# BHAKTA KAVI NARSINH MEHTA UNIVERSITY
# JUNAGADH 362263

# SYLLABUS


## Faculty of Science

## M.Sc. - Physics

## Semester – I

**Under Choice Based Credit System (CBCS)**

**Effective From June - 2019**

# Syllabus

# MASTER OF SCIENCE

# SEMESTER – I

# PHYSICS

## Choice Based Credit System (CBCS)

## M.Sc. PHYSICS
## (CBCS)
## Semester-I

## 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-I**

**Core Paper: CT-1: Mathematical Physics and Classical Mechanics**

**Syllabus**

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Mathematical Physics and Classical Mechanics (CT-1)
Course (Paper) Unique Code: 1603010102010100
External Examination Time Duration: 2½ hours

| Name of Programme | Semester | Course Group | Credit | Internal Marks | External Marks | Practical /Viva Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| M.Sc. | 1 | 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-1**

**Course Content**

**Unit 1** **07 hrs**

**Ordinary Differential Equations**

Introduction, Solution of Second Order Differential with Variable Coefficients (1) Homogenous Equations (2) Inhomogeneous Equations

Series Integration Method of the Solution of Linear Differential Equations (Frobenius" Method)

**Unit 2** **11 hrs**

**Laplace and Fourier Transforms**

Integral transform, Laplace transform, some simple properties of Laplace transforms (a) linearity property (b) shifting properties, first & second shifting (c) change of scale property

Laplace Transform of Derivatives & Integral, Inverse Laplace Transform by Partial Functions

Fourier Series and Applications. Fourier Transform, Fourier Sine & Cosine Transform Simple Application of Fourier Transform

**Unit 3 08 hrs The Equation of Motion and First Integrals**

Differential Equation for the Orbit, Condition for Closed Orbits, Bertrand‟s Theorem, Kepler‟s Problem, Inverse Square Law of Force, Classification of Orbit‟s, Rutherford Scattering

**Unit 4** **06 hrs**

**Canonical Transformations**

Equation of Canonical Transformation, Example of Harmonic Oscillator, Poisson Brackets Properties of Poisson Brackets, Angular Momentum Poisson Bracket Relation. Virial Theorem

**Unit 5** **08 hrs**

**Hamilton – Jacobi Theory**

Hamilton – Jacobi Theory, Hamilton – Jacobi Equation for Hamilton‟s Principal Function, Harmonic Oscillator Example, Hamilton‟s Characteristic and Principle Functions.

Moving Coordinate System, Coordinate System with Relative Translational Motions, Rotating Coordinate Systems, Coriolis Force, Motion on the Earth

**Reference Books**


1. Mathematical Physics – Rajput
2. Mathematics for Physics – M.L. Boas
3. Mathematical Methods for Physics – G. Arfkan
4. Classical Mechanics – H. Goldstein
5. Classical Mechanics – N.C. Rana and P.S. Joag
6. Introduction to Classical Mechanics – R.G. Takwale & Puranik
7. Classical Mechanics of Particles and Rigid Bodies – Kiran C. Gupta
8. Classical Mechanics – Y.R. Waghmare
9. Classical Mechanics – Bhatia
10. Classical Mechanics – Leech


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**FACULTY OF SCIENCE**
**M. Sc. (Physics) Semester-I**

**Core Paper: CT-2: Solid State Electronic Devices and Circuits**

**Syllabus**

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Solid State Electronic Devices and Circuits (CT-2)
Course (Paper) Unique Code: 1603010202010200
External Examination Time Duration: 2½ hours

| Name of Programme | Semester | Course Group | Credit | Internal Marks | External Marks | Practical /Viva Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| M.Sc. | 1 | 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-1**

**Course Content**

**Unit 1** **08 hrs**

Junction Field Effect Transistors, Comparison with BJT, basic Construction, polarity conventions, Characteristics, JFET parameters, JFET-biasing methods, Common source amplifier,Source-follower,MOSFETS,DE-MOSFETS: Constructionand Characteristics, E-MOSFETS: Construction and Characteristics, Complementary MOS (CMOS)

**Unit 2** **08 hrs**

**Optoelectronic Devices**

Photometry and radiometry units, Classification of optoelectronic devices,, Radiative and non-radiative transitions, Light dependent resistors, , Photo-diode, PIN Photodiode, Photo-transistor, Light emitting diodes, Physics of LED, materials for LED, Liquid Crystal Displays

**Unit 3 10 hrs Solid State Devices for Special Applications**

Zener diode, voltage regulation, Silicon Controlled Rectifier, TRIAC, DIAC, Uni-Junction transistor, UJT-relaxation oscillator, Programmable UJT (PUT), Thermistors, Solar-cells, Semiconductor Laser, population inversion at junction, optical gain and threshold current for lasing

**Unit 4 08 hrs Integrated Logic Families**

Digital IC terminology, The TTL logic family, Loading and fan-out, other TTL series, The ECL logic family, MOS digital ICs, CMOS series characteristics

**Unit 5 06 hrs Combinational logic Circuits Designing Using SSI**

Review of Boolean algebra, Axioms and theorems, Canonical and standard Boolean functions, Designing of combinational logic circuits using gates, Various implementations, Design examples

**References Books**


1. Electronic Circuits: Discrete and Integrated, Donald Schilling & Charles Belove, MaGraw Hill International
2. Electronic devices and circuit theory, Robert Boylestad & Louis Nahselsky, PHI
3. Solid State Devices and integrated circuits, W.D. Cooper Weisbecker, Reston Pub (USA)
4. Solid state Devices & applications, Frederick Driscoll & Robert Coughlin, Prantice Hall
5. Digital Systems: Principles and Applications, Ronald J. Tocci, PHI


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**FACULTY OF SCIENCE**
**M. Sc. (Physics) Semester-I**

**Core Paper: CT-3: Quantum Mechanics – I (CT-3)**

**Syllabus**

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Quantum Mechanics – I (CT-3)
Course (Paper) Unique Code: 1603010302010300
External Examination Time Duration: 2½ hours

| Name of Programme | Semester | Course Group | Credit | Internal Marks | External Marks | Practical /Viva Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| M.Sc. | 1 | 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) |



**Course Content**

**Unit 1** **08 hrs**

One – dimensional harmonic oscillator by Schrodinger equation – power series solution, Plotting of Harmonic oscillator wave functions – classical correspondence – operator methods. Bra and Ket notations, Matrix representation of an operator, The Unitary transformation

**Unit 2** **08 hrs**

Angular momentum commutation relation, coordinate transformation, Angular momentum operators and its eigen value problems in position representation, Spherical harmonics

**Unit 3** **08 hrs**

Solution of Schrodinger equation in three dimension separable variable method, Applications to (I) Square well (II) Attractive coulomb potential (III) Hydrogen Atom

**Unit 4** **08 hrs**

Time independent perturbation theory: Stationary perturbation, Degenerate and no degenerate case, Application such as stark effect. Time dependent perturbation, General formulation and the first order theory, Periodic perturbation and Fermi Golden Rule, Interaction of electromagnetic field with atom

**Unit 5** **08 hrs**

Approximation methods: Variational method and its application. WKB approximation – solution of one – dimensional Schrodinger equation, Conditions at turning points. Application of WKB approximation

**References Books**


1. Quantum Mechanics – Schiff (McGraw Hill)
2. A text book of Quantum Mechanics – Mathews and Venkatesan
3. Quantum Mechanics – Amit Gowsami
4. Fundamental of Quantum Mechanics – Vaghmare
5. Modern Quantum Mechanics – J. J. Sakurai
6. Quantum Mechanics – J. P. E. Peebles
7. Quantum Mechanics – K. K. Chopra, G. C. Agarwal


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**FACULTY OF SCIENCE**
**M. Sc. (Physics) Semester-I**

**Core Paper: CT-4: Electrodynamics and Plasma Physics**

**Syllabus**

Faculty Code: 03 Subject Code: 01 Level Code: 02
Name of Programme: M.Sc. Subject: PHYSICS
Course (Paper) Name & No.: Electrodynamics and Plasma Physics (CT-4)
Course (Paper) Unique Code: 1603010402010400
External Examination Time Duration: 2½ hours

| Name of Programme | Semester | Course Group | Credit | Internal Marks | External Marks | Practical /Viva Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| M.Sc. | 1 | 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) |



**Course Content**

**Unit 1** **08 hrs**

**Maxwell's Equations**

Vector algebra, Introduction to electrodynamics, Electrodynamics before Maxwell, Ampere‟s law, Maxwell equations in matter and boundary conditions

**Unit 2 10 hrs Electromagnetic Waves, Potentials and Fields**

The wave equation for E and B, propagation in linear media, reflection and transmission at normal and oblique incidence, electromagnetic waves in conductors, scalar and vector potentials, Gauge transformations, Retarded potentials, Lienard - Wiechert potentials, the field of a moving point charge

**Unit 3** **08 hrs**

Definition of Plasma, Plasma parameters, criteria for plasma, Applications of Plasma Motion of Charged particle in Uniform B and E fields, non uniform B and E fields, time varying E field, adiabatic invariants

**Unit 4** **07 hrs**

Dielectric constant of Plasma, Fluid equation of Plasma, convective derivative, fluid drifts perpendicular to B, plasma instabilities

**Unit 5** **07 hrs**

Concept of phase and group velocities, plasma oscillations, expression for $\omega_p$, Experimental consequences – Whistler modes, Faraday rotation, Hydro magnetic waves and Magneto sonic or Alfven waves

**References Books**


1. Introduction to Plasma Physics & controlled fusion (II$^{nd}$ edition): Vol. 1: Plasma Physics By F.F. Chen
2. Introduction to electrodynamics, D.J. Griffith (PHI, New Delhi)
3. Plasma Physics by Bittencourt
4. Plasma Physics by Chakraborty


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