SEMESTER IV

M4PHY01-CT11: Nuclear and Particle Physics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks Internal: 20 marks
Lectures: 40hrs Tutorials: 10hrs
Additional Contact Hours : 10 (seminars, quiz, assignments, group discussion etc.)

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

UNIT-I

Properties of stable nuclei (4L)
Nuclear Size: Different type of radii and brief discussion of methods to determine radii., spin and magnetic moment of nuclei, Quadrupole moment of nuclei.

Nuclear Force and Two body problem (4L)
Ground state of deuteron: Ground state wave function, Nucleon-Nucleon scattering: Qualitative discussion of n-p and p-p scattering cross section

UNIT-II

Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces, isospin, exchange nature of nuclear force. (3L)

Nuclear Model (5L): Liquid Drop Model, Evidence of shell structure, single- particle shell model, its validity and limitations; Brief discussion of Nuclear Collective model

UNIT-III

Nuclear Reactions (5L): Nuclear Reactions: Energy considerations, Cross section for nuclear reactions : statistical considerations. Compound Nucleus & Direct reactions, Nuclear fission and fusion (brief discussion), Neutron scattering cross section (brief discussion)

Alpha Decay (3L)
Range and disintegration energy, Geiger Nuttal law, Fine structure of alpha spectrum

UNIT-IV

Beta Decay (4L): Beta particles: experimental information, neutrino hypothesis, Fermi theory of

beta decay, Fermi Kurie plot, Brief survey of *ft* values : allowed and forbidden transitions, Non-conservation of parity in beta decay, Helicity of Neutrino.

Gamma Decay (4L): Electromagnetic transitions in nuclei, Gamma ray transition probability: (qualitative study only), Internal conversion of gamma rays (qualitative study only), Brief discussion of Angular correlation of gamma rays

UNIT-V

Introduction to Particle Physics (8L) : Classification of Elementary Particles, Particle interactions. Brief survey of different types of elementary particles (Electrons, protons, neutrons, mesons, hyperons and their anti-particles). Conservation laws. Spin and parity assignments, isospin, strangeness. C, P, and T invariance and applications of symmetry arguments to particle reactions. Parity non-conservation in weak interactions

Tutorials (10 T hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Reference Books:

1. Fundamentals of Nuclear Physics, Varma, Bhandari and Somayajulu, CBS, New Delhi 2005
2. Nuclear Physics, D. C. Tayal, Himalaya Publishing House

M4PHY02-CT12: Experimental Techniques in Physics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks Internal: 20 marks

Lectures: 40hrs Tutorials : 10 hrs

Additional Contact Hours : 10 (seminars, quiz, assignments, group discussion etc.)

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

UNIT-I

Sensors & transducers (8L): Mechanical and Electromechanical sensors: Strain Gauge, inductive and capacitative sensors. Thermal Sensors and measurement of temperature: Resistance change, thermo-emf, junction semiconductor, thermal radiation. Magnetic Sensors: Magnetic resistive, Hall effect, inductive and eddy current based sensors. Opto- electronic devices: Solar cells, LED, Photo detectors. Radiation detectors: GM detector, Scintillation, Semiconductor pin detector.

UNIT-II

Analog Signal Processing (8L): Signal classifications, functions in analog signal processing, Errors in signal processing, Signal conditioning, Recovery & Conversion, Sample and hold circuits, Impedance matching, filtering and noise reduction, shielding and grounding, Analog to Digital Conversion, Digital to Analog Conversion, Box-car integrator, modulation techniques, Phased locked Loop, lock-in detector, Lock in Amplifier,

UNIT-III

Vacuum Techniques and Thin Films (8L): Introductory vacuum concepts: System volume, leak rates, pumping speed, conductance and measurement of system pressure. Vacuum Pumps: Rotary, Diffusion pumps, UHV pumps and materials for UHV, measurement of vacuum, surface preparation and cleaning procedure. Thin film preparation techniques: Thermal evaporation, sputtering, ion-beam, molecular epitaxial and chemical vapor methods.

UNIT-IV

Digital Imaging and Basics of Imaging techniques (8L): Field effect Transistors, homo and hetro-junction devices: device structure, characteristics, frequency dependence and applications,

Charge coupled Devices and its applications, Microscopic techniques in Physics (Field Ion Microscopy, Scanning Tunneling Microscopy, Electron Microscopy: Principle, typical experimental setup and measurement).

UNIT-V

Mass spectroscopy (2L): Principle, spectrometer, and its operation, resolution, Mass spectrum, applications.

Physical Property Measurements of Solids (6L): Experimental techniques for measurement of Heat capacity, Electrical resistance of metals, thermal conductivity and magnetic susceptibility (Principle, typical experimental setup and measurement).

Tutorials (10 T)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Reference Books:

1. Sensors &Transducers by D. Patranabis, PHI, New Delhi
2. Analog Signal Processing by Ramón Pallás-Areny, John G. Webster, Wiley
3. Vacuum Science and Technology by VV Rao, TB Ghosh and KL Chopra, APL, New Delhi
4. Advanced Experimental techniques in Modern Physics by KM Varier, A Jodrph and PP Pradyumnan, PP, New Delhi
5. Microscopy Techniques for Material Science by Ashley Clarke, Colin Nigel Eberhardt, CRC press
6. Experimental techniques in low-temperature physics, by Guy Kendall White, Philip J. Meeson, Oxford University Press
7. Lecture Notes by the Eminent Teachers and Instrument Manuals available on www.google.com

M4PHY03-ET03A : FUNDAMENTALS OF NANOSCIENCE

UNIT I INTRODUCTION

Nanoscale Science and Technology - Implications for Physics, Chemistry, Biology and Engineering - Classifications of nanostructured materials - nano particles - quantum dots, Nanowires – ultra – thinfilms - multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS

Bottom-up Synthesis -Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARACTERISATION TECHNIQUES

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques - AFM, SPM, STM, SNOM, ESCA, SIMS - Nanoindentation.

TEXT BOOKS: 1. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996)

2. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES: 1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999

2. Akhlesh Lakhtakia (Editor) The Hand Book of Nano Technology, “Nanometer Structure”, Theory, Modeling and Simulations. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course M4PHY03-ET03B Atmospheric Physics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks | Internal: 20 marks

Lectures: 40hrs | Tutorials: 10hrs

UNIT-I

Radiative transfer in the atmosphere(8L):

Temperature of the sun and spectral distribution of solar radiation, blackbody radiation budget of radiation energy, Passage of solar radiation through the atmosphere, atmospheric windows, emissivity, absorption spectra of atmospheric gases, optically thick and thin approximation, aerosol, scattering, calculation of radiative heating and cooling, terrestrial radiation and its passage through the atmosphere.

UNIT-II

Atmospheric thermodynamics(8L):

Laws of thermodynamics, Lapse rate, thermodynamic equations entropy change water-air mixture, moisture variables, potential temperature, virtual temperature, thermodynamic diagram, dry and moist static energy, static stability, convective instability.

UNIT-III

Basic equations of atmospheric dynamics(8L):

Equations of motion in spherical coordinates, rotating frame, coriolis force, quasistatic approximation, scale analysis, Rossby number, balanced flow, natural coordinate system, equations of continuity in spherical and Cartesian coordinates. Thermodynamic energy equations, pressure as vertical coordinate.

UNIT-IV

Cloud microphysics(6L):

Cloud forms and characteristics, formation and growth of precipitation particles, terminal velocity, thunderstorms, artificial rain making.

UNIT-V

Atmospheric Circulation(8L):

Circulation, Vorticity, divergence and deformation Circulation theorems and applications, Barotropic and baroclinic fluids, dynamic instabilities.

Tutorials (10 T hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Reference Books:

Physical meteorology, H.G. Houghton, 1985
Atmospheric Sciences : an introductory survey, J.M. Vallace and P.V. Hobbs, Acad. Press, 1977.
A short course on cloud Physics, R.R. Rogers, 1979.
An introduction to dynamic meteology, J.R. Holton, Acad. Press, 1979.
Introduction to Theoretical Meteorology, S.L. Hess, 1959.
Atmospheric Waves, T. Beer, Wiley, 1974.
Atmospheric Tides, Chapman and Lindzen, Riedel, 1969.

M4PHY03-ET03C: Microwave Electronics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks Internal: 20 marks
Lectures: 40hrs Tutorials : 10 hrs
Additional Contact Hours : 10 (seminars, quiz, assignments, group discussion etc.)

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

Unit-I

Introduction (1hr): Introduction to microwaves and its frequencies spectrum, Necessity of microwaves and their applications

Wave Guides:
(a) **Rectangular wave guides (3hrs):** Wave equation & its solutions, TE and TM modes. Dominant mode and choice of wave guide dimensions, Methods of excitation of wave guide, Power transmission and power losses.
(b) **Circular wave guides (4hrs):** Wave equation and its solutions, TE, TM and TEM modes, Power transmission and power losses.

UNIT-II

Resonators (3hrs): Resonant modes of rectangular and cylindrical cavity resonators, Q of the cavity resonators, Frequency meter, Dielectric resonators
Striplines (3hrs): Introduction to mircostrip lines, Characteristic impedance of microstrip lines, Losses in microstrip lines, Quality factor of microstrip lines, Basics of parallel and coplanar strip lines.
Transferred electron devices (2hrs): Gunn effect, Differential negative resistance, Two-valley model theory (No derivation), Microwave generation using Gunn diode.

UNIT-III

Microwave linear beam tubes (8hrs): Space charge spreading of an electron beam, Beam focusings, Velocity modulation, Two cavity Klystron, Reflex Klystron and efficiency of Klystrons,

Slow wave structure of helix TWT, Amplification process and working principle of TWT.

UNIT-IV

Microwave crossed field tube (4hrs): Types and description, Theoretical relations between electric and magnetic field of oscillations for magnetrons. Modes of oscillations and operating characteristics of magnetrons. Construction and working principle of Gyrotron.

Ferrites (4hrs): Microwave propagation in ferrites, Faraday rotation, Devices employing Faraday rotation (isolator, gyrator, circulator). Introduction to single crystal ferromagnetic resonators.

UNIT-V

Microwave test equipment (5hrs): Measurement of power, frequency, attenuation, impedance and VSWR. Reflectometer, Antenna measurements and radiation pattern.

Complex permittivity of materials and its measurement (3hrs): Definition of complex permittivity of solids, Dielectric properties of materials using shift of minima method.

Tutorials (10 T hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Reference Books:

1. Microwave devices and circuits by Samuel Y. Liao (Pearson).
2. Microwaves by M.L. Sisodia & Vijay Laxmi Gupta (New Age International).
3. Microwave Devices and Applications by Dinesh C. Dube (Narosa).
4. Foundations of Microwave Engineering by R.E. Collin (McGraw Hill).
5. Electromagnetic Waves & Radiating System-Jorden & Balmain (PHI Learning).
6. Theory and Applications of Microwaves A.B. Brownwell & R.E. Beam (Mc Graw Hill).
7. Introduction to Microwave Theory by Atwater (McGraw Hill).
8. Principles of Microwave circuits by G.C. Montogmetry (McGraw Hill).

M4PHY04-ET04A : Materials Science

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks Internal: 20 marks
Lectures: 40hrs Tutorials : 10 hrs
Additional Contact Hours : 10 (seminars, quiz, assignments, group discussion etc.)

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

UNIT-I

Phase diagrams (10L):

Definitions and basic concepts. Solubility limit. Phases, microstructure. Phase equilibria. Equilibrium phase diagram. Binary isomorphous systems. Interpretations of phase diagrams. Binary eutectic systems. Development of microstructures in eutectic alloys. The Fe-Fe; C phase diagram, Development of microstructures in iron-carbon alloys.
Phase transformations: Kinetics of phase transformation, metastable vs equilibrium states.

UNIT-II

Ceramics (5L):

Ceramic structure, ceramics density calculations, Silicate Ceramics, imperfections in ceramics, ceramic phase diagram of Al_2O_3-Cr_2O_3 system, Brittle fracture of ceramics, stress, strain behaviours (qualitative)

Glasses (5L)

Properties of glasses, glass forming. Heat treating glasses glass ceramic. Clay products. Characteristics of clay. Composition of clay products. Refractories. Abrasives, Cement.

UNIT-III

Polymers (8L):

Hydrocarbon molecules. Polymer molecules. The chemistry of polymer molecules. Molecular weight and shape. Molecular structure. Molecular configuration. Stress-strain behaviour. Thermoplastic and thermosetting polymers, viscoelasticity. Deformation of elastomers. Impact strength, fatigue, strength and hardness.

UNIT-IV

Composites: Particles Reinforced composites, large particles composites, dispersion strengthened composites, Fiber Reinforced Composites: Influence of fiber length, orientation and concentration. The Fiber phase, matrix phase, Polymer-matrix, Metal-Matrix, Ceramic-Matrix Composites,

Carbon-Carbon composites, laminar composites, sandwich panels.

UNIT-V

Magnetic Materials (8L):

Soft magnetic materials, hard magnetic materials, qualitative discussion of magnetic thin films, multilayers - DMS, GMR, CMR (no derivations). Magnetic nanoparticles, Measurement of Particle size density- porosity- lattice constant using X-ray. Working principles of magnetic characterization using Mössbauer spectroscopy (qualitative discussion only), and VSM (Low and high field magnetic field and temperature) (qualitative discussion only).

Tutorials (10 hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Text Book:

1. Material Science and Engineering : An Introduction : William D. Callister Jr., John Wiley & Sons.
2. Introduction To Magnetic Materials 2nd Edition: Cullity and Graham
3. Jagdish Varma, Roop Chand Bhandari, D.R.S. Somayajulu : Fundamentals of Nuclear Physics

Course M4PHY04-ET04B : Ionospheric Physics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks | Internal: 20 marks

Lectures: 40hrs | Tutorials: 10hrs

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

UNIT-I

Ionosphere propagation and measurement techniques (8L)

Effect of Ionosphere on radiowave propagation, Refraction, Dispersion and polarization, Magnetoionic theory, critical frequency and virtual height, Oblique propagation and maximum usable frequency, Ground based techniques : ionosondes, radars, scintillation and TEC, ionospheric absorption, rocket and satellite borne techniques: Langmuir probe, electric field probe mass spectrometer.

UNIT-II

Ionospheric Plasma Dynamics (8L):

Basic Fluid equations, steady state ionospheric Plasma motions due to applied forces, generation of Electric field mapping, collision frequencies, Electrical conductivities, Plasma diffusion, Ionospheric dynamo, Sq current system, Equatorial Electrojet & EIA.

UNIT-III

Airglow and its measurement(8L)

Night glow, Dayglow, Twilight glow, Aurora, Photometers, Spectrometers and imagers for airglow measureent, applications of Airglow measurement for ionospheric dynamics and composition.

UNIT-IV

Ionospheric Plasma irregularities(8L):

E-region irregularities associated with electrojet, Sporadic-E, Auroral electrojet and associated irregularities, F-region irregularities, Equatorial Spread F and its various manifestations. Airglow depletions and plasma bubbles, Ground based, rocket borne and satellite based measurement techniques for these irregularities. Theories of ESF.

UNIT-V

Ionospheric modeling and models (8L):

IRI, SUPIM, TIGCM, PIM. Brief introduction to ionospheres of Mars, Venus and Jupiter.

Tutorials (10 T hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

Reference Books:-

1. Aeronomy of the Middle Atmosphere , Guy Brasseur and Susan Solomon.
2. Electromagnetic waves and Radiating System , Jordan
3. Antennas and Radio Wave Propagation , R.E. Collin.
4. Electronics Communication Systems, B.P.Lathi.
5. Electronics Communication , Kennedy.
6. Introduction of Ionospheric Physics, Risbeth and Garriot.

Course M4PHY04-ET04C : Astronomy and Astrophysics

*(**Note**: At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)*

External: 80 Marks | Internal: 20 marks
Lectures: 40hrs | Tutorials: 10hrs

Note: Candidates whose attendance is less than 75% will be awarded zero marks in the Internal

UNIT-I

Introductory Concepts (8L)

Basic parameters in Astronomical observations (Magnitude scales , Coordinate system), Stellar classification -H.R. Diagram , Saha's equation , Jean's criteria for stellar formation, Galaxy classification

Cosmology : Cosmological models , observations , cosmic violence (in nucleus of the Galaxy), Cosmic back-ground radiation, Elementary particles and cosmos, Big-Bang.

Model of inflationary Universe (flatness and horizontal problem), Relativistic and Cosmic geometry of space – time and universe.

UNIT-II

Optical and near IR studies of Stars and Galaxies (8L)

Optical Telescopes with CCD's -High angular Resolution Techniques (Speckle, Lunar Occultation adaptive optics). Interferometry with Telescopes.

Spectral Energy Distribution (in optical Bands) in Stars, Rotation of stars, Study of Binary Stars, Gaseous Nebulae.

Extinction curve of interstellar matter, dust-Rotation, Curve of galaxies, Spectral Energy Distribution, Colour studies (Imaging of galaxies in Different bands).

UNIT -III

High Energy astronomy (8L)

Atmospheric transmission, Detection Techniques for X-rays and Gamma-rays, X-ray-Telescopes with imaging and Spectroscopy -Radiation Processes in Accretion Disks around Black Holes and X-rays Binaries -Active Galactic Nuclei.

UNIT-IV (8L)

Dark Matter: Evidences of dark matter – Dark matter components in our galaxy, in Halos of the spiral galaxy, in clusters of candidates in dark matter. Baryonic and non-Baryonic candidates in dark matter.

Radio Telescopes – Radio Interferometry. Very long Base Interferometry (VLBI) of Radio Pulsars, Radio galaxies – Distribution of HI gas in Galaxies – Radiation mechanism

UNIT-V (8L)

Black hole Observation, Gravitational lens, Schwarzschild radius, Singularity, X-rays and Gamma rays bursts through cosmic flux detection using photo-multiplier tubes.
Hubble's law and Hubble's constant (Red shift, distance, age of the Universe Measurements) – Galactic Structure – Rotation and spiral (Optical, radio, X-rays, Gamma radiation observation).

Tutorials (10 T hrs)

Examples and problems from Reference books will be listed in the Lecture schedule as Tutorials and assignments

REFERENCES:

1. Solar Astrophysics by Peter V. Foukal.
2. Galaxy Formation (second edition) by Malcolm S. Longair.
3. Fundamentals of solar Astronomy by Arvind Bhattnagar and William livingston.
4. The Fundamentals of Stellar Astrophysics by George W. Collins, II .
5. Stellar Astrophysics by R.Q. Haung , K. N. yu.
6. Advanced Stellar Astrophysics by William Kenneth Rose.
7. Introduction to Stellar Astrophysics by Erika Bohm- Vitense.
8. Quasars and Active Galactic Nuclei by Ajit K. Kembhavi and Jayant Vishnu Narlikar.
9. Astrophysics Stars and Galaxies by K.D. Abhyankar.
10 The Sun by Michael Stix.
10. Spectropolarimetry by Jean Stein Flow.

M4PHY05-CP06 : Modern Physics Laboratory

1. To study random events for a Co-60 source using a G.M. counter
2. To determine end point energy of beta-particles of the given radioactive source
3. To study absorption coefficient of lead for cobalt 60 gamma rays using G.M. counter
4. To calibrate the given scintillation counter and measure the energy emitted by an unknown radioactive source
5. To calibrate the given scintillation counter and calculate the resolution of the counter using Cesium-137 source
6. To determine the d value, Miller indices (h,k,l) and calculate the lattice constant ‘a’ for Silicon
7. To determine the d value, Miller indices (h,k,l) and calculate the lattice constant ‘a’ for and KCl
8. To determine the d value, Miller indices (h,k,l) and calculate the lattice constant ‘a’ for and NaCl
9. To determine the d value, Miller indices (h,k,l) and calculate the lattice constant ‘a’ for and Al

M4PHY06-EP0XX: Practical Based on Electives

M4PHY06-EP03A: Fundamentals of Nanoscience
M4PHY06-EP03B: Atmospheric Physics

M4PHY06-EP03C : Microwave Electronics Laboratory

1. Study the mode characteristics of reflex Klystron and to determine the mode number, transit time, ETR and ETS.
2. Determine the wavelength and frequency of microwaves produced by Klystron source.
3. Determine the wavelength and frequency of microwaves produced by Gunn diode source.
4. Study of the V-I characteristic of a Gunn diode and to measure its power.
5. Determine the dielectric constant of given dielectric material using reflex Klystron.
6. To study the radiation pattern of given antenna by plotting polar graph and find out 3 dB parameters.
7. To determine the low, medium and high voltage standing wave ratio using Klystron tube.
8. Bragg's diffraction based experiments using microwaves.
9. To study substitution method for the measurement of attenuation and to study variation in attenuation with the frequency.
10. To study square law behavior of a microwave crystal detector and hence to determine operating range and detection efficiency.

Reference books:

1. Basic Microwave Technique and Laboratory Manual by M.L. Sisodia and G.S. Raghuvanshi (Wiley Eastern Limited).
2. Microwave Engineering by D. M. Pozar (John Wiley & Sons Inc).
3. Microwave Engineering by A. Das and S. K. Das (Tata McGraw-Hill)

M4PHY06-EP04A : Materials Science Laboratory

1. To calculate the average particle size of the given sample from the given TEM micrograph

2. To index the XRD spectrum, calculate the lattice parameter (a_0) and determine the average size by the Scherrer method of the given sample

3. To measure the density and hence calculate the porosity of the given sample

4. To calibrate the given Mössbauer spectrum and hence determine the magnetic hyperfine field of Fe

5. To calibrate the given Mössbauer spectrum and hence determine the isomer shift and electric field gradient of the given sample

6. To determine the magnetic parameters (saturation magnetization, coercivity, retentivity) of the given ferromagnetic sample
7. Determination of g-value of electron using ESR
8. Measure resistivity of a semi-conductor at different temperatures by Four Probe method
9. Measurement of magnetic susceptibility of a paramagnetic solution by Quincke's method.
10. Determination of the Curie temperature of the given ferrite sample.
11. Study of the surface of the given sample using AFM

M4PHY06-EP04B: Ionospheric Physics
M4PHY06-EP04C: Astronomy and Astrophysics
M4PHY06-EP02P: Project Work

M4PHY07-SP02E: Skill Enhancement Course :

Programming in C

(At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensure questions are set within scope of the syllabus)

External: 80 Marks Internal: 20 marks
Contact hours: 40hrs

Note:

a. The practical aspects of the course must be taught as laboratory instructions using computers.
b. Teacher is required to ensure that students carry out the computer implementation of the algorithm/program in the laboratory as a part of this course.
c. Five assignments and five internal assessments (practical), one from each unit are to be carried out

UNIT - I

Algorithm development: Steps in program design, Problem identification, algorithms, flow chart, top-down and bottom up design.

BASICS OF C: Structure of a C program, C tokens, identifiers, character set, keywords, basic I/O data types and sizes. Constants, variables, special symbols

UNIT – II

Operators: Arithmetic, relational and logical operators, increment and decrement operators, conditional operator, assignment operators, expressions, bit wise operators

Conditional statements: Two-way: if, if- else, null else, nested if, Multi-way : switch, else-if.

UNIT – III

Iterative: Loops - for, while and do-while, break, continue, initialization and accessing, nested loops, exit ( ), goto statements

UNIT – IV

Functions: built-in and user-defined functions function declaration, parameter passing- call by value & call by reference, recursive functions.

Storage classes - auto, extern, global and static.

UNIT – V

Array: one dimensional and multi-dimensional array, array handling, passing arrays to functions, arrays and strings, string-handling functions.

Recommended books :

- *Yashavant* P. *Kanetkar,Let us C*
- *E Balagurusamy, Programming In Ansi C*

LIST OF SAMPLE PRACTICAL PROGRAMS:
Note: Students are required to perform all the experiments.

Unit 1

1. C Program Print Hello Word
2. C Program Declaring Variable and Printing its Value
3. C Program to perform arithmetic operation.
4. C Program to Calculate Area and Circumference of Circle
5. C Program to Calculate Area of Rectangle
6. C Program to Calculate Area of Square
7. C Program to Convert temperature from degree centigrade to Fahrenheit
8. C Program to Swap of two no's without using third variable

Unit -2

1. C Program to check enter number is even or odd
2. C program to check enter year is Leap year or not
3. C Program to check enter character is vowel or consonant.
4. C Program to Find greatest in 3 numbers
5. C Program to Calculate sum of 5 subjects and Find percentage
6. C Program to Find the simple interest.
7. C Program to Solve Second Order Quadratic Equation.

Unit-3

1. C Program to Print First 10 Natural Numbers
2. C Program to Even number Series
3. C Program to Odd number Series
4. C Program to Find Factorial of Number
5. C Program to print Fibonacci series
6. C Program to Print table of n and square of n using pow()
7. Check Whether Given Number is Palindrome or Not
8. C Program to Check Whether Number is Prime or not
9. C Program to Check for Armstrong Number in C
10. C Program to Check Whether Number is Perfect Or Not

Unit-4

All programs of Units 1, 2 and 3 implemented by Function

Unit-5

1. C Program to delete duplicate elements in an array
2. C Program to calculate Addition of All Elements in Array
3. C program to find Smallest Element in Array in C Programming
4. C Program to find Largest Element in Array in C Programming
5. C Program to reversing an Array Elements in C Programming
6. C Program to Searching element in 1-D array
7. C program for addition of two matrices of 3*3
8. C Program to Addition of Diagonal Elements in Matrix
9. C Program to Addition of All Elements in Matrix
10. C Program to Multiply Two 3 X 3 Matrices
11. C Program to find transpose
12. C Program to find addition of Lower Triangular Elements
13. C program to calculate sum of Upper Triangular Elements in C
14. C Program to evaluate Subtraction of two matrices (matrix) in C