BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH 362263

SYLLABUS

Faculty of Science

M.Sc. - Physics

Semester – III

Under Choice Based Credit System (CBCS)

Effective From June - 2019

Syllabus

MASTER OF SCIENCE

SEMESTER – III

PHYSICS

Choice Based Credit System (CBCS)

M.Sc. PHYSICS
(CBCS)
Semester- III

DEPARTMENT OF PHYSICS
Bhakta Kavi Narsinh Mehta University Junagadh

Effective from June 2019

M. Sc. (Physics) Program
Choice Based Credit System
(CBCS)
Semester-I to IV

The Master of Science (M.Sc.) PHYSICS programme with Choice Based Credit System (CBCS) comprises of total **16 theory papers** classified as TWELVE core (compulsory) theory papers, FOUR elective (optional) theory papers to be selected out of 12 elective papers. It is to be noted that out of the 12 core compulsory papers, two papers *"Physics and Chemistry of nano-materials"* and "*Experimental Techniques with interdisciplinary applications"* are of *interdisciplinary nature* so that the students of Chemistry, Bio-sciences, Electronics and Pharmaceutical sciences can take these courses. The students will get a choice to select any two elective theory papers out of a set of six elective theory in semester-3 and two elective theory papers in semester-4 out of the six offered elective papers. However, the Department will offer a set of elective papers at the beginning of third and fourth semester depending upon the availability of teachers in the Department. In each semester, there will be 4 theory papers and one Practical course. Examination in each theory paper will be of 2½ hours duration and will carry 70 marks and each practical and/or project examination of 3 hours duration and of 200 marks. This 200 marks will consist of 150 marks for the practical's and/or project and 50 marks for Viva-voce.

As regards the Practical's, the students shall perform general practical's during Semester-I to IV. The students may also be allowed to perform Project work in Semester-IV which can be experimental or theoretical. The students can also take-up in-depth and detailed study of a specific topic in Physics as a project work. In case of project work the students are required to submit a dissertation (project report) at the end of Semester-IV and also required to make presentation of the project work during practical examination. In Semester-IV for the students taking up projects, the bifurcation of marks for practical's examination will be as follows: Practical (75 marks) + Project work (75 marks) + Viva voce (50 marks) = 200 marks.

The educational tour will be conducted for the students for exposure to the advanced technology, equipments and research facilities in national laboratories, institutes and industries in accordance with their study of elective papers, interdisciplinary papers and projects upon receiving proposal for educational tour from the concerned teachers.

The M. Sc. (Physics) CBCS Course is full time and is divided into 4 semesters (2 years) Grant of term (admission to examination) will be based on satisfactory attendance as per the University rules. The Course Structure of the M. Sc. (Physics) CBCS Program Semester-I to IV is summarized as follows:

The Course Structure of the M.Sc. (Physics) Program Semester-I to IV
M.Sc. Physics Four Semester course: Total Credits: 96 Total marks: 2400

Semester I	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Courses - 1 – 4	16	16	400
PRACTICALS	Practical Course – 1 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester II	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Courses - 5 – 8	16	16	400
PRACTICALS	Practical Course – 2 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester III	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Course - 9	04	04	100
	Core Theory Course - 10	04	04	100
	Elective Courses 1 - 2	08	08	200
PRACTICALS	Practical Course – 3 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester IV	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Course-11	04	04	100
	Core Theory Course-12	04	04	100
	Elective Courses 3 - 4	08	08	200
PRACTICALS AND PROJECTS	Practical Course – 4 (includes Practicals and/or Project work)	08	08	200
	Total	**24**	**24**	**600**
		Total	**96**	**2400**

Theory Papers

The titles of the core theory papers and elective theory papers are given below. The core theory papers (CT-1 to CT-12) are compulsory for all the students.

The Department shall announce a set of six Elective theory papers to be offered on the beginning of Semester-III and IV. A student can choose any two elective theory papers out of a set of six elective papers in Sem-3 and similarly two elective papers out of a set of six elective papers. However, number of elective theory papers will be offered depending upon the availability of expert faculty members.

A student shall study total 16 theory papers during the M.Sc. Physics four semester programme.

Titles of Core Theory Courses CT1 – CT12 (Compulsory for all students) and Elective papers (ET1 to ET12).

Semester: 1

CT1	Mathematical Physics and Classical
CT2	Mechanics Solid State Electronic Devices and
CT3	Circuits Quantum Mechanics - 1
CT4	Electrodynamics and Plasma Physics

Semester: 2

CT5	Quantum Mechanics - 2 and Statistical Mechanics
CT6	Atomic and Molecular Physics
CT7	Space Physics
CT8	Solid State Physics

Semester: 3

CT9	Nuclear and Particle Physics
CT10	Physics and Chemistry of Nano-materials

Six Elective Theory Papers: (a student has to select any two out of the following)

ET1	Synthesis of Materials
ET2	Physics of ionosphere-magnetosphere system
ET3	Space Technology
ET4	Analog and Digital Systems
ET5	Nuclear Radiation Detectors & Accelerators
ET6	Neutron Physics and Nuclear Reactor Theory

Semester: 4

CT11	Numerical Analysis and Computer Programming
CT12	Experimental Techniques with interdisciplinary applications

Six Elective Theory papers: (a student has to select any two)

ET7	Materials Characterization
ET8	Functional Materials
ET9	Remote sensing and Applications
ET10	Pulse & Microwave Electronics
ET11	Electronic Communications
ET12	Nuclear Reactions, Nuclear Energy and Nuclear Models

FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Core Paper: CT-9: Nuclear and Particle Physics

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Nuclear and Particle Physics (CT-9)
Course (Paper) Unique Code: 1603010902030900
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Core	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **08 hrs**

Basic nuclear properties – Nuclear mass, charge and size – Intrinsic angular momentum of a nucleus – Dynamic properties of nuclei – nomenclature – Nuclear binding energy – Average binding energy per nucleon and saturation of nuclear forces-separation energy systematic – Abundance systematic of stable nuclides

Unit 2 **09 hrs**

Liquid drop model- Semi empirical mass formula – mass parabola – liquid drop model of fission – experimental evidences for shell effects – shell model – spin orbit coupling model– magic numbers – angular momenta and parities of nuclear ground states

Unit 3 **10 hrs**

Beta decay – introduction – modes of beta decay- conditions for spontaneous emission of beta decay- neutrino hypothesis – decay constant for beta decay- Fermi‟s theory of beta decay – shape of beta spectrum – life time and classification of beta decay – Allowed and forbidden transitions – selection rules – parity non conservation in beta decay - electron capture decay – detection and properties of neutrino

Unit 4 **07 hrs**

Gamma decay – energetics of gamma decay – interaction of gamma rays with matter – internal conversion

Nuclear reactions – introduction – conservation laws – non relativistic Q – equation – types of nuclear reactions - cross sections

Unit 5 **06 hrs**

Elementary particles – interaction of charge particles with matter - leptons – hadrons – elementary particle quantum numbers – isospin - symmetry and conservation laws – Quarks – charm, bottom and top quarks – fundamental interactions

References Books:

1. Elements of Nuclear Physics, L.E. Mayerhof, Tata Mc Graw Hill, 1959
2. Concepts of modern physics, Arthur Beiser, Mc Graw Hill Inter. 1987
3. Nuclear structure, A.Bohr and B.R. Mottelson, Vol.1 (1969) & Vol.2, Benjamin Reading A.(1975)
4. Introductory Nuclear Physics, Kenneth S. Kiane, Wiley, New York, 1988
5. Atomic and Nuclear Physics, Vol.2 ,Ghoshal
6. Introduction to High Energy Physics, P.H. Perkins, Addison-Wesley, London, 1982
7. Nuclear Physics Vol. 1 & 2, Shirokov Yudin,Mir Publishers, Moscow, 1982
8. Introduction to Elementary Particles, D. Griffiths,Har4per and Row, New York, 1987
9. Introduction to Nuclear Physics, H.A. Enge, Addision-Wesley, 1975
10. Nucleon – Nucleon Interaction, G.E. Brown and A.D. Jackson, North – Holland, Amsterdam 1976
11. Nuclear Interaction, S. de Benedetti, Hohn Wiley &Sons, New York, 1964
12. Theory of Nuclear Structure, M.K. Pal, Affiliated East West Madras, 1982
13. Introductory Nuclear Physics, Y.R. Waghmare, Oxford – IBH, Bombay, 1981
14. Elementary Particles, J.M. Longo, Mc Graw Hill, New York, 1971
15. Atomic Nucleus, R.D. Evans, Mc Graw Hill, New York, 1955
16. Nuclear Physics, I. Kaplan, 2nd Ed., Narosa, Madras, 1989
17. Concepts of Nuclear Physics, B.L.Cohen, TMGH, Bombay, 1971
18. Nuclear Physics, R.R. Roy and B.P. Nigam, Wiley-Eastern Ltd. 1983

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Core Paper: CT-10: Physics and Chemistry of Nanomaterials

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Physics and Chemistry of Nanomaterials (CT-10)
Course (Paper) Unique Code: 1603011002031000
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Core	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **06 hrs**

Nanomaterials and Nanotechnology

Introduction, Scientific Revolutions, Basic Science, Nanotechnology, Materials at Nanoscale, Quantum Confinement, Size Effects, Size and Shape Matter

Unit 2 **10 hrs**

Carbon in the Nanoworld

Introduction, Graphite, Diamond, Fullerenes, Graphene, Carbon Nanotubes – Structure, Types, Properties, Growth and Applications

Prime Materials in Nanotechnology

Introduction, Natural and Man–Made, Semiconductors – ZnO and TiO_2, Ceramics, Polymers, Composites, Metals – Silver, Gold, Iron and Copper, Biomaterials

Unit 3 **06 hrs**

Nanofabrication

Introduction, Synthesis Categories, Top–Down Fabrication Methods – Arc Discharge, Laser Ablation, Ball Milling and Inert Gas Condensation, Bottom–Up Fabrication Methods – Homogeneous Nucleation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol – Gel, Hydrothermal and Microwave, Challenges in Fabrications

Unit 4 10 hrs Nanomaterial Characterization Techniques Structural Characterizations

X-Ray Diffraction (XRD), Small Angle X-ray Scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM)

Chemical Characterizations

Optical Spectroscopy, Electron Spectroscopy, Photoelectron Spectroscopy (PS), Vibrational Spectroscopy, Ionic Spectroscopy: RBS, SIM, FIB Dynamic Light Scattering (DLS)

Physical Properties (Overview)

Mechanical, Optical, Electrical Conductivity, Magnetic

Unit 5 **08 hrs**

Applications of Nanomaterials

Molecular and Nano Electronics

Molecular Motors, Molecular Devices, Single Molecular Devices

Nanotribology

Nanotribometer, Surface Force Apparatus, Quartz Crystal Microbalance, Superlubricity, Hard Disk Capacity, Micro-Electromechanical Systems (MEMS)

Nanosensors

Nanoscale Organization, Quantum Size Effects, Electrochemical Sensors, Nano-Bio-Sensors, Future

Nanomedicines

Developments, Various Nanosystems in use, Diagnostic and Therapeutic Applications

References Books:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by Guozhong Cao, Imperial College Press (Distributed by World Scientific Publishers, Singapore)
2. Nanotechnology: The Science of Small by M.A. Shah and K.A. Shah, WILEY

(2013)
3. Nano - The Essentials: Understanding Nanoscience and Nanotechnology by T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi
4. Nanophysics and Nanotechnology by Edward C-Wolf, Wiley – VCH
5. Introduction to Nanotechnology by Charles P. Poole Jr. and Frank J. Owens, Wiley Interscience
6. Introduction to nano-science & nano-technology by K.K.Chattopadhyay and A.N. Banerjee, PHI
7. Nanoscience and Nanotechnology: Fundamental to Frontiers by M.S. Ramachandra Rao & Shubra Singh, Wiley India Pvt. Ltd. (2013)
8. Nanotechnology by S. Shanmugam, MJP Publishers

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-1: Synthesis of Materials

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Synthesis of Materials (ET-1)
Course (Paper) Unique Code: 1603011102031101
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **08 hrs**

Physical Methods

Solid State Reaction (Ceramic) Method

General Principles, Experimental Procedure: Reagents, Mixing, Container Material, Heat Treatment, Analysis, Kinetics of Solid State Reaction, Disadvantages

Microwave Synthesis

Background & General Principle, Preparation of $YBa_2Cu_3O_{7-\delta}$ Superconductor through Microwave Synthesis, Importance

Unit 2 **08 hrs**

Chemical Routes

Sol-gel Method

Principle, Lithium Niobate ($LiNbO_3$), Doped Tin Dioxide

Co-precipitation Method

Co-precipitation as a precursor to Solid State Reaction, Advantages & Disadvantages, Synthesis of CMR Manganites

Unit 3 **08 hrs**

Thin Film Synthesis

Vacuum Evaporation, Sputtering, Spin Coating, Pulsed Laser Deposition (PLD)

Unit 4 **10 hrs**

Growth of Single Crystals

Introduction to Methods of Growth of Crystals, Czochralski Method, Bridgman and Stockbarger Methods, Zone Melting and Zone Refining Methods, Impurity Leveling Factor, Verneuil Method, Molten Flux Method

Unit 5 06 hrs Vapor Phase Transport Methods and Thin Film Growth

Hydrothermal Methods, Vapor Methods, Fundamental of Epitaxial Growth of Thin Layers

References Books:

1. Solid State Chemistry and its Applications
   Anthony R. West (John Wiley & Sons, Singapore)
2. Solid State Chemistry – An Introduction
   Lesley E. Smart and Elaine Moore (Viva Books Private Limited)
3. Solid State Chemistry
   R.C. Ropp (Elsevier)
4. Reactions and Characterization of Solids
   Sandra E. Dann (The Royal Society of Chemistry)
5. Magnetic Ceramics
   Raul Valenzuela (Cambridge Uni. Press)
6. New Directions in Solid State Chemistry
   C. N. R. Rao and J. Gopalakrishnan (Cambridge Uni. Press)
7. Hand Book of Thin Film Technology
   K. L. Chopra (MacGrow Hill)
8. Thin Film Fundamentals
   Goswami A. (New Age International)
9. Hand Book of Thin-Film Deposition Processes and Techniques
   Krishna Seshan (Noyes Publications)
10. Crystal Growth – A Tutorial Approach
    Eds. W. Bradsley, D.T.J. Hurle & J. B. Mullin (North Holland)
11. Crystal Growth Processes & Methods
    P. Santhana Raghavan, P. Ramasamy (KRU Publications)

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-2: Physics of Ionosphere-Magnetosphere System

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Physics of Ionosphere-Magnetosphere System (ET-2)
Course (Paper) Unique Code: 1603011202031202
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **10 hrs**

Ionospheric Plasma motions due to applied forces, generation of Electric field, collision frequencies, charged particle motion, response to neutral air wind and electric field, Electrical conductivities

Unit 2 **08 hrs**

Ionospheric conductivity, Ionospheric electric currents, Sq current system, EEJ Peculiarities of low latitude ionosphere, ionospheric storms, irregularities (ESF, scintillation and EEJ irregularities), EIA

Unit 3 **08 hrs**

Aurora and Airglow: Night glow, Dayglow, Twilight glow, Aurora, Photometer for airglow measurement, applications of Airglow measurement for ionospheric dynamics and composition

Unit 4 **10 hrs**

Magnetosphere: Circulation in the magnetosphere, magentospheric electric fields, particles in the magnetosphere, plasmasphere and its dynamics, magnetospheric current system, magneto pause current tail current ring current and Birlkeland current

Unit 5 **04 hrs**

Magentospheric substorms, substorm triggering and influence of IMF, substorm currents, Whistlers, micro pulsations

References Books:

1. The solar terrestrial environment – J K Hargreaves, CUP
2. Space Plasma Physics – A C Das, Narosa Publications
3. Introduction to Ionosphere and Magnetosphere: J.A. Ratcliffe (CUP)
4. Introduction Space Physics: M.J. Kievelson (CUP)

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-3: Space Technology

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Space Technology (ET-3)
Course (Paper) Unique Code: 1603011302031303
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **12 hrs**

Orbital dynamics, Control and Guidance

Spherical coordinate system, Kepler‟s laws, sub satellite point, orbital parameters, sun-synchronous and geo-synchronous orbits, low earth orbits, attitude sensors, sun sensors, star sensors, earth sensors, magnetic aspect sensors, accuracies, spin stabilization and gyros, control of flight path, closed loop guidance, altitude control system

Unit 2 **06 hrs**

Power Generation and Storage

Space craft power system, special power sources, solar cells and panels, nuclear power, thermoelectric power generation, fuel cells, primary and secondary batteries, controlled harcware

Unit 3 **08 hrs**

Rocketry

Principles of Rocketry, sounding rockets, launchers, rocket fuels, combustion and thrust generation, solid and liquid propellent motors, electric propeulsion, multistage rockets

Unit 4 **10 hrs**

Ground based Experimental Techniques

Ionospheric sounding, Partial reflection, Scintillation and TEC measurements, airglow photometer, Volume scattering, Coherence and Incoherent scatter, Incoherent scatter radar, MST radar, LIDAR

Unit 5 04 hrs Space borne Experimental Techniques

Langmuir probe and derivatives, Impedance and resonance probe, Mass spectrometers

References Books:

1. The Solar-Terrestrial environment, J.K. Hargreaves, CUP, 1992
2. Spacecraft system engineering – P Fortescue et al , Wiley

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-4: Analog and Digital Systems

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Analog and Digital Systems (ET-4)
Course (Paper) Unique Code: 1603011402031404
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **08 hrs**

The Basic Operational Amplifier

Block diagram representation of typical op-amp, Schematic symbol IC packages, Op-amp data sheet and op-amp electrical parameters, ideal op-amp, equivalent circuit of op-amp, ideal voltage transfer curve, open loop configurations, Op-amp with negative feedback: Feedback configurations, voltage series feedback amplifier (non-inverting amplifier with feedback), voltage shunt feedback amplifier (inverting amplifier with feedback)

Unit 2 **08 hrs**

Op-amp Circuits

Summing, Scaling and averaging amplifiers, subtractor, Integrator, differentiator, Active filters, first order low pass and high pass butterworth filters, Band-pass, Band reject and all pass filters, Phase shift and Wien bridge oscillators, Voltage controlled oscillator, Comparator, zero crossing detection, Voltage limiters

Unit 3 **08 hrs**

Combinational Logic Circuits

Implementation with gates, design procedure, designing binary adder and subtractor, BCD to Excess – 3 code converter

Implementation with MSI & LSI

Parallel binary adder, carry propagation delay and look ahead carry generator, 4-bit magnitude comparator, decoders, BCD to seven segment decoder, multiplexers

Unit 4 08 hrs Sequential logic circuits

Flip-flops, Buffer registers, shift registers, bi-directional shift register, Ring counters, binary counters, Ripple counters, Synchronous counters, Counters with MOD number less than 2N, presettable counter, decade counter

Unit 5 **08 hrs**

A/D and D/A Converters

Digital to analog conversion, R-2R ladder network, Analog to digital conversion, open-loop methods, flash converter, time window converter, tracking A/D converter, successive approximation converter

References Books:

1. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI
2. Digital Electronics : Christopher Strangio ,PHI
3. Fundamentals of Digital Circuits : Anadkumar, PHI
4. Digital Logic and Computer Design : M. Morris Mano, PHI
5. Digital Systems : Principles and Applications : Ronald Tocci, PHI

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-5: Nuclear Radiation Detectors & Accelerators

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Nuclear Radiation Detectors & Accelerators (ET-5)
Course (Paper) Unique Code: 1603011502031505
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-3

Course Content

Unit 1 **09 hrs**

Ionizing Radiations
Ionization and transport phenomena in gas – Avalanche multiplication
Detector Properties
Detection – Energy measurement – Position measurement Time measurement
Gas Counters
Ionization chambers – Proportional counters – Multiwire proportional counters – Geiger – Muller counters

Unit 2 **07 hrs**

Solid State Detectors

Semiconductor detector – Surface barrier detectors

Scintillation Counters

Organic and inorganic scintillation – Theory, characteristics and detection efficiency

Unit 3 08 hrs High Energy Particle Detectors

General principles – Nuclear emulsions – Cloud chambers – Bubble chambers – Cerenkov counter - Neutron Detectors & Spectroscopy

Unit 4 08 hrs Historical Developments

Different types of accelerators –Layout and compoents of accelerators – Accelerator applications

Linear Accelerators

Historical milestones, Fundamental properties of accelerating structures Particle acceleration by EM waves

Unit 5 08 hrs Principle and Design Details of Accelerators

Basic principle and design details of accelerator viz electrostatic, electrodynamic resonant with special emphasis on microtron, pelletron and cyclotron – Synchrotron radiation sources – Spectrum of the emitted radiation and the applications

References Books:

1. Nuclear Radiation Detectors S.S. Kapoor and V.S. Ramamurthy, Wiley – Eastern, New Delhi 1986
2. Radiation Detection, W.H. Tait, Butterworths, London, 1980
3. Nuclear Radiation Detection, W.J. Price, Mc Graw Hill, New York, 1964
4. Accelerator Physics, S.Y. Lee, World Scientific, Singapore, 1999
5. Principles of Cyclic Particle Accelerators, J.J. Livingood, D. Van Nostrand Co. 1961
6. Particle Accelerators, J.P. Blewett, McGraw Hill Book Co.
7. The Microtron, S.P. Kapitza and V.N. Melekhin, Harwood Academic Publishers
8. Particle Accelerators and Their Uses, W. Scharf, Harwood Academic Publishers
9. Theory of Resonance Linear Accelerators, I.M. Kapchinskyu, Harwood Academic Publishers
10. Linear Acccelerators, P. Lapostole and A. Septier, North Holland

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-III

Elective Paper: ET-6: Neutron Physics and Nuclear Reactor Theory

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Neutron Physics and Nuclear Reactor Theory (ET-6)
Course (Paper) Unique Code: 1603011602031606
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	3	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Course Content

Unit 1 **06 hrs**

Neutrons and its Interaction with Matter

Nuclear cross section – Microscopic cross section – Macroscopic cross section – Cross section for mixtures

Unit 2 **10 hrs**

Slowing Down of Neutrons

Neutron moderation by elastic scattering – Collision kinematics – Differential elastic scattering cross section – Isotropic scattering – Average energy loss per collision and average cosine of scattering angle – Double differential scattering cross section – Description of the dynamics of elastic collision in terms of lethargy – Average lethargy gain – Slowing down power and moderation ratio – Average logarithmic energy decrement

Unit 3 **08 hrs**

Diffusion of Neutrons

Transport theory – Diffusion theory approximation – Calculation of neutron leakage – The diffusion equation – Solution of the diffusion equation – Boundary conditions – The linear extrapolation distance – Diffusion of mono-energic neutrons from a point source – The diffusion length

Unit 4 10 hrs The Fission Chain Reaction and Nuclear Reactors

Self sustained chain reaction and reactor criticality – Critical Size and critical mass of a reactor – The multiplication factor – Approximate kinetics of chain reaction – Neutron life cycle and four factor formula – An infinite system – finite system – Nuclear reactors – Classification – General features – Efficiency – thermal reactors

Fuel Depletion and Poisoning Effects

Fuel depletion and its consequences – Fission product poisoning – Xenon poisoning – Samarium poisoning

Unit 5 06 hrs Radiation Protection and Environmental Effects

Radiation hazards – Different types of radiation – External and internal radiation sources – Radiation Units – The Roentgen and the Rad – The Rem

Biological Effect of Radiation

Somatic effects of radiation – Genetic effects of radiation

References Books

1. Physics of nuclear reactors, S Garg, F. Ahmed, L.S. Kothari, Tata-McGraw Hill
2. Nuclear reactor engineering, S.Glasstone and A. Sesonske, CBS publisher & distributors
3. Introduction to nuclear reactor theory, J.R. Lamarash, Addison Wesely

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BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH 362263

SYLLABUS

Faculty of Science

M.Sc. - Physics

Semester – IV

Under Choice Based Credit System (CBCS)

Effective From June - 2019

Syllabus

MASTER OF SCIENCE

SEMESTER – IV

PHYSICS

Choice Based Credit System (CBCS)

M.Sc. PHYSICS
(CBCS)
Semester-IV

DEPARTMENT OF PHYSICS
Bhakta Kavi Narsinh Mehta University Junagadh

Effective from June 2019

M. Sc. (Physics) Program
Choice Based Credit System
(CBCS)
Semester-I to IV

The Master of Science (M.Sc.) PHYSICS programme with Choice Based Credit System (CBCS) comprises of total **16 theory papers** classified as TWELVE core (compulsory) theory papers, FOUR elective (optional) theory papers to be selected out of 12 elective papers. It is to be noted that out of the 12 core compulsory papers, two papers *"Physics and Chemistry of nano-materials"* and "*Experimental Techniques with interdisciplinary applications"* are of *interdisciplinary nature* so that the students of Chemistry, Bio-sciences, Electronics and Pharmaceutical sciences can take these courses. The students will get a choice to select any two elective theory papers out of a set of six elective theory in semester-3 and two elective theory papers in semester-4 out of the six offered elective papers. However, the Department will offer a set of elective papers at the beginning of third and fourth semester depending upon the availability of teachers in the Department. In each semester, there will be 4 theory papers and one Practical course. Examination in each theory paper will be of 2½ hours duration and will carry 70 marks and each practical and/or project examination of 3 hours duration and of 200 marks. This 200 marks will consist of 150 marks for the practical's and/or project and 50 marks for Viva-voce.

As regards the Practical's, the students shall perform general practical's during Semester-I to IV. The students may also be allowed to perform Project work in Semester-IV which can be experimental or theoretical. The students can also take-up in-depth and detailed study of a specific topic in Physics as a project work. In case of project work the students are required to submit a dissertation (project report) at the end of Semester-IV and also required to make presentation of the project work during practical examination. In Semester-IV for the students taking up projects, the bifurcation of marks for practical's examination will be as follows: Practical (75 marks) + Project work (75 marks) + Viva voce (50 marks) = 200 marks.

The educational tour will be conducted for the students for exposure to the advanced technology, equipments and research facilities in national laboratories, institutes and industries in accordance with their study of elective papers, interdisciplinary papers and projects upon receiving proposal for educational tour from the concerned teachers.

The M. Sc. (Physics) CBCS Course is full time and is divided into 4 semesters (2 years) Grant of term (admission to examination) will be based on satisfactory attendance as per the University rules. The Course Structure of the M. Sc. (Physics) CBCS Program Semester-I to IV is summarized as follows:

The Course Structure of the M.Sc. (Physics) Program Semester-I to IV
M.Sc. Physics Four Semester course: Total Credits: 96 Total marks: 2400

Semester I	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Courses - 1 – 4	16	16	400
PRACTICALS	Practical Course – 1 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester II	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Courses - 5 – 8	16	16	400
PRACTICALS	Practical Course – 2 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester III	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Course - 9	04	04	100
	Core Theory Course - 10	04	04	100
	Elective Courses 1 - 2	08	08	200
PRACTICALS	Practical Course – 3 (includes experimental work, data analysis, library work and viva-voce preparation)	08	08	200
	Total	**24**	**24**	**600**

Semester IV	Course	No. of hrs/wk	Credits	Marks
THEORY (includes lectures, tutorials and assignments)	Core Theory Course-11	04	04	100
	Core Theory Course-12	04	04	100
	Elective Courses 3 - 4	08	08	200
PRACTICALS AND PROJECTS	Practical Course – 4 (includes Practicals and/or Project work)	08	08	200
	Total	**24**	**24**	**600**
		Total	**96**	**2400**

Theory Papers

The titles of the core theory papers and elective theory papers are given below. The core theory papers (CT-1 to CT-12) are compulsory for all the students.

The Department shall announce a set of six Elective theory papers to be offered on the beginning of Semester-III and IV. A student can choose any two elective theory papers out of a set of six elective papers in Sem-3 and similarly two elective papers out of a set of six elective papers. However, number of elective theory papers will be offered depending upon the availability of expert faculty members.

A student shall study total 16 theory papers during the M.Sc. Physics four semester programme.

Titles of Core Theory Courses CT1 – CT12 (Compulsory for all students) and Elective papers (ET1 to ET12).

Semester: 1

CT1	Mathematical Physics and Classical
CT2	Mechanics Solid State Electronic Devices and
CT3	Circuits Quantum Mechanics - 1
CT4	Electrodynamics and Plasma Physics

Semester: 2

CT5	Quantum Mechanics - 2 and Statistical Mechanics
CT6	Atomic and Molecular Physics
CT7	Space Physics
CT8	Solid State Physics

Semester: 3

CT9	Nuclear and Particle Physics
CT10	Physics and Chemistry of Nano-materials

Six Elective Theory Papers: (a student has to select any two out of the following)

ET1	Synthesis of Materials
ET2	Physics of ionosphere-magnetosphere system
ET3	Space Technology
ET4	Analog and Digital Systems
ET5	Nuclear Radiation Detectors & Accelerators
ET6	Neutron Physics and Nuclear Reactor Theory

Semester: 4

CT11	Numerical Analysis and Computer Programming
CT12	Experimental Techniques with interdisciplinary applications

Six Elective Theory papers: (a student has to select any two)

ET7	Materials Characterization
ET8	Functional Materials
ET9	Remote sensing and Applications
ET10	Pulse & Microwave Electronics
ET11	Electronic Communications
ET12	Nuclear Reactions, Nuclear Energy and Nuclear Models

FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Core Paper: CT-11: Numerical Analysis and Computer Programming

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Numerical Analysis and Computer Programming (CT-11)
Course (Paper) Unique Code: 1603011702041700
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Core	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-4

Course Content

Unit 1 **10 hrs**

Methods of solving of linear and non-linear algebraic equations, transcendental equations, Convergence of Solutions, Solution of simultaneous linear equations, Gaussian elimination

Finite differences, interpolation with equally spaced and unevenly spaced points, Curve fitting, Polynomial, Least squares and Cubic Spline fitting

Unit 2 **10 hrs**

Numerical differential and integration, error estimates. Numerical solutions of ordinary differential equations – Euler and Runge-Kutta methods
Harmonic Analysis and FFT techniques

Unit 3 **02 hrs**

Elementary information about digital computers, Introduction to compilers and Operating systems

Unit 4 **14 hrs**

Programming introduction to FORTRAN, Flow Charts, Data type and structures, Constants and variables, mathematical Expressions in programming, , built in functions, Input and output statements, Logical control statements(with examples), functions and subroutines , operation with files, formatted input and output

Unit 5 **04 hrs**

Programme of straight line fitting, Programme for numerical integration techniques, Harmonic analysis

References Books

1. Numerical Recipes – (CUP)
2. Computer Programming In FORTRAN 77– Rajaraman , PHI
3. Programming & Computing with FORTRAN 77/90 – P.S. Grover
4. Computer based Numerical analysis – Shanthakumar – Khanna Pub

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Core Paper: CT-12: Experimental Techniques with Interdisciplinary Applications

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Experimental Techniques with Interdisciplinary Applications (CT-12)
Course (Paper) Unique Code: 1603011802041800
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Core	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-4

Course Content

Unit 1 **09 hrs**
Radiation sources, Radiation interactions, Radiation detectors – gas filled detectors – scintillation detectors – semiconductor detectors

Unit 2 **09 hrs**
Introduction to production of X-ray & X-ray spectra, Instrumentation, X-ray generation, collimators, filters, detectors, X-ray absorption methods, X-ray fluorescence methods, XF – Spectrometer (XFS), Electron spectroscopy for chemical analysis (ESCA)

Unit 3 **07 hrs**

Nuclear Magnetic Resonance (NMR) spectroscopy, basic principles, nuclear magnetic energy levels, magnetic resonance, NMR Spectrometer

Electron Spin Resonance spectroscopy, ESR spectrometer, ESR spectra, Hyperfine interactions

Unit 4 **07 hrs**

Mass spectroscopy – principle, spectrometer, and its operation, resolution, Mass spectrum, applications

Infrared Spectroscopy, correlation of IR spectra with molecular structure, Instrumentation

Unit 5 **08 hrs**

Mossbauer Spectroscopy – Mossbauer effect, spectrometer, 57 Fe Mossbauer spectroscopy, nuclear hyperfine interactions

Neutron diffraction, neutron diffractometer (position sensitive diffractometer)

References Books

1. Instrumentation Methods of analysis: VIIth Edition, Willard Meritt, Dean, Settle, CBS publishers & distributors
2. Mossbauer Spectroscopy : Leopold May, Plenum Press, N.Y.
3. Neutron Diffraction: G.C. Becon
4. X-Ray diffraction: B.D. Culity, Edison Weisley
5. Radiation Detection & Measurement: Glenn F. Knoll, McGraw Hill

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-7: Materials Characterization

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Materials Characterization (ET-7)
Course (Paper) Unique Code: 1603011902041901
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-4

Course Content

Unit 1 **09 hrs**

X-ray Diffraction

X-rays and their Generation, Diffraction: Diffraction of Light by an Optical Grating, Crystals and the Diffraction of X-rays, d-spacing & Unit Cell Formulae, Overview of Powder Diffractometer

Effect of Crystal Size on the Powder Pattern; Particle Size Measurement, Effect of Stress on a Powder Pattern, Refinement of Unit Cell Parameters and Indexing of Powder Patterns, A Powder Pattern as a Crystal‟s „Fingerprint‟, Structure Determination from Powder Patterns, Powder Patterns Calculated from Crystal Structure Data, Influence of Crystal Symmetry and Multiplicities on Powder Patterns

Unit 2 **08 hrs**

Imaging Techniques (Microscopy)

Scanning Electron Microscopy (SEM)

Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM, Advantages over conventional SEM, Applications

Transmission Electron Microscopy (TEM)

Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation

Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)

Introduction, Instrumentation, Topography, Profilometry, Sample Requirements

Unit 3 **08 hrs**

Resistivity

Two point-four point probes, Derivation of four point probe expression, Correction factors, Measurement errors and precautions factors:- sample size, Carrier injection, probe spacing, current, temperature, surface preparation, high sheet resistance material, Van der Pauw method – measurement of arbitrary shape samples

Dielectric Study

Dielectric materials, types of polarizability, dielectric behavior with frequency, introduction to Cole- Cole plot, Ferro-electricity, P-E loop

Unit 4 **09 hrs**

UV-Vis

Introduction, principle of UV-vis spectroscopy, Beer-Lambert‟s law, molar absorbility, absorbing species, containing π, σ and η electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications

FT-IR

What is FT-IR, Why IR spectroscopy, Principle of IR spectroscopy, Theory of infrared absorption, vibrational modes, infrared ranges, Typical Instrumentation, use of FT-IR, typical spectral analysis

Unit 5 **06 hrs**

Magnetometry

Basic principle, Vibrating sample magnetometer, SQUID magnetometer

Thermogravimetry

Principle, Apparatus, application, Differential thermal analysis and Differential Scanning Calorimetry, Principles, Apparatus and Applications

References Books

1. Solid State Chemistry and its Applications
   Anthony R. West, John Wiley & Sons, Singapore
2. Characterization of Materials by P.K. Mitra, PHI (2014)
3. Encyclopedia of Materials Characterization
   C. R. Brundle, C. A. Evans, S. Wilson, Butter Worth-Heinemann, Boston
4. Elements of X-ray Crystallography
   L. V. Azaroff, McGraw-Hill Book Company
5. Characterization of Materials
   E. N. Kaufmann, Wiley- Interscience
6. Principles of Instrumental Analysis
   D. A. Skoog and P. M. West
7. Spectroscopy
   B. K. Sharma, Goel Publication
8. Semiconductor Material and Device Characterization
   D. K. Schroder, IEEE, Wiley Interscience
9. Nano: The Essentials Understanding: Nano Science and Nano-technology by T. Pradeep, Tata McGraw Hill
10. Nanotechnology by S. Shanmugam, MJP Publishers
11. Infrared Spectroscopy by Barbara Stuart, Wiley Publication

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-8: Functional Materials

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Functional Materials (ET-8)
Course (Paper) Unique Code: 1603012002042002
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-4

Course Content

Unit 1 **04 hrs**

Fundamental Concepts

Crystallographic Structure, Chemical Structure, Bonding, Concept of Mixed Valances, Material Properties and Functional Characteristics

Unit 2 10 hrs Magnetic Oxide Functional Materials: CMR Manganites

Structure and Chemistry of Mixed Valent Manganites, Concept of Magnetoresistance, Types of Magnetoresistance (MR), Physical Properties and Affecting Parameters, Role of Mn – O Lattice, Zener Double Exchange Mechanism, Jahn – Teller Effect, Phase Diagram of Mixed Valent Manganites, Applications of Manganites

Unit 3 08 hrs Multiferroics (MFs)

Introduction, Types of Ordering, Magnetoelectric Effect, Problem with Multiferroics, Structural – Physical – Chemical Behavior, Types of Multiferroics, Multiferroicity in $BiFeO_3$

Unit 4 10 hrs High Temperature Superconductor (HTSC)

Discovery, Families of HTSC, General Features, Synthesis of YBCO (123) Superconductor and Crystallographic Structure – Property Correlations, Role of Copper and Oxygen, Application of HTSC

Unit 5 **08 hrs**

Ferrites

Fundamentals, Crystal Structures, Synthesis Methods, Properties and Applications, Hard and Soft Ferrites, Ferrites Compositions for Specific Applications

Diluted Magnetic Semiconductor (DMS)

Introduction to Spintronics, Properties and Applications of Spintronics, Origin of Ferromagnetism in DMS: Model Considering Defects, Mean Field Theory and Bound Magnetic Polaron

References Books

1. Functional and Smart Materials by Zhong Lin Wang and Z.C. Kang, Plenum Press, 1998 Plenum Publishing Corp
2. Colossal Magnetoresistance by C.N.R. Rao & B. Raveau World Scientific, Singapore, 1998
3. Superconductivity Today by T.V. Ramakrishnan and C.N.R. Rao University press Hyderabad

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-9: Elective Theory Paper: Remote sensing and Applications

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Elective Theory Paper: Remote sensing and Applications (ET-9)
Course (Paper) Unique Code: 1603012102042103
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks
Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each
Q.2 Answer the following : Any two out of three questions (7 marks each)
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
OR
Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.4 Answer the following : Any two out of three questions (7 marks each)
Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Semester-4

Course Content

Unit 1 **10 hrs**

Elements of Photographic Systems

Early history of Aerial photography, Basic negative to positive photographic sequence, Film exposure, Film density and characteristic curves, structure & Spectral sensitivity of black and white, color and color infrared films, film resolution, Aerial cameras, filters, electronic imaging, multiband imaging

Unit 2 08 hrs Principles of Photogrammetry

Basic geometric characteristics of aerial photograph Photographic scale, Area measurement, Relief displacement of vertical features, image parallax, measurement of object height and ground coordinate, Mapping with aerial photographs

Unit 3 06 hrs Visual Image Interpretation

Fundamentals of visual image interpretation, Basic visual image interpretation equipment, Land use/land cover mapping, Geologic and soil mapping, Forestry mapping, water resources and wetland mapping

Unit 4 **06 hrs**

Multispectral and Thermal Scanning

Across tack and along track scanning, Operating principles of multi spectral scanners, Across track thermal scanning, thermal radiation principles, interpreting thermal scanner imagery, Radiometric calibration of thermal scanners. Temperature mapping with thermal scanner data

Unit 5 **10 hrs**

Digital Image Processing

Introduction, Image rectification and restoration, Image enhancement, contrast manipulation, spatial feature manipulation, image classification, different classification schemes, Classification accuracy assessment, Image transmission and compression

Earth Resources Satellites

Early history of space imaging Landsat 1-4 system, Landsat image interpretation, SPOT satellite program, IRS system, data and applications

References Books

1. Remote sensing and image interpretation. T.M. Lillesand and R.W. Kiefer (4th ed.) John Wiley and Sons, 2002
2. Fundamentals of Remote Sensing – George Joseph Univ. Press

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-10: Pulse & Microwave Electronics Syllabus

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Pulse & Microwave Electronics Syllabus (ET-10)
Course (Paper) Unique Code: 1603012202042204
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each Q.2 Answer the following : Any two out of three questions (7 marks each) Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) OR Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) Q.4 Answer the following : Any two out of three questions (7 marks each) Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Course Content

Unit 1 **08 hrs**

Characteristic of Pulse waveforms, rise time, fall time, duty cycle concept, tilt, R-C circuits, constant rate charging, relationship between rise time and upper cutoff frequency, relationship between fall time and tilt, integrating and differentiating circuits. Clipping and clamping circuits using diodes

Unit 2 06 hrs Schmitt trigger and Ramp generator **:** Circuit operation, designing for a given upper
trigger point (UTP) and lower trigger point (LTP), speed-up capacitor, input and output characteristics, RC ramp generators, constant current ramp generators

Unit 3 **08 hrs**

Transistorised Multivibrators

Astable and Monostable multivibrators, Bistable multivibrator with set-reset triggering
The timer IC-555, functional block diagram, Astable & Monostable multivibrator using IC-555

Unit 4 **10 hrs**

Fundamentals of microwave technology, limitations of vacuum tubes. Klystrons, Two cavity Klystron, Multi-cavity and Reflex Klystrons, Traveling wave tube, Magnetron

Solid-State Microwave Devices

Microwave transistors, Tunnel diodes, Gunn Effect diodes

Unit 5 **08 hrs**

Antennas

Terms and definition, Antenna gain, resistance, beamwidth and polarization, resonant & non resonant antenna, effect of ground on antennas, antenna height, directional high frequency antennas, dipole arrays, Yagi-Uda antenna, Parabolic reflector

Radar

Basic principle, Radar Range equation, Factor influencing maximum range, display methods, moving target indication

References Books

1. Solid State Pulse Circuits, David A Bell, PHI
2. Electronic Communication Systems : George Kennedy TMH
3. Microwave Devices & Circuits, III Edition, Samuel Y. Liao, PHI
4. Electronic communications systems, Wayne Tomasi, Pearson Education

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-11: Electronic Communication

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Electronic Communication (ET-11)
Course (Paper) Unique Code: 1603012302042305
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each Q.2 Answer the following : Any two out of three questions (7 marks each) Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) OR Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) Q.4 Answer the following : Any two out of three questions (7 marks each) Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Course Content

Unit 1 **06 hrs**

Radio wave propagation, propagation in free space, transmission – path, loss, ground-wave propagation, space-wave propagation: radio horizon, sky wave propagation: ionosphere, plasma and critical frequency, secant law and MUF Vertical height, Service range, skip distance

Unit 2 **10 hrs**

Digital communication, Shannon limit for information capacity, digital amplitude modulation, frequency shift keying, FSK transmitter and receiver, Phase shift keying, BPSK, QPSK, Quardrature Amplitude modulation (8-QAM), bandwidth efficiency, Pulse code modulation (PCM)

Unit 3 **08 hrs**

Satellite communication, Orbital and geostationary satellites orbital patterns, look angles, satellite construction, radiation patterns, satellite system link models, transponder, satellite system parameters

Unit 4 **10 hrs**

Transmission lines and waveguides : Equivalent circuit, primary constants, transmission line equations, infinite line, characteristic impedance, secondary constants, open and short circuited line, line with any termination

Waveguides

Rectangular waveguides, Modes, Properties of TE_{10} mode, generating TE_{10} mode from two TEM waves, fields patterns

Unit 5 **06 hrs**

Optical fiber communication, fiber optic communication link, fiber type, cable construction, propagation of light through optical fiber configurations, signle mode and multi mode slip index fiber, graded-index fiber, Acceptance angle and cone, numerical aperture, losses in optical fiber, Light sources and detectors

References Books

1. Electronic Communication Systems, Wyne Tomasi, Pearson Education Asia, II Ed. (2001)
2. Electronic Communication System : George Kennedy TMH
3. Electronic Communications, Dennis Roddy & John Coolen, PHI
4. Modern Electronic Communication, Gray M. Miller & Jeffrey S. Beasley, PHI

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FACULTY OF SCIENCE
M. Sc. (Physics) Semester-IV

Elective Paper: ET-12: Nuclear Reactions, Nuclear Energy and Nuclear Models

Syllabus

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Nuclear Reactions, Nuclear Energy and Nuclear Models (ET-12)
Course (Paper) Unique Code: 1603012402042406
External Examination Time Duration: 2½ hours

Name of Programme	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
M.Sc.	4	Elective	04	30	70	--	100

Total Contact hours: 48 (Including tutorials)

Structure of Question paper for Semester end Examination
Maximum Marks: 70 and Time: 2½ hours
All FIVE questions are of equal weightage: 14 marks Q.1 Answer the following: Any SEVEN out of TEN objective type short questions from whole syllabus, 2 marks each Q.2 Answer the following : Any two out of three questions (7 marks each) Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) OR Q.3 Answer the following : a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory) Q.4 Answer the following : Any two out of three questions (7 marks each) Q.5 Answer the following : Any TWO out of FOUR questions (7 marks each)

Course Content

Unit 1 **08 hrs**

Nuclear reaction characteristics – Reaction energetics Non-relativistic and relativistic Q–equation – Energy correlation analysis – Energy levels in nuclei – Theories of nuclear reactions – Compound nucleus model – Breit – Wigner formula – Resonance scattering and resonance cross sections

Unit 2 **10 hrs**

Mechanism of Nuclear Fission, Fission Cross sections, Fission reactors, Fission Rate & reactor Power, Fission neutrons and gamma rays, prompt neutrons, delayed neutrons, fission gamma rays, Fission products, Amounts and activities of fission products, Fission–product activity after shutdown, Heat generation after shutdown

Unit 3 **07 hrs**

Nuclear Fusion – Thermonuclear reactions – Energy production in stars, Fundamental interactions & elementary particles, Strong, Weak & Electromagnetic interactions

Unit 4 **08 hrs**

Nuclear shell model – Single particle potential – spin orbit potential – analysis of shell model predictions – single particle shell model – total spins J for various configurations (J) – Nuclear isomerism – magnetic moment – configuration mixing – Individual (independent) particle model – Russell Saunders coupling (L-S) coupling – jj coupling scheme – transformation between the L-S and the jj coupling schemes and beta decay

Unit 5 **07 hrs**

Unified (Collective) Model

Introduction – The vibrational modes of a spherical nucleus – Collective modes of deformed even-even nucleus – Symmetries of the collective wave function for well deformed eve-even nuclei – Collective spectral of even-even nuclei

References Books

1. Structure of the Nucleus, M.A. Preston and R.K. Bhaduri, Addison Wesley
2. Nuclear Physics : Theory and Experiments, R. Roy and B.P. Nigam, Wiley Eastern
3. Physics of Nuclei and Particles, P. Marmier and E. Sheldon, Vol.1, Academic Press Physics of the Nucleus, M.A. Preston Addision Wesley
4. Nuclear and Particle Physics, W.S.C. Williams, Clarendon Press
5. Fundamentals of Radiochemistry, D.D. Sood, A.V.R. Reddy, N. Ramamoorthy, Indian association of nuclear chemists & allied scientists

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DEPARTMENT OF PHYSICS, SAURASHTRA UNIVERSITY, RAJKOT

List of Theory papers of M.Sc. Physics programme with their examination-unique codes

Sr. No.	Name of Paper	Unique code
1	Mathematical Physics & Classical Mechanics	1603010102010100
2	Solid State Electronic Devices and Circuits	1603010202010200
3	Quantum Mechanics – I (CT-3)	1603010302010300
4	Electrodynamics and Plasma Physics	1603010402010400
5	Quantum Mechanics – II & Statistical Mechanics	1603010502020500
6	Atomic and Molecular Physics	1603010602020600
7	Space Physics	1603010702020700
8	Solid State Physics	1603010802020800
9	Nuclear and Particle Physics	1603010902030900
10	Physics and Chemistry of Nanomaterials	1603011002031000
11	Synthesis of Materials	1603011102031101
12	Physics of Ionosphere-Magnetosphere System	1603011202031202
13	Space Technology	1603011302031303
14	Analog and Digital Systems	1603011402031404
15	Nuclear Radiation Detectors & Accelerators	1603011502031505
16	Neutron Physics and Nuclear Reactor Theory	1603011602031606
17	Numerical Analysis & Computer Programming	1603011702041700
18	Experimental Techniques with Interdisciplinary Applications	1603011802041800
19	Materials Characterization	1603011902041901
20	Functional Materials	1603012002042002
21	Remote sensing and Applications	1603012102042103
22	Pulse & Microwave Electronics Syllabus	1603012202042204
23	Electronic Communication	1603012302042305
24	Nuclear Reactions, Nuclear Energy and Nuclear Models	1603012402042406