Board of Studies in Physics

FACULTY OF SCIENCE

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

M.Sc. Second Year (Semester Pattern)
(Choice Based Credit System)

SUBJECT - PHYSICS

Semester III & Semester IV

Syllabus for M. Sc. Physics

Choice Based Credit System (Semester Pattern)
Gondwana University, Gadchiroli
Effective from 2016-2017

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in subjects Physics
Semester III;

Core	Theory / Practical	Teaching Scheme Hrs/ week			Credit	Examination Scheme					
						Duration hrs.	Max. Marks		Total	Minimum Marks	
		Theory	Practical	Total			External	Internal		Theory	Practical
Core 9 (PSCPH YT09)	Paper 9 Quantum Mechanics II	4	-	4	4	3	80	20	100	40	
Core 10 (PSCPH YT10)	Paper 10 Solid State Physics and Spectroscopy	4	-	4	4	3	80	20	100	40	
Core Elective I (PSCPH YT11)	Paper11 Material Science I OR Nanoscience and Nanotechnology I OR Atomic and Molecular Physics I	4	-	4	4	3	80	20	100	40	
Foundation Course I (PSCPH YT12)	Paper 12 Fundamental of Spectroscopy OR Fundamental of Nanoscience and Nanotechnology	4	-	4	4	3	80	20	100	40	
Practical.5	Practical 5 (Based on Core 9 & 10)	-	8	8	4	3-8*	80	20	100		40
Practical. Elective I	Practical 6	-	8	8	4	3-8*	80	20	100		40
Seminar 3	Seminar 3	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Semester IV:

Core	Theory / Practical	Teaching Scheme Hrs/ week			Credit	Examination Scheme					
						Duration in hrs	Max. Marks		Total	Minimum Marks	
		Theory	Practical	Total			External	Internal		Theory	Practical
Core 11 (PSCPHY T11)	Paper 13 Nuclear and Particle Physics	4	-	4	4	3	80	20	100	40	
Core 12 (PSCPHY T12)	Paper 14 Solid State Physics	4	-	4	4	3	80	20	100	40	
Core Elective II (PSCPHYT15)	Paper 15 Material Science II OR Nanoscience and Nanotechnology II OR Atomic and Molecular Physics II	4	-	4	4	3	80	20	100	40	
Fundation Course II	Paper 16 Spectroscopic Applications OR Optics and Optical instruments	4	-	4	4	3	80	20	100	40	
Practical.	Practical 7 (Based on Core11,12and Elective II)	-	8	8	4	3-8*	80	20	100		40
Project	Project	-	8	8			80	20	100		40
Seminar 4	Seminar 4	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in one copy to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
   a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
   b) There shall be three assignments (as described above) per course.
   c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
   d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
   e) **At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she propose to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
   f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

Practical Examination

1. Each practical carries 100(80 Pr+20 Int) marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _
Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee Head of the Department

1. _
2. _

General Rules and Regulations regarding pattern of question paper for the semester end examination:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80.
3. Question paper will consist of five questions, each of 16 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

M.Sc. Physics Semester III

1. (Core 9) Paper 9: Quantum Mechanics-II
2. (Core 10) Paper 10: Solid State Physics and Spectroscopy
3. Any one of the Elective papers from the following list. Paper 11 (Core Elective 1)

E1.1 Materials Science I
E1.2Nanoscience and Nanotechnology I E1.3. Atomic and Molecular Physics I
E1.4Applied Electronics I

4. Foundation course 1
Any one of following courses: Paper 12

F1.1 Fundamentals of Spectroscopy
F1.2 Fundamentals of Nanoscience and Nanotechnology

M.Sc. Physics Semester IV

1. (Core 11) Paper 13: Nuclear and Particle Physics
2. (Core 12) Paper 14: Solid State Physics
3. One of the elective papers from list below Paper 15 (Core Elective 2)

E2.1 Materials Science II
E2.2 Nanoscience and Nanotechnology II E2.3 Atomic and Molecular Physics II
E2.4 Applied Electronics II

4. Foundation course II
Any one of the following courses: Paper 16
F2.1Spectroscopic Applications
F2.2Optics and Optical Instruments

Semester III   Paper 9 (Core 9) Quantum Mechanics II

Unit- I

Time independent perturbation theory, First order perturbation theory applied to non-degenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, and harmonic oscillator.

Unit II

Time dependent perturbation theory, transition state, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission, atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein's A and b coefficients and their calculations.

Approximation methods: W. K. B. method and its application to barrier penetration.

Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential.

Unit III

System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.

Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule.

Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential, Partial wave method, phase shifts and their importance, scattering by a square well potential and a perfectly rigid sphere, resonance scattering.

Unit IV

Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac's relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac's theory, negative energy states and their qualitative explanations.

Text and References Books:

1. E. Merzbacher, Quantum Mechanics (Wiley and Sons-Toppon)
2. J. L. Powell and B. Crasemann, Quantum mechanics (B I Publications)
3. L. I. Schiff, Quantum Mechanics (McGraw-Hill)
4. Quantum Mechanics: Aruldhas
5. Pauling and Wilson, Introduction to Quantum Mechanics
6. A.K. Ghatak and Lokanathan, Quantum Mechanics (Macmillan, India)
7. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester III Paper 10 (Core 10) Solid State Physics and Sprectroscopy

Unit I: Order in Solids-Crystal classes and system, 2d and 3d lattices, Space groups, Concept of point group, bonding of common crystal structure; reciprocal lattice, diffraction and structure factor, Miller and Bravais indices, Bonding, diffraction and structure factor in solids, short and long range order in liquids and solids, liquid crystals, quasicrystals and glasses

Unit II

Defects: Vacancies, Point defects, line defects and stacking faults, Burgers vector andBurger circuit, presence of dislocation, dislocation motion, perfect and imperfect dislocations, slip planes and slip directions, dislocation reactions

Dielectric Properties: -Polarization mechanisms, Clausius-Mossotti equation, piezo,pyro and ferroelectricity

Unit III

Atomic Structure and Atomic Spectra : Quantum states of an electron in an atom.Electron spin.Spectrum of helium and alkali atom. Some features of one-electron and two electron atoms, Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Inner shell vacancy, X-rays and Auger transitions.chemical shift. Frank-Condon principle.

Unit IV

Molecular Structure and Molecular Spectra : Types of molecules, Electronic,rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule, PQR branches. Elementary discussion of Raman, ESR and NMR spectroscopy, chemical shift

Reference Books:

1. Physics of Atoms and Molecules: Bransden and Joachain.
2. Introduction to Atomic Spectra: H.E. White.
3. Solid State Physics, Charles Kittel, John Willey & Sons
4. Molecular Spectra and Molecular Spectroscopy (Vol. 1), G. Herzberg
5. Introduction to Atomic Spectra: HG Kuhn
6. Fundamentals of molecular spectroscopy, C.B. Banwell
7. Introduction to molecular Spectroscopy , G. M. Barrow
8. Introduction to Solid State Physics: C. Kittle
9. Materials Science and Engineering: V. Raghavan
10. Solid State Physics: S. O. Pillai (New Age International 2006)
11. FerroelectricityJona and Shirane

Semester III Practical 5

Practical 5 (Core 9 and Core 10)

1.Determination of ionization potential of lithium

2.X-ray diffraction by TELEXOMETER.

3.Study of emission spectra of iron (Iron arc).

4.Determination of Dissociation Energy of Iodine Molecule by photography of the absorption band of Iodine in the visible region.

5.Study of Stark effect

6.Study of Molecular Spectra

7.Determination of Rydberg's constant

8.Determination of Plank's constant

9. Study of Crystals

10. Study of line spectra

Note: Instructor can introduce new and relevant experiments which are not in the list.

Semester III Paper 11 (Core Elective E1.1) Materials Science I

Unit- I

Equilibrium and kinetics: Stability and metastability, Basic thermodynamic functions,Statistical nature of entropy, Kinetics of thermally activated process.

Phase diagrams: The phase rule, free energy composition diagram, correlation betweenfree energy and phase diagram, calculation of phase boundaries, thermodynamics of solutions, single component system (water), two component system containing two phases and three phases, Binary phase diagrams having intermediate phases, Binary phase diagrams with eutectic system. Lever principle, maximum, minimum, super lattice, miscibility gap, microstructure changes during cooling, application to zone refining.

Unit – II

Phase transformations: Time scale for phase changes, peritectic reaction, eutectoid andeutectic transformations, order disorder transformation, transformation diagrams, dendritic structure in alloys, transformation on heating and cooling, grain size effect on rate of transformation at constant temperature and on continuous cooling, grain size effect on rate of transformation, nucleation kinetics, growth kinetics, interface kinetics leading to the crystal growth.

Unit-III

Diffusion in solids: Fick's laws and their solutions, the Kirkendall effect, mechanism ofdiffusion, temperature dependence of diffusion co-efficient, self diffusion, interstitial diffusion, the Snoek effect in diffusion, diffusion in ionic crystals, diffusion path other than the crystal lattice, thermal vibrations and activation energy, diffusion of carbon in iron.

Solid State Ionics: Definition, classification and characteristic properties of solidelectrolytes. Complex impedance spectroscopy, Arrhenius theory of ionic conductivity. Chemical sensors: Nernst equation, potentiometer and amperometric sensors for various gases, electrochemical redox-reaction, advantages of electrochemical sensors.

UNIT-IV

Solid state energy devices: Fundamental of Solar cells, Primary and secondary solidstate cells, advantages of lithium batteries, ion intercalation compounds for secondary cell, open circuit voltage and short circuit current, intercalation compounds for secondary cell, open circuit voltage and short circuit current, Energy density, power density. Fuel cells – advantages and disadvantages, classification, efficiency- emf of fuel cells, hydrogen/oxygen fuel cell, criteria for the selection electrode and electrolyte, methanol fuel cell, solid oxide fuel cells, phosphoric acid fuel cells, molten carbonate fuel cell, proton exchange membrane fuel cell, biochemical fuel cell.

Text and Reference books:

1. Vanvellak: Materials Science.
2. V. Raghvan: Materials Science.
3. D. Kingery: Introduction to ceramics.
4. R. E. Reedhil: Physical metallurgy.
5. Martin Start Sharger: Introductory materials.
6. Sinnot: Solid state for engineers.
7. Kelly and Groves: Crystal and defects.
8. Kittel: Solid state physics, Vth edition.
9. M. A. Azaroff: Elements of crystallography
9. Introduction to solid state theory: Modelung.
10. Fuel Cells – A. Mcdougall, Macmillan 1976 Ch 3,5,7,8 and 11.

Semester III   Paper 11 (Core Elective E1.2) Nanoscience and Nanotechnology I

Unit I:

Introduction to Nanoscience:

Free electron theory (qualitative idea) and its features, Idea of band structure, Density ofstates for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Structure property relation, Size dependence properties. Determination of particle size, Increase in width of XRDpeaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nano-materials.

Unit II:

Synthesis of Nanomaterials:

Physical methods**:** High energy Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit III:

Nanomaterials Characterizations:

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Electron Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer, Spintronics

Unit IV:

Special Nanomaterials and Properties:

Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assemblednanomaterials. Metal and semiconductor nanoclusters

Mechanical, Thermal, Electrical, Optical, Magnetic, Structural properties of nanomaterials

Text and Reference books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.

2. Nanostructures &Nanomaterials Synthesis, Properties & Applications**.**Guozhong Cao, Imperials College Press London.

3.Nanomaterials: Synthesis, Properties & Applications**.**Edited by A.S. Edelstein &R.C.Commorata.Institute of Physics Publishing, Bristol & Philadelphia.

4. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student ed.

5. Nano: The Essentials. T.Pradeep , McGraw Hill Education.

6. Handbook of Nanostructures: Materials and Nanotechnology. H. S. NalwaVol 1- 5, Academic Press, Bostan.

7. Hand Book of Nanotechnology, Bhushan

8. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng

Semester III   Paper 11 (Core Elective E1.3) Atomic and Molecular Physics I

Unit I

Quantum states of an electron in an atomic Electron spin, spectrum of hydrogen, Helium and alkali atoms, Relativistic corrections for energy levels of hydrogen; Basic principles of interaction of spin and applied magnetic field.
Concepts of NMR spectroscopy concepts of spin-spin and spin-lattice relaxation, chemical shift; spin-spin coupling between two and more nuclei; chemical analysis using NMR.
Mossbauer effect-Recoil less emission of gamma rays, chemical shieft,
magnetic hyperfine interaction,

Unit II

electron spin resonance, experimental setup, hyperfine structure and isotopic shift,width of spectral lines, LS & JJ coupling, Zeeman, Paschen Back & Stark effect. Spontaneous and Stimulated emission, Einstein A & B Coefficients; LASERS, optical pumping, population inversion, rate equation, modes of resonators and coherence length, Role of resonant cavity, three and four level systems, Ammonia MASER, ruby, He-Ne, $CO2$, dye and diode lasers, Lasers applications

Unit III

Rotational, vibrational and Raman spectra of diatomic molecules, Quantum theory, Molecular polarizability, Intensity alteration in Raman spectra of diatomic molecules, Experimental setup for Raman spectroscopy in the structure determination of simple molecules. polyatomic molecules, symmetric top asymmetric top molecules. Hunds rule.

Unit IV

Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational Coarse structure of electronic bands, intensity of electronic bonds, Franck Condon principle, and selection rules,dissociation and pre dissociation, dissociation energy, rotational fine structure of electronic bands. General treatment of molecular orbitals, Hund's coupling cases.

Text Book and References:

1. Molecular Spectroscopy: - Jeane L. McHale.
2. Mossbauer spectroscopy –M. R. Bhide.
3. NMR and Chemistry – J. W. Akitt.
4. Structural Methods in inorganic chemistry, E.A V.Ebsworth, D. W. H.Rankin, S.Crdock.
5. Introduction to Atomic Spectra – H. E. White.
6. Fundamental of Molecular Spectroscopy – C. B. Banwell.
7. Spectroscopy Vol. I, II and III, Walker and Straghen.
8. Introduction to Molecular Spectroscopy – G. M. Barrow.
9. Spectra of diatomic molecules – Herzberg.
10. Molecular spectroscopy – Jeanne L. McHale.
11. Molecular spectroscopy – J. M. Brown.
12. Spectra of Atoms and Molecules – P. F. Bemath.
13. Modern Spectroscopy – J. M. Holkas.
14. Laser spectroscopy and instrumentation- Demtroder

Semester III   Paper 11 (Core Elective E1.4) Applied Electronics I

Unit – I

Operational Amplifiers, Block diagram of a typical operational amplifier, analysis, open loop configuration, inverting and non-inverting amplifiers, operational amplifier with negative feedback,voltage series feedback, effect of feedback on close loop gain, input resistance output resistance bandwidth and output offset voltage, voltage follower. Practical operational amplifier, input offset voltage, input bias current, input off set current, total output off set voltage, CMRR, frequency response, dc and ac amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, integrator and differentiator.Application of Op-Amp as fixed and variable voltage regulator. Oscillators principles- Barkhausen criterion for oscillations, The phase shift oscillator, Weinbridge oscillator, LC tunable oscillator, multi-vibrators, mono-stable and astable, comparators, square wave and triangular wave generators

UNIT II

Communication electronics: Amplitude modulation , generation of AM waves, demodulation of AM waves, DS BSC modulation, generation of DSBSC waves, coherent detection DSBSC wave, SSB modulation, generation and detection of SSB waves, Vestigial sideband modulation, frequency division multiplexing (FDM).

Microwave communication: Advantage and disadvantage of microwave transmission, loss in free space propagation of microwaves, atmospheric effect on propagation, Fresnel zone problem, ground refection,fading sources, detector components, antennas used in microwave communication systems

Unit – III

Microprocessor: Introduction to microcomputers, Memory. Input-output devices, interfacing devices.8085 CPU, architecture, bus timing, de-multiplexing, the address bus, generating control signals,instruction set, addressing modes, illustrative programmes, assembly language programmes, looping, counting and indexing, counters and timing delay, stack and sub routings. read only memory (ROM) and applications. Random access memory (RAM) and applications,

Digital to analogue converters. Ladder and weighted register types, analog to digital converters, ,successive approximations and dual slop converters, application of DAC and ADC,

Unit – IV

Microwave devices: Klystrons, magnetrons, and travelling wave tubes, velocity modulation, basic principle of two cavity klystrons and reflex klystrons, principle of operation of magnetrons, Helix travelling wave tubes, wave modes, transferred electron devices, gunn effect, principle of operation,modes of operation, read diode, IMPATT diode, TRAPATT diode..

Text and Reference Books:

1. Electronic devices and circuit theory: RobortBoylested and L. Nashdsky (PHI, New Delhi).
2. OP-Amps and linear integrated circuits: Ramakanth A. Gayakwad (PHI 2nd Edn).
3. Digital principles and Applications: A. P. Malvino and D. P. Leach (Tata Ma-Graw Hill).
4. Microprocessor architecture, programming and Application with 8085/8086, Ramesh S. Gaonkar(Wiley-Estern).
5. Microelectronics: Jacob Millman (Mc-Graw Hill International).
6. Optoelectronics: Theory and Practices: Edited by Alien Chappal (McGraw Hill).
7. Microwaves: K. L. Gupta (Wiley Ester New Delhi).
8. Advanced electronics communication systems: Wayne Tomasi (Phi Edn).
9. Fundamentals of microprocessors and Micro-computers: B. Ram. (DhanpatRao and Sons.).

Semester III   Practical 6 and 7 for elective papers

Practical 6 and 7 (elective)
Materials Science

1. Crystal structure determination by powder diffraction.
2. Study of microstructures of metal alloys.
3. Dislocation in alkali halide crystals.
4. Crystal growth from slow cooling of the melt.
5. Thermal analysis of binary alloy.
6. Differential thermal analysis of BaTiO3-PbTiO3 solid solution.
7. To study electrochemical method of corrosion control.
8. Dielectric behaviour of LiNbO3 and BaTiO3 in crystals and ceramics.
9. Electrical conductivity of ionic solids.
10. To test hardness of a material by Brinell hardness tester.
11. Photo elasticity study.
12. Multiple beam interferromentric study of surfaces.
13. Thermal conductivity of bad conductor. 14. Thermal expansion coefficient of metals.
15. Study of transport property in solid electrolytes.
16. Verification Nernst law/Oxygen sensor.
17. Determination of Thermoelectricity Power.

Nanoscience and Nanotechnology

1. Synthesis of metal oxide nanoparticles by wet chemical method.
2. Deposition of thin films by spray pyrolysis technique.
3. Synthesis of inorganic nanomaterials by combustion method.
4. Synthesis of nanomaterials by sol-gel method.
5. Synthesis of conducting polymer nanofibres by chemical oxidation method.
6. Study of optical absorption of nanoparticles.
7. Determination of particle size of nanomaterials from x-ray diffraction.
8. Study of photoluminescence of well known luminescent nanoparticles.
9. Deposition of thin films by spin coating method.
10. Thermoluminescence study of nanomaterials.
11. Deposition of thin films by dip coating technique.
12. Study of particle size effect on luminescence.
13. Electrical characterization of nanostructured materials.
14. Synthesis of metal oxide nanoparticles by hydro-thermal method.
15. Deposition of thin film in vacuum.
16. Electrical resistivity of nanomaterials using four probe method
17. Photoluminescence study of prepared red/blue/green luminescent nanomaterials.
18. Characterization of nanomaterials using SEM/TEM.
19. Computer modelling methods for studying materials on a wide variety of length and time scales.

Atomic and Molecular Physics

1. Study of line spectra on photographed plates/films and calculation of plate factor.
2. Verification of Hartman's dispersion formula.
3. Study of sharp and diffuse series of potassium atom and calculation of spin orbit interaction constant.
4. Determination of metallic element in a given inorganic salt.
5. To record the spectrum of CN violet bands and to perform vibrational analysis.
6. To record the visible bands of ALO and to perform vibrational analysis.

7. To photograph and analyse the reddish glow discharge in air under moderate pressure.
8. To photograph the analyse the whitish glow discharge in air under reduced pressure.
9. To perform vibrational analysis of a band system of N2.
10. To perform vibrational analysis of band system of C2
11. To photograph and analyse the line spectrum of Calcium atom.
12. To record/analyse the fluorescence spectrum of a sample.
13. To record/analyse the Raman spectrum of a sample.
14. Study of Hyperfine structure of the green line of mercury.
15. To photograph the (O, O) band of CuH and to perform rotational analysis.
16. Flashing & quenching in Neon Gas.
17. E/m of electron.
18. Experiments on Prism/Grating Spectrometer.
19. Wavelength of laser light.
20. Faraday effect with laser.
21. Michelson interferometer.
22. Analysis of ESR Spectra of transition metals.
23. Analysis of H-atom spectra in minerals.
24. Measurements of dielectric constant of polymer sheet at low frequency.
25. E.S.R. of DPPH.
26. To measure the dielectric constant and polarisation of unknown liquid.
27. To measure the dielectric constant of unknown wood at microwave frequency
28. To measure the ultrasonic velocity in unknown liquid.
29. He-Ne Layer
30. To study polarisation of sodium light
31. To study polarisation of light using Babinet compensator.

Applied Electronic

1. Pulse amplitude modulation/demodulation
2. Pulse position/Pulse width modulation/demodulation
3. FSK modulation/demodulation using Timer/PPL
4. Microwave characterization and measurements.
5. PLL circuit and application.
6. Fibre Optics Communication.
7. Design of active filters.
8. BCD to seven segment display.
9. A/D and D/A conversion.
10. Experiments using various type of memory elements.
11. Addition, Subtraction, Multiplication and Division using 8085/8086.
12. Wave form generation and storage Oscilloscope.
13. Frequency Temperature voltage measurements.
14. Motor speed temperature control using 8086.
15. Trouble shooting using signature analyzer.
16. Assembly language programming on PC.
17. Experiment based on Computer aided design.
18. OPAMP as a integrator and differentiator.
19. OPAMP as a Schmitt trigger generator.
20. Construction and study of astable, monostable and bistablemultivibrator.
21. Study of OPAMP as fixed and variable voltage regulator.

Note: Instructor can introduce new and relevant experiments which are not in the list.

Semester III Paper 12 (Foundation course F1.1) Fundamentals of Spectroscopy

Unit I

Atomic Spectra: The hydrogen atom and the three quantum numbers*n*,*l*and*ml*.– electronspin -Vector atom model-electron spin-Stern-Grelach experiment spectroscopic terms. Spin-orbit interaction, fine structure in sodium atom, selection rules.Lande g-factor, normal and anomalous Zeeman effects, Paschen–Back effect,Stark effect in one electron system. L S and j j coupling schemes (vector diagram) – examples

Unit II

Molecular Spectra:MicrowaveSpectra: Rotational spectra of rigid diatomic molecules -effect of isotopic substitution. Non–rigid rotor – rotational spectra ofpolyatomic molecules

IR Spectra: Vibrating diatomic molecule as anharmonic oscillator,
diatomic vibrating rotor – break down of Born-Oppenheimer approximation
- vibrations of polyatomic molecules - overtone and combination frequencies
- analysis by IR technique - Fourier transform IR spectroscopy.

Unit III

Raman Spectroscopy: Pure rotational Raman spectra - linear and symmetrictop molecules - vibrational Raman spectra – Raman activity of vibrations - structure determination from Raman and IR spectroscopy.

Unit IV

Electronic Spectroscopy: Electronic spectra of diatomic molecules -progressions and sequences - intensity of spectral lines. Franck – Condon principle - dissociation energy Rotational fine structure of electronic-vibrational transition - Fortrat parabola – Pre dissociation energy-fluorescence and phosphorescence.

Reference Books:

1. Introduction of Atomic Spectra, H.E. White, McGraw Hill
2. Spectroscopy (Vol. 2 & 3), B.P. Straughan& S. Walker, Sciencepaperbacks 1976
3. Raman Spectroscopy, D.A. Long, McGraw Hill international, 1977
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill
5. Molecular Spectra and Molecular Structure, Vol. 1, 2 & 3. G.Herzberg, Van Nostard, London.
6. Elements of Spectroscopy, Gupta, Kumar & Sharma, PragathiPrakshan
7. The Infra Red Spectra of Complex Molecules, L.J. Bellamy,Chapman& Hall. Vol. 1 &2
8. Laser Spectroscopy techniques and applications, E.R. Menzel, CRCPress, India

Semester III Paper 12 (Foundation course F1.2) Fundamentals of Nanoscience and Nanotechnology

Unit-I Basics of Nanoscience

Introduction to quantum physics, electron as waves, wave mechanics, Schrödinger equation and particle in a box, Heisenberg's uncertainty principle, exclusion principal, Free electron theory (qualitative idea) and its features, Idea of band structure, Density ofstates for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size

The p-n-junction and bipolar transistor, Metal semiconductor and metal insulator, semiconductor junction, field effect transistor.

Unit-II Properties of Nanomaterials

Mechanical, Thermal, Electrical, Optical, Magnetic and Structural.

Carbon nanostructures- Fabrication, structure, electrical properties and mechanical properties.

Unit-III Synthesis of Nonmaterial's

Physical methods**:** Bottom up-Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser pyrolysis, Sputter deposition, Electric arc deposition, Gas evaporation.

Chemical methods**:** Hydrothermal combustion, bath deposition with capping techniques and top down,Chemicalvapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit-IV Bionanotechnology

Biological building blocks, nanostructure, protein nanoparticles, DNA double nanowire.

Bionanostructures- Micelles, vesicles, multilayer films, biological interactions, bilayers, bioelectronics and bioscensors.

Text and Reference Books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni, Capital Publishing Co.New Delhi.
2. Carbon nanotechnology..recent developments in Chemistry, Physics, materials science and device applications, -Elsevier Science
3.Nanostructures&Nanomaterials Synthesis, Properties & Applications. Guozhong Cao, Imperials College Press London
4. Physics, Chemistry and Application of Nanostructures, world scientific co.
5. Nanomaterials: Synthesis, Properties & Applications. Edited by A.S. Edelstein &R.C.Commorata. Institute of Physics Publishing, Bristol & Philadelphia.
6.Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student Edition.
7.Nano: The Essentials. T.Pradeep , McGraw Hill Education.
8. Handbook of Nanostructures: Materials and Nanotechnology. H. S. NalwaVol 1-5, Academic Press, Boston.
9.Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng
10. Hand Book of Nanotechnology, Bhushan

Semester IV Paper 13 (Core 11) Nuclear and Particle Physics

UNIT 1 ;

Basic nuclear properties; size, radii, shape, and charge distribution, spin, parity, mass, binding energy, semi-empirical mass formula, liquid drop model, nuclear stability, laws of radioactive decay. Nature of nuclear force, elements of deuteron problem, n-n scattering, charge independence and charge symmetry of nuclear forces.Electric and magnetic moments of nuclei.Evidence for nuclear shell structure, single particle shell model-its validity and limitations.

UNIT 2 :

Elementary properties of alpha-, beta-, and gamma-, decay of nuclei, their classification, characteristics and selection rules. Elementary theories of alpha-, beta-, and gamma-, decay. Nuclear reactions- conservation laws, mechanism, and cross section. Nuclear reaction mechanism, compound nucleus, direct reactions. Fission and fusion reactions, nuclear energy, elements of nuclear power.

UNIT 3 :

Interaction of charged particles and electromagnetic radiation with matter. Principles of nuclear radiation detectors: G-M counter, proportional counter, Na(Tl) scintillation detector, semiconductor detectors. Elementary principles of particle accelerators: linear accelerators, Van de Graaf, cyclotron, betatron, synchrocyclotron, ion beam accelerators.

UNIT 4 :

Classification of elementary particles, strong, weak and electromagnetic interaction.Gellmann-Nishijima formula Properties of hadrons, baryons, mesons, leptons, and quarks- their quantum numbers, charge, mass, spin, parity, iso-spin, strangeness etc. Symmetry and conservation laws.Elements of quark model and standard model.Higgs boson.

Text-books recommended:

1) Introductory Nuclear Physics,: Kenneth S Krane, Wiley, New York ,1988.
2) Nuclear and Particle Physics: Brian Martin.
3) Atomic and Nuclear Physics: S.N. Ghoshal.
4) Introduction to Particle Physics : D. Griffiths.
5) Introduction to Nuclear Physics: F. A. Enge, Addison Wesley (1975)
6) Introductory Nuclear Physics: Burcham

Semester IV Paper 14 (Core 12) Solid State Physics

Unit I: Band Theory: Bloch theorem, the Kronig- Penney model, construction of Brillouinzones, extended and reduced zone schemes, effective mass of an electron, tight binding approximation. Fermi surface.

Magnetic Properties:

Quantum theory of paramagnetism, magnetism of iron group and rare earth ions,.exchange interactions. Pauli paramagnetic susceptibility

Unit II

Lattice Dynamics: Energy of atomic motions, adiabatic principle, harmonic approximation,cyclic boundary condition.Lattice vibrations of linear monoatomic and diatomic chains.Dispersion relations, acoustic and optical phonons.

Theories of lattice specific heat, Dulong and Petit'slaw, Einstein and Debye models, T^3 law, Born procedure, anharmonicity and thermal expansion.

Unit III: Free Electron Theory: Electrons moving in one and three dimensional potentialwells, quantum state and degeneracy, density of states, electrical and thermal conductivity of metals, relaxation time and mean free path, the electrical resistivity of metals, thermonic emission. Seebeck effect, thermoelectric power.

Semiconductors: Free carrier concentration in semiconductors, Fermi level and carrierconcentration in semiconductors, effect of temperature on mobility, electrical conductivity of semiconductors, Hall effect in conductors and semiconductors.

Unit IV

Superconductivity, Type I and II super conductors, Meissner effect, isotope effect, London equation, coherence length, elements of B. C. S. theory, tunnelling DC and AC Josephson effect, Ginzberg-Landau Theory macroscopic quantum interference. Josephson junction.high temperature superconductor (elementary).

Text and Reference books:

1. C. Kittle: Introduction to Solid State Physics (2nd and 4th Edition).
2. A. J. Dekker : Solid State Physics.
3. Kubo and Nagamiya : Solid State Physics.
4. Feynman Lectures: Vol. III.
5. Board and Huano : Dynamical Theory of Crystal Lattice.
6. N. W. Ashcroft and D. Mermin: Solid State Physics.

Semester IV Practical 7 for core papers

Practicals based on core 11 and core 12

1. Measurement of resistivity of a semiconductor by four probe method at two different temperatures and determination of band gap energy.
2. Measurement of Hall coefficient of given semiconductor: identification of type of semiconductor and estimation of charge carrier concentration.
3. Determination of Hall life of ‘In”.
4. Determination of range of Beta-rays from Ra and Cs.
5. G-M counter
6. Magnetoresistance by Hall effect
7. Determination of Dielectric constant
8. Random decay of nuclear disintegration using dice (or simulation)

In all 7 practicals, instructor can introduce new and relevant experiments which are not in the list.

Semester IV Paper 15 (Core Elective E2.1) Materials Science II

Unit –I

Mechanical response of Materials : Elasticity, model of elastic response, inelasticity,viscoelasticity, stress-strain curves, concept of various mechanical properties such as hardness, yield strength, toughness, ductility, yield toughness, ductility, brittleness, stiffness, young modulus, shear modulus, shear strength, Frenkel model, Peierls-Nabarro relation, Plastic deformation,

Corrosion and degradation of materials –electrochemical considerations–passivity formsof corrosion – corrosion inhibition.

Spintronics and Photonics: Spin glass, magnetic bubbles, domain walls, magneticmultilayers, magnenites, GMR and CMR, DMS materials. Photonic band gap materials.

Unit – II

Concept of Synthesis: Concept of equilibrium and nonequilibrium processing and theirimportance in materials science.

Synthesis of materials: Physical method–Bottom up: cluster beam evaporation, Ion beamdeposition, Gas evaporation, Chemical method – Hydrothermal, combustion, bath deposition with capping techniques and top down: Ball milling. Solvated metal atom dispersion – thermal decomposition – reduction methods – colloidal and micellar approach.

Unit-III

Processing of materials: Metallic and non metallic, Ceramics and other materials. Onlybasic elements of powder technologies, compaction, sintering calcination, vitrification reactions, with different example, phenomenon of particle coalescence, porosity.Quenching : concept, glass formation

structural characterization:

Diffraction techniques: interpretation of x-ray powder diffraction patterns, Identification & quantitative estimation of unknown samples by X-ray powder diffraction technique Electron and neutron diffraction.

Unit –IV

Structural determination by fluorescent analysis. Theory and method of particle size analysis. Integral breadth method, Warren-Averbach's Fourier method, profile fitting method.

Microscopic techniques –TEM, SEM & STEM.AFM, EDX and XPS.

Text and Reference Books:

1. Basic Solid State Chemistry, 2nd Edition, Anthony R. West, John Wiley & Sons, 1996.
2. New Directions in Solid State Chemistry, C. N. R. Rao and J. Gopalkrishnan, Cambridge University Press, Cambridge, 1986.
3. Chemical approaches to the synthesis of inorganic materials, C. N. R. Rao Wiley Eastern Ltd.1994.
4. Materials Science and Engineering – An Introduction, W. D. Callister Jr. John Wiley & Sons,1991.
5. Materials Science, J. C. Anderson, K. D. Leaver, R. D. Rawlings and J. M. Alexander, 4^{th} Edition, Chapman & Hall (1994).

Semester IV Paper 15 (Core Elective E2.3) NanoScience and Nanotechnology II

Unit – I:

Nanophotonics:

Fundamentals of photonics and photonic devices, Lasers, CFLs, LEDs, OLEDs, Wall paper lighting, Display devices, X-ray imaging nanophosphers, Photo therapy lamps and its applications, Nanomaterials for radiation, Dosimetery special for thermoluminescence. Optical stimulated luminescence, Luminescence solar concentration.

Unit – II:

Nanomagnetics:

Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics.

Unit – III:

Nanoelectronics:

Top down and bottom up approach, CMOS Scaling, Nanoscale MOSFETs, Limits to Scaling, System Integration, Interconnects;

NanoDevices: Nanowire Field Effect Transistors, FINFETs, Vertical MOSFETs, Other Nanowire Applications, Tunneling Devices, Single Electron Transistors, Carbon nanotube transistors, Memory Devices,

Unit – IV:

Nanocomposites:

Classification of nanocomposites, Metallic, ceramic and polymer nanocomposites, Tribology of polymeric nanocomposites, Nano ceramic for ultra high temperature MEMS, Optimizing nanofiller performance in polymers, Preparation techniques, Graphene/Fullerene/Carbon nanotube (CNT) polymer nanocomposites, One dimensional conducting polymer nanocomposites and their applications

Text and reference books:

1. H.S.Nalwa; Hand book of Nanostructure materials and nanotechnology; (Vol.1-5), Acad. Press, Boston, 2000
2. C.P.Poole Jr., F.J.Owens; Introduction to Nanotechnology, John Wiley and sons, 2003
3. C. Furetta; Hand book of thermoluminescence; World Scientific Publ.
4. S.W.S. McKEEVER; Thermoluminescence in solids; Cambridge Univ. Press.
5. Alex Ryer; Light measurement hand book; Int. light Publ.
6. M.J.Weber; Inorganic Phosphors; The CRC Press.

7. T.J.Deming; Nanotechnology; Springer Verrlag, Berlin, 1999
8. W.D.Kalister Jr., Materials Science and Engineering, 6th Eds, WSE Wiley, 2003
9. Gusev; Nanocrystalline Materials
10. C. Delerue, M.Lannoo; Nanostructures theory and Modelling
11. Fausto, Fiorillo ; Measurement and Characterization of Magnetic materials
12. Bhushan; Hand Book of Nanotechnology
13. Janos H., Fendler; Nanoparticles and Nanostructured Films
14. T.Pradip; Nano: The Essentials

15. Liu; Hand Book of Advanced Magnetic Materials (4 Vol.)
16. Lakhtakia; Nanometer Structure
17. Banwong, Anurag Mittal; Nano CMOS Circuit and Physical Design
18. G.W.Hanson: Fundamental of Nanoelectronics
19. Edward L. Wolf (2nd Ed.), *Nanophysics & Nanotechnology: An Introduction toModern Concepts in Nanoscience*, WILEY-VCH, 2006
20. S. Sakka; Sol-gel science and technology processing, characterization and applications; Kluwer Acad. Publ.
21. Goser et al, "*Nanoelectronics&Nanosystems: From Transistor to Molecular & Quantum Devices"*
22. SupriyoDatta, "*From Atom to Transistor*"
23. John H. Davies, *The Physics of Low Dimensional Semiconductors: An Introduction",* Cambridge University Press, 1998.
24. Hari Singh Nalwa, "*Encyclopedia of Nanotechnology*"
25. A. A. Balandin and K. L. Wang, "*Handbook of Semiconductor Nanostructures&Nanodevices*"
26. Cao Guozhong, "*Nanostructures &Nanomaterials - Synthesis, Properties &Applications*

Semester IV Paper 15 (Core Elective E2.4) Atomic and Molecular Physics II

Unit I

Time dependence in quantum mechanics, Time dependent perturbation theory, rate expression for emission, perturbation theory, calculation of polarizability.Quantum mechanical expression for emission rate.

time correlation function and spectral Fourier transform pair, properties of time correlation functions and spectral time shape,

Fluctuation dissipation theorem rotational correlation function and pure rotational spectra, Re-orientational spectroscopy of liquids.

Unit II

Saturation spectroscopy, Burning and detection of holes in Doppler broadened two level systems, Experimental methods of saturation spectroscopy in laser, Ramsey fringes, Saturation techniques for condensed matter application,

Laser optogalvanicspectroscopy.Two photon absorption spectroscopy, Selection rules, Expression for TPA cross section –photo acoustic spectroscopy, PAS in gaseous medium, Roseneweig and Greshow theory, Thermally thin, thick samples, Typical experimental set up, Application in Spectroscopy,

Unit III

Stimulated Raman scattering, Quantum mechanical treatment, Raman Oscillation Parametric instabilities, Electromagnetic theory of SRS.Vibronic interaction, Herzberg Teller theory, Fluorescence spectroscopy, Kasha's rule, Quantum yield, Non-radioactive transitions, Jablonski diagram, Time resolved fluorescence and determination of excited state lifetime.Light detectors, Single photon counting technique, Phase sensitive detectors.

Unit IV

Matrix isolation spectroscopy, Fourier transforms spectroscopy, Laser cooling. Molecular symmetry and group theory, Matrix representation of symmetry elementsof a point group, Reducible and irreducible representations, and character tables specially for C_{2v} and C_3 point group molecules, Normal coordinates normal modes, Application of group theory to molecular vibrations.

Text Book and References:

1. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.
2. Quantum electron – A. Yariv.
3. Introduction to non-linear laser spectroscopy – M. D. Levenson.
4. Photoacoustics and its applications, Roseneweig.
5. J. M. Hollas, High resolution spectroscopy.
6. Cotton, Chemical Applications of Group Theory.
7. Herzberg, Molecular spectra and molecular structure II and III.
8. Demtroder, Laser spectroscopy and instrumentation.
9. King, Molecular spectroscopy.
10. Lakowicz, Principles of fluorescence spectroscopy.
11. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.

Semester IV Paper 15 (Core Elective E2.5) Applied Electronics II

Unit – I:

An Overview of Electronic Communication system ; block diagram of an digital electronic Communication system, Pulse modulation systems, sampling theorem, lowpass and band-pass signals,PAM channel bandwidth for a PAM signal, Natural sampling, flat top sampling, signal recovery throughholding, quantization of signals, quantization, differential PCM delta modulation, adoptive delta modulation CVSD. Digital modulation techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK. Mathematical representation of noise, sources of noise, frequency domain representation of noise, Noise in Pulse Code and Delta modulation system, PCM transmission, calculation of quantization of noise, out pit signal power effect of thermal noise, outr signal to noise ratio in PCM, DM, quantization noise in DM, out put signal power, DM oput-put, signal to quantization noise ratio, effect of thermal noise in delta modulation, output signal to noise ratio in DM.

Unit – II

Computer communication systems: Types of networks, design features of communication network,examples, TYMNET, ARPANET, ISDN, LAN.Mobile radio and satellite - time division multiplex access (TDMA) frequency division multiplex access(FDMA) ALOHA, Slotted ALOHA, Carrier sense multiple access (CSMA) Poisson distribution protocols.

Unit – III

Microprocessor and Micro-computers: Microprocessor and architecture, Pin out and pin functions of 8086/8088 Internal microprocessor architecture, bus buffering and latching ,Bus timings, ready and wait states, minimum mode versus and maximum mode. Real and protected mode of memory addressing, memory paging, addressing modes, data addressing modes, programme memory addressing mode, stack memory addressing modes, instruction sets, data movement instruction, arithmetic and logic instruction, programme control instruction, clock generator (8284A),

Unit –IV

Memory and I/O Interface : Memory devices, ROM,RAM.,DRAM, SRAM, Address decoding , 3 to 8 line decoder 74LS138, 8086, and 80386(16 bits) Memory interface, , Introduction to I/O interface , Interfacing using 8255, Introduction to PIT 8254, Basic Communication device(UART) pin diagram and functioning of 16550 Interrupts: Basic interrupt processing, Hardware interrupt, expanding the interrupt structure, 8259A PIC.

Text and Reference books.

1. Principles of communication systems :Taub and Schilling (ii Edn THM ,1994)
2. Principles of communication systems: Taub and Schilling GoutamSaha Third Edition
3. Communication systems : Simon Haykin (iii Edn John Wiley & Sons)
4. The intel microprocessors 8086/80188,80386,80486, Pentium and Pentium processor architecture, programming and interfacing : Barry B. Brey (PHI iv Edn, 1999)
5. Microprocessor and interfacing ,programming and hardware : Douglas V. Hall (ii Edn, McGrawHill International edn. 1992)
6. The 80x86 IBMPC compatible computer: Muhammad Ali Maxidi and J .G. Mazidi (ii Edn.Prentice –Hall International.)

Semester IV Paper 16 (Foundation course F2.1) Spectroscopic applications

Unit-I

Principle of spectroscopic instruments, UV-VIS visible: Absorption of light, radiation sources, sample holder, monochromator, radiation detectors, samples holder, monochromator, radiation detector, single and double beam experiment.

Infrared and Raman spectroscopy, predicting number of active modes of vibration, analysis of representative spectra of metal complexs with various functional groups at the coordination sites, organic and inorganic functional group identification through IR spectroscopy.

Unit-II

NMR phenomenon, spin ½ nuclei, (^{1}H, ^{13}C, ^{31}p and $^{1}9F$), ^{1}H NMR, Zeeman splitting, effect of magnetic field strength on sensitivity and resolution, chemical shift , chemical and magnetic equivalence of spins, spin-spin coupling constant J.

Electronic spectroscopy, basic principle, electronic transitions in organic, inorganic and organometalic molecules and application to structure elucidation.

Unit-III

Electron paramagnetic resonance (EPR) spectroscopy of inorganic and organic compounds with unpaired electrons, determination of electronic structure, Zeeman splitting, g values hyoerfine and superhyperfime coupling constant.

Mossebauer spectroscopy-Mossebauer effect, recoilless emission and absorption, hyperfine interaction, chemical isomer shift, magnetic hyperfine and quadrupole interaction and interpretation of spectra.

Unit-IV

Mass spectroscopy, basic principles, ionization techniques, isotope abundance, molecular ion, high resolution MS, soft ionization methods, ESI-MS and MALDI-MS, illustrative example from macromolecules and supramolecules studies of inorganic/coordination and organometallic representative compounds.

Text books

1 Electronic paramagnetic transitions of metal ions, A Abragam, B Bleaney, Oxford University Press, 1970.

2. Physical methods for chemist, R S Drago, Saundevis 1992.

3.Fundamentals of molecular spectroscopy, C. N. Bawell and E.M. Mc cash, 4^{th}ed, MCGRAW-Hill, 1994.

4.NMR spectroscopy, H. Gunther, 2^{nd} edition John Wileny and Sons, 1995.

Semester IV Paper 16 (Foundation course F2.2) Optics and Optical Instruments

Unit-1

General theory of image formation, Cardinal points of an optical system, thick lens and lens combination, telescopic combinations, telephoto lens and eyepieces, Abration in images; chromatic aberration, monochromatic aberration and their reductions, aspherical mirrors and correction plates, meniscus lens, entrance and exit pupil, need for multiple eyepiece, Ramsden and Huygens eyepiece, microscope and telescope, astronomical telescope.

Unit-2

Principal of superposition, coherence optical path retardation, fringes in thin film, localized fringes, two slit interference, Newton's rings and applications, Michelson interferometer and its applications,

Diffraction; Fresenel type- half period zone, rectilinear propogation, straight edge, Fraunhofer type-Diffraction at a slit, half period zone, circular aperature , plane transmission, reflection, blazed and concave grating, resolving power of grating, Raileigh criterion of resolution, resolving power of prism and grating.

Refraction- refraction in uniaxial crystal, double image prism, plane, circular and elliptical polarized light, Nicols prism, optical rotation in liquid crystals.

Unir-3

Optical instruments- magnifying glass, principal of pho camera, pinhole, lens and SLR camera, video camera, angular magnification, aperature, camera lucida, collimator and compound microscope, lens, periscope, binocular, field glass, jeweler's glass, projector, eyeglasses and its principal, prism spectroscope.

Unit-4

Holography: Importance of coherence, Principle of holography and characteristics, Recording and reconstruction, classification of hologram and application, non-destructive testing, optical fibre waveguides (step index, graded index, single mode), attenuation in fibre, couplers and connectors, LED,

X-ray –Principal and process of X-ray image (radiographs) production, factors affecting radiographs, Computed Tomography, principal and working of fluoroscopy, principal and working of CT-scanning, Ultrasound, working principal, imaging by us waves, Doppler ultrasound, magnetic resonance imaging, its working principal.

References;

1. Optics by Ajay Ghatak
2. Fundamental of optics by Jetkins and white
3.Optics and spectroscopy by R. Murugeshan, kiruthignsivaprakash.
4.Basic physics of X-ray imaging, Carl A Carlsson and Gudrun AlmCarlsson, 1996
5.Collaborative radiology by Chales De Kahn, 2013