or conversions processes and materials(air, water, sodium and lead etc.) Power of a thermal reactor (both thermal and electric) Build up of isotopes and actinides in a reactor. Problem of nuclear waste. Problem related to Thorium as a fuel. Elementry idea of repository. Level of health hazard inside and out side of reactor building. Status of reactors in India,

High energy and spallation neutron sources, sub critical system and possibility of solution of nuclear waste problem. Thorium fuel and prospects in India.

Text and References Books:

1. Solar Energy - Principles of thermal collection and storage, S.P. Sukhatme, second edition, Tata McGraw-Hill,New Delhi, 1996
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, New Delhi.
3. Solar Energy Fundamentals,design, modeling, & application - G.N. Tiwari, Narosa publishing House, New Delhi.
4. Fundamentals of Renewable Energy Sources, G.N. Tiwari, M.K. Ghoshal, Narosa publishing House, New Delhi.
5. Solar Energy Fundamentals & Applications -HP Garg, J. Prakash, Tata Mcgraw Hill, New Delhi
6. Nuclear Reactor Engineering Fourth Edition, Sammuel Glasstone and Alexander Sesonske, CBS publishers and ditributers (India).
7. H. Nifenecker, O. Meplan and S.david, Book on 'Accelerator Driven Sub-critical Reactors' Institute of Physics Publishing,Bristol and Philadelphia (2003)

PAPER III (B) INTRODUCTION TO QUANTUM COMPUTING

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

Background : Technological limitations of classical computation, Review of quantum mechanics; superposition, qubits, Unitary transformation, quantum measurement, composite quantum system, tensor product, entanglement and Bell states.

Introduction to computer science: Models for computation Tuning machines and circuits, analysis of computational problems, computational complexity classes, energy and computation .

Quantum gates and circuits : qubits on a Bloch sphere, single and multi qubit gates, universal gates and operations, quantum circuits, teleportation, superdense coding, no cloning theorem.

Quantum Algorithms : Introduction to quantum algorithms, Quantum Parallelism, Deutsch's and Deutsch-Josza algorithm, Quantum Fourier transform, Phase estimation, Shor's algorithm, Grover's search Algorithm.

Physical realization of quantum computers, Divicenzo criteria for quantum computation, Harmonic oscillator quantum computer, various types of quantum computers :, optical photon quantum computer, optical cavity quantum electrodynamics, Icon traps, Nuclear magnetic resonance.

Reference Books :

1. Quantum Computation and Quantum Information : by Michael A. Nielsen and Issac L. Chuang, Cambridge Press.
2. Principles of Quantum computation and Information :, Vol. I by Benenti and casati, World Scientific
3. G.P. Berman, Introduction to Quantum Computers (World Scientific).
4. N.D. Mermin, Quantum Compugter Science (Cambridge)
5. Kaye Philip, Laflamme Raymond, Mosca Michele, An Introduction to Quantum Computing, Oxford University Press.

Semester II

PAPER V ADVANCE RESEARCH METHODOLOGY

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

Intrumentation and Charcatersation by Spectorscopic Techniques

IR Spectrophotometer - Instrumentation, simple handling techniques. FTIR Spectroscopy. Application to simple poly atomic molecules like H_2O,CO_2.

Raman Spectrophotometer - Sample handling techniques. Laser Raman Spectrophotometer. Structure determination by IR simple NMR spectra.

NMR Instrumentation - Chemical shift, relaxation processes, NMR spectra of a spin $^1/_2$ AB system. Interpretation of simple NMR spectra.

X - ray Spectrometer - Instrumentation of Laue and powder diffraction techniques. Structural analysis of NaCI single cystal and silver wire respectively.

ESR Spectrophotometer- Instrumentation. EPR of transition metal ions Cu2+ and Mn2+ ESR spectra of free redicals.

Mossbauer Spectrophotometer- Description of the techniques. Isomer shift, mafhetic hyperfine interaction. Applications of Mossbauer Effect.

Surface analysis techniques

Atomic Collision and Backscattering Spectrometry - Energy loss of Light Ions and Backscattering - Channeling ; Basic and its application in Thin Film analysis - X-ray Photoelectron Spectroscopy - Electron Microprobe analysis of surface - Nonradiative Transition and Auger Electron Spectroscopy

Microprocessor and ID Applications

8085 μp - Architecture and organization of 8085 microprocessor. Addressing models. Writing assembly language programmes. Stacks and subroutines. Programmable peripheral Interphase (PPI) 8255. programmable Interval timer 8253. 8286 up - Architecture and organization of 8086 microprocessor Writing simple programmes using assembler.

8051 Controller - Architecture and organization of 8051 microprocessor.

Measuement Techniques

Temperature - measurement and control devices. Resistance type temperature sensors, thermistors, thermocouples and solid state sensors.

Optical Intensity - measurement by photomultiplier method.

Density - Various measurement techniques for solids and liquids and their relative merits.

Reference Books

1. **Spectroscopy, Vols I & II,** Ed.Straughun and Walker
2. **The Determination of Molecular Structure,** P.J.Wheatly,Oxford Press (1968)
3. **Experiments in solid State Physics,** D.B. Sirdeshmukh and K.G. Subhadra,(1968)
4. **Microprocessor Architecture,** Programming and Application with the 8085/8085A, R.S. Goankar, Wiley Eastern Limited,(2001).
5. **Introductory Methods of Numerical Analysis,** S.S. Sastry, Prentice - Hall India, NewDelhi,(1990).
6. **Techniques of Orbanic Chemistry,** Ed Weisberg.
7. Fundamentals of surface and thin film analysis - Leonard Felmann and James W mayer.

PAPER VI (A) NONLINEAR DYNAMICS AND ELECTRODYNAMICS

Time 3 Hrs Max. Marks 35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1. Introduction to Dynamical System

Physics of nonlinear systems, dynamical equations and constants of motion, phase space fixed points,stability analysis. Bifurcations and their classification, Poincare section and interative maps.

2. Dissipative Systems

One-dimensional non invertible maps, simple and strange attractors, iterative maps, period doubling and universality, intermittency,invariant measure, Lyapunov exponents, higher dimensional system, Henon map, Lorenz equation. Fractal geometry, generalized dimensions, examples of fractals.

3. Hamiltonian Systems

Integrability, Liouville's theorem, action-angle variables,introduction to perturbation techniques, KAM theorem, area preserving maps, concepts of chaos and stochasticity.

4. Coherence

Superpositions of waves, coherence-spatial and temporal, couple signal respresentationn of quasi monochromatic light, theory of partial coherence, power spectrum and intensity distribution, Laser-principal and working, elements of holography.

5. Radiation by moving charges

Power radiated by an accelerated charge. Larmor's formula and its relativistic generalization, frequency and angular distribution - emitted by an accelerated charge, extreme relativistic case. Thomson scattering,scattering of radiation by quasi-free charges, coherent and incoherent scattering transition radiation.

6. Radiation by collision

Bremstrahlung radiation in Coulomb collision, non relativistic and relativistic case screening effects,method of virtual quanta, radiation emitted during beta decay and orbital electron capture disappearance of charge and magnetic moment.

Text and References Books:

1. A.P. French (I) Vibrations (Arnold-Heinemann India. 1973)
2. Applied Mathematics for Engineers and Physicsists (Mc Graw Hill Book co.1970).
3. G.R. Fowels. An Introduction to Modern Optics (Mait.Rinchart and Winston INC.1968)
4. J.D., Jackson, classical electrodynamics. (wiley-Eastern limited.1975) chapter 14. IS.
5. The physics of Vibrations : HJ. Pain John Wiley and Sons 1968
6. Waves Physics Courses : F. S. Grawford Jr. Me. Graw Hill Vo.3 1968
7. Optical Physics : S.C. Lipson, Cambridge Univ.Press,H. Lipson
8. Physics of Vibrations : Vierk
9. Electricity and Magnetism: Panofsky and Philips Addision Wesley
10. Introduction to Dynamics : Percival and D. Richards
11. Nonlinear Dynamics : I & II : E.A. Jackson.
12. Introduction to Dynamical system : R.L.. Devaney Regular and stochastic Motion: AJ. Lichtenberg and M.A. Lieberman
13. Chaos in Classical and Quantum Mechanics: M.C. GulzwiHer: E, Ott. M. Tabor

PAPER VI (B) PHYSICS OF NANO MATERIALS AND LIQUID CRYSTALS

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1. Free electron theory

Free electron theory (qualitative ideas) and its features, idea of band structure, Metals, insulator and semiconductors, Density of states in bands, Variation of density of states with energy, Variation of density of state and band gap with size of crystal. Definition and properties of nano structured materials, methods of synthesis of nano structured materials special experimental tequniques for characterization of nano structured.materials, TET,STM,AFM

2. Quantum Size Effect

Electron confinement in infinitely deep square well, confinement in two and one dimensional well. Idea of quantum well structure. Quantum dots Quantum wires.

Determination of particle size, Increase in width of XRD peaks of nanoparticles, shift in photoluminescence peaks. Variation in Raman spectra of nanomaterials. Different mrethods of preparation of nanomaterials, Bottom up : Cluster beam evaporation, Ion beams deposition, Chemical bath deposition with capping tequniques and Top down : Ball Milling, Littography.

3. Exotic Solids

Structure of liquid crystals, Aperiodic solids and quasicrystals, Fibonaccy sequence and penrose lattice, extension of penrose lattice to quasicrystals. Special Carbon solids : fullerenos and tubules and their formation and charcterisation. Carbon nanotubes single wall and multiwall.

4. Classification of Liquid Crystals

Symmetry, structure and classification of liquid Crystals, Polymorphism in tan thermotropics. Reentrant phenomena in liquid crystals, Blue phases. Polymer liquid crystals, Distribution function and order parameters, macroscopic and microscopic order parameters. Measurement of order parameter magietic resonance electron spin resonance, Raman Scattering and X-ray diffraction Ferroelectric liquid Cystals The properties of smectic C, continuum description, smectic C smectic A transition applications.

5. Discotic Liquid Crystals

Symmetry and structure, mean - field description, continuum description Lyotropic liquid crystals of discotic liquid crystals, and biological membrane Application of liquid crystals.

Text and References Books:

1. Nanotechnology Molecularly designed materials by Gan - Moog Chow, Kenneth E. Gonsalves, American Chemical Society.
2. Quantum dot heterostructrures by D. Bimerg, M. Grundmann and N.N. Ledentsov, John Wiley & Sons. 1998
3. Nano Technology : Molecular speculations on global abundance by B.C. Crandall,MIT Press 1996.
4. Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ.Press 1997.
5. Physics of nano structures by K.P. Jain, Narosa 1997, and bio system: Integrating materials science engineering biology by HarveyC. Hoch, Harold G. Craighead and Lynn Jelinski, Cambidge Univ.Press 1996.
6. Nano particles and nano structured films: Preparation characterization and application Ed. J.H.Fendler, John Wiley & Sons 1998.
7. Chandrasekhar Liquid Crystals.
8. Vertpgem & de Jei, Liquid Crystals : Fundamentals.
9. de Gennes & Prost The Physics of Liquid Crystals.
10. Intoduction to liquid crystals : Physics and Chemistry (1997, Taylor and Francis)
11. Elston & Sambles ; The Optics of Liquid Crystals
12. Collyer : Liquid Crystals Polymers : From Structures to Applications Goodby et al: Ferroelectric Liquid Clystal: Principals, Properties & Application.

PAPER-VII (A)-NUCLEAR AND HIGH ENRGY PHYSICS

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

1 Nucleon-nucleon Scattering and Potentials

Elecrostatic potential. Yukawa potential, Klien Gordan equation, One Boson Exchange Potential (OBEP), One Pion Exchange Potential (OPEP), Two and three pion production. Modern N-N potentials, storng interaction potentials- Wood Saxon Potential, Optical potential.

2. Nuclear Models

Pre equilibrium and compound nucleus formation model, Weisskopf model,Bohr's model, Introduction of Fission theory. Fireball model of multiparticle production, Shock wave model of collision of nuclei.

3. Thermonuclear and fission reactions

Q-value and threshold energies, fusion of nuclear particles, possibility of self sustained fusion, alpha, e-,s-, p- and x- processes. Thermo-nuclear reactions in sun. Age of a Galaxy. Possibility of fusion reactor and safety issues. Material requirement of fusion reactors. Fussion process, spontaneous fission and sources. Thermal and fast fission processes. Pressurized heavy water reactors and the light water reactors. Understanding about the Thorium based reactors.

4. Introduction of particles and symmetries

Discovery of pion, spin, parity and mean life three pions. Iso-spin, space parity, Charge conjugation and Time symmetry, Starangeness, Kaon and theta-tau puzzle, CP- violation, K -meson regeneration,CPT therorem. Baryon octets and meson nonets, Introduction of SU (2) and SU(3) symmetries. Pion-nucleon interaction and production of deltas. Quark Model. Flavors and color quantum numbers. Discovery of J/y particles and Introduction of fifth and sixth flavors. Discovery of W+,and Zo basons.Higgs bosons. Energy density and concept of Quark Gluon Plasma.

5, Detector System and Instruments

Ionization chambers for fast high energy particles, Multi wire Proportional Chambers(MWPC), Gamma detection and measurement, NaI, HPGe and High Resolution X-ray detectors, their, resolution, calibration and maintenance. Idea of Gamma spectrometry, Beta spectrometers,XRF and characterization of materials, Instruments for alpha range and stopping power, Methods of neutron detection and neutron dose measurements BF3 and other high density detectors, like BC-501, Measurement of neutron flux, Cerenkov detectors, calorimetry of high flux events.

Text and References Books:

1. Introduction to High Energy Physics, E, Perkins.
2. A text book of Nuclear Physics, CMH Smith, Pergamon Press.
3. Experimental Nuclear Physics, K.N. Mukhin, Vol. 1 Mir Publication, Moscow.
4. Detectors and Particle Radiation, Konard Kleinknecht, Cambridge University Press

5. The Atomic Nucleus R.D. Evans, Me Graw Hill, 1955
6. Introduction to Experiments, R.M. Singru Wiley Eastern Pvt. Ltd.

PAPER VII (B) Principles of Quantum Information System

Time 3 hrs. Max.Marks.35

Note : Seven question will be set in the question paper. Candidates are required to attempt five questions in all. All questions carry equal marks.

Density matrix, Schmidt decomposition, Purification, Kraus representation, Measurement of the density matrix for a qubit, Generalized measurements, Weak measurements, POVM measurements, Shannon entropy, Classical data compression, Shannon's noiseless coding theorem, Von Neumann entropy, Quantum data compression, Schumacher's quantum noiseless coding theorem, Accessible information, Holevo bound, Entanglement concentration and von Neumann entropy.

Decoherence , Measuring a Quantum operation acting on a qubit, Quantum circuits simulating noise channels, bit-flip channel, phase-flip channel, bit-phase-flip channel, depolarizing channel, Amplitude damping, Phase damping, De-entanglement.

Quantum Error Correction, three-qubit bit-flip code, three-qubit phase-flip code, General properties of quantum error correction, quantum Hamming bound, five-qubit code, Classical linear codes, The Hamming codes, CSS codes. Quantum cryptography, Private and public key cryptography, Privacy amplification and information reconciliation, Quantum key distribution, The security of quantum key distribution.

Reference Books :

1. M.A. Nielsen and I.L.Chuang, Quantum Computation and Quantum Information (Cambridge).
2. Benenti and Casati, Principles of Quantum computation and Information : Vol. II, World Scientific.
3. D. Bouwmeester The Physics of Quantum Information (springer).
4. H.-K. Lo, T. Spiller, S. Popescu, Introduction to Quantum Computation and Information (World Scientific).
5. G. Alber et al. Quantum Information : An Introduction to Basic Theoretical Concepts and Experiments (Springer).

PAPER VIII Dissertation

Students must start their dissertation work in semester I and Complete before end of semester - II.

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