Master of Science

M.Sc.

Semester-III & IV

PHYSICS

C.B.C.S

Syllabus

DEPARTMENT OF PHYSICS
SAURASHTRA UNIVERSITY
RAJKOT

June: 2011

Dr. Hiren H. Joshi
Professor & Head,
Department of Physics
Saurashtra University
Rajkot
The syllabi for the CBCS: Sem-I and II have already in force since June 2010.

There are two core papers (CT-9 and CT-10), 12 Elective papers (ET) and 4 interdisciplinary papers (ID) of Sem-III and Sem-IV in CBCS (to be implemented from June-2011) as follows:

The Department will declare the set of elective papers and interdisciplinary papers to be taught in Sem-III and in Sem-IV before commencement of each academic year. The Department will decide a set of Elective and interdisciplinary theory papers to be offered for Semester: III and IV each academic year out of the following list depending upon the availability of expert faculties.

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Dr. Hiren H. Joshi
Professor & Head,
Department of Physics
Saurashtra University
Rajkot
M. Sc. (Physics)
CBCS
Semester-III

Core Theory Paper : CT-9 Nuclear and Particle Physics

Title of Course: Nuclear and Particle Physics
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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)

Detailed Syllabus:

Unit-1

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

Unit-3  
10 hours


Unit-4  
7 hours

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  
6 hours


Reference Books:

- Elements of Nuclear Physics, L.E. Mayerhof, Tata McGraw Hill, 1959
- Introductory Nuclear Physics, Kenneth S. Kiane, Wiley, New York, 1988
- Atomic and Nuclear Physics, Vol.2, Ghoshal
- Nuclear Physics Vol. 1 & 2, Shirokov Yudin, Mir Publishers, Moscow, 1982
- Introduction to Elementary Particles, D. Griffiths, Har 4 per and Row, New York, 1987
- Introduction to Nuclear Physics, H.A. Enge, Addison-Wesley, 1975
- Nuclear Interaction, S. de Benedetti, John Wiley & Sons, New York, 1964
- Introductory Nuclear Physics, Y.R. Waghmare, Oxford — IBH, Bombay, 1981
- Nuclear Physics, I. Kaplan, 2nd Ed., Narosa, Madras, 1989
- Concepts of Nuclear Physics, B.L. Cohen, TMGH, Bombay, 1971
- Nuclear Physics, K.K. Roy and B.P. Nigam, Wiley-Eastern Ltd. 1983
M. Sc. (Physics)
CBCS
Semester-IV

Core Theory Paper : **CT-10**: Numerical Analysis and Computer Programming

**Title of Course:** Numerical Analysis and Computer Programming
**No. of Credits:** 03 + 01 (Tutorial & Assignment) = 04
**Teaching hours:** 40 hrs
**Internal examination, Preparation and evaluation:** 05 hrs

**Total Contact hours:** 45

**Total Marks:** 100
**External marks:** 70
**Internal marks:** 30

**Structure of Semester end Examination:**
**Maximum marks:** 70
**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)

**Detailed Syllabus:**

**Unit-1**

10 hours

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 hours


Unit-3

02 hours

Elementary information about digital computers, Introduction to compilers and Operating system.

Unit-4

14 hours

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 hours

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

Reference Books:

- Numerical Recipes – (CUP)
- Computer Programming In FORTRAN 77 – Rajaraman, PHI
- Programming & Computing with FORTRAN 77/90 – P.S. Grover
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper: ET-I: Synthesis of Materials

Title of Course: Synthesis of Materials
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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 , 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)

Detailed Syllabus:

Unit-I
- Physical Methods:
  (i) Solid State Reaction (Ceramic) Method:
    - General Principles
    - Experimental Procedure: Reagents, Mixing, Container Material, Heat Treatment, Analysis
    - Kinetics of Solid State Reaction
    - Disadvantages
  (ii) Microwave Synthesis:
    - Background
    - Preparation of \( \text{YBa}_2\text{Cu}_3\text{O}_7\) Superconductor through Microwave Synthesis
    - Importance
Unit-2

- Chemical Routes:
  (i) Sol-gel Method:
    - Principle
    - Lithium Niobate (LiNbO₃)
    - Doped Tin Dioxide
    - Silica for Optical Fibers

(ii) Co-precipitation Method:
    - Co-precipitation as a precursor to Solid State Reaction
    - Advantages & Disadvantages
    - Synthesis of CMR Manganites

Unit-3

- Thin Film Synthesis:
  - Vacuum Evaporation
  - Sputtering
  - Spin Coating
  - Dip Coating
  - Pulsed Laser Deposition (PLD)
  - Spray Pyrolysis
  - Chemical Vapour Deposition (CVD)

Unit-4

- Growth of Single Crystals:
  - Czochralski Method
  - Bridgman and Stockbarger Methods
  - Zone Melting
  - Precipitation from Solution or Melt; Flux Method
  - Epitaxial Growth of Thin Layers

Unit-5

- Vapour Phase Transport Methods
- High Pressure & Hydrothermal Methods:
  - Background
  - Hydrothermal Methods
  - Dry High Pressure Methods
Reference Books:

- Solid State Chemistry and its Applications
  Anthony R. West (John Wiley & Sons)
- Solid State Chemistry – An Introduction
  Lesley Smart and Elaine Moore (Viva Books Private Limited)
- Hand Book of Thin Film Technology
  K. L. Chopra (MacGrow Hill)
- Thin Film Fundamentals
  Goswani A. (New Age International)
- Hand Book of Thin-Film Deposition Processes and Techniques
  Krishna Seshan (Noyes Publications)
- Crystal Growth – A Tutorial Approach
  Eds. W. Bradsley, D.T.J. Hurle & J. B. Mullin (North Holland)
- Crystal Growth Processes & Methods
  P. Santhana Raghavan, P. Ramasamy (KRU Publications)
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper: ET-2: Materials Characterization

Title of Course: Materials Characterization
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45
Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
Time: 3½ 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)

Details of Syllabus:

Unit-1

09 hours

X-ray Diffraction:
Introduction, basic principle, Direction of rays, intensity of diffracted X-rays, overview of X-ray diffraction methods.
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, Powder pattern as a fingerprint, Structure determination from powder patterns, Powder pattern calculated from crystal structure data, influence of crystal symmetry and multiplicity on powder pattern.
Electron Diffraction:
TEM, electron diffraction mode, analysis

Unit-2

Electron Microscopy:
SEM: Physical Basis and primary mode of operation, Instrumentation, Sample requirement, application

TEM: Basic Principle, resolution, Sensitivity, TEM Operation, Image mode, Specimen preparation

STM and SFM: Introduction, Instrumentation, topography, profilometry, sample requirements

Unit-3

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 polarizbilities, dielectric behavior with frequency, Introduction to Cole-Cole plot, Ferro-electricity, P-E loop

Unit-4

UV-Vis: Introduction, absorbing species, containing π, σ and η electrons, charge transfer absorption, Typical instrumentations, applications

FT-IR: Theory of infrared absorption, vibrational modes, infrared ranges, Fourier transform infrared, instrumentation, use of FT-IR, typical spectral analysis

Unit-5

Magnetometry: Basic principle, Vibrating sample magnetometer, SQUID magnetometer
Thermogravimetry: Principle, Apparatus, application, Differential thermal analysis and Differential Scanning Calorimetry, Principles, Apparatus and Applications
Reference books:

- Principles of Instrumental Analysis
  D. A. Skoog and P. M. West
- Spectroscopy
  B. K. Sharma, Goel Publication
- Characterization of Materials
  E. N. Kaufmann, Wiley-Intersciences
- Semiconductor Material and Device Characterization
  D. K. Schroder, IEEE, Wiley Interscience
- Solid State Chemistry and its Applications
  A.R. West, John Wiley Publication
- Encyclopedia of Materials Characterization
  C. R. Brundle, C. A. Evans, S. Wilson Butterworths
  Heinmann Boston,
- Nano: The Essentials Understanding :Nano Science and Nanotechnology
  T. Pradeep, Tata McGrawHill
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper: ET-3: Functional Materials

Title of Course: Functional Materials
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester and Examination:
Maximum marks: 70
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).

Detailed Syllabus:

Unit-1

Fundamental Concepts: Crystallographic structure, chemical structure, bonding, concept of mixed valances, material properties and functional characteristics.

04 hrs

Unit-2

Magnetic Oxide Functional Materials: Diluted magnetic semiconductor (DMS): Origin of ferromagnetism, SPINTRONICS- properties and applications, Magnetic and transfer properties of doped ZnO and TiO2. CMR Manganites: Types of magnetoresistance (MR), Mixed valent manganites, Discovery of colossal magnetoresistance (CMR) effect, Physical properties and crystal structures, Phase diagram of LCMO and LSMO magnetaes, Doping studies, device applications.
Unit-3

Multiferroics (MFs): Basics, synthesis of MF materials, types of multiferroics, Magneto Electric (ME) effect, BiFeO₃ (BFO) multiferroics – synthesis, structure, electric and magnetic properties, applications

Unit-4

High Temperature Superconductor (HTSC): Discovery, Families of HTSC, General feature, Synthesis of YBCO (123) superconductor and crystallographic Structure-property correlations, Role of copper and oxygen, application of HTSC

Unit-5

Ferrites: Fundamentals, Crystal structures, Synthesis methods, properties and applications, Hard and soft ferrites, ferrites compositions for specific applications

Reference books:

- Superconductivity Today by T.V. Ramakrishnan and C.N.R. Rao University press Hyderabad
M. Sc. (Physics)
CBCS
Semester-III / IV

Elective Paper: ET -4 : Physics of ionosphere-magnetosphere system

Title of Course: Physics of ionosphere-magnetosphere system
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination,
Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks : 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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 )

Detailed Syllabus:

Unit-1

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

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

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

Unit 4

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

Unit 5

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

Reference Books:

- The solar terrestrial environment – J K Hargreaves, CUP
**M. Sc. (Physics)**

**CBCS**

**Elective Theory Paper: ET-5: Remote sensing and Applications**

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<th>Remote sensing and Applications</th>
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<td>No. of Credits:</td>
<td>03 + 01 (Tutorial &amp; Assignment) = 04</td>
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<tr>
<td>Teaching hours:</td>
<td>40 hrs</td>
</tr>
<tr>
<td>Internal examination, Preparation and evaluation:</td>
<td>05 hrs</td>
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**Total Contact hours:** 45

| Total Marks: | 100 |
| External marks: | 70 |
| Internal marks: | 30 |

**Structure of Semester and Examination:**

Maximum marks: 70

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)

**Detailed Syllabus:**

**Unit-1: Elements of Photographic systems:** 10 hours

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: Principles of photogrammetry:** 08 hours

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: Visual image interpretation: 06 hours
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: Multispectral and Thermal scanning: 06 hours
Across track 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: Digital image processing: 10 hours
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

Reference Books:

M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper : ET-6: Space Technology

Title of Course:  Space Technology
No. of Credits:  03 + 01 (Tutorial & Assignment) = 04
Teaching hours:  40 hrs
Internal examination, Preparation and evaluation:  05 hrs

Total Contact hours:  45

Total Marks :  100
External marks:  70
Internal marks:  30

Structure of Semester end Examination:
Maximum marks: 70
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 )

Detailed Syllabus:

Unit 1 : Orbital dynamics, Control and Guidance:  14 hours
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 : Power Generation and storage:  06 hours
Space craft power system, special power sources, solar cells and panels, nuclear power, thermoelectric power generation, fuel cells, primary and secondary batteries, controlled hardware.
Unit 3: Rocketry: 08 hours
Principles of Rocketry, sounding rockets, launchers, rocket fuels, combustion and thrust generation, solid and liquid propellant motors, electric propulsion, multistage rockets.

Unit 4: Ground based experimental Techniques: 14 hours
Ionospheric sounding, Partial reflection, Scintillation and TEC measurements, airglow photometer, Volume scattering, Coherence and Incoherent scatter, Incoherent scatter radar, MST radar, LIDAR.

Unit 5: Space borne experimental techniques: 06 hours

Reference Books:

- Spacecraft system engineering – P Fortescue et al., Wiley Pub.
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper : ET-7: Analog and Digital Systems

Title of Course: Analog and Digital Systems
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal Examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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)

Detailed Syllabus:

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

03 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

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

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

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.

Reference Books:

- Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI
- Digital Electronics: Christopher Strangio, PHI
- Fundamentals of Digital Circuits: Anadkumar, PHI
- Digital Logic and Computer Design: M. Morris Mano, PHI
- Digital Systems: Principles and Applications: Ronald Tocci, PHI
M. Sc. (Physics)  
CBCS  
Semester-III / IV  
Elective Theory Paper : ET-8: Pulse & Microwave Electronics

Title of Course: Pulse & Microwave Electronics  
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04  
Teaching hours: 40 hrs  
Internal examination: 05 hrs  
Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100  
External marks: 70  
Internal marks: 30

Structure of Semester end Examination:  
Maximum marks: 70  
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)

Detailed Syllabus:

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  
05 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

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

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

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

Reference Books :

- Solid State Pulse Circuits, David A Bell PHI
- Electronic Communication Systems : George Kennedy TMH
- Electronic communications systems, Wayne Tomasi, Pearson Education
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper : ET-9: Electronic Communication

Title of Course: Electronic Communication
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks : 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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 )

Detailed Syllabus:

Unit-1

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

Digital communication, Shannon limit for information capacity, digital amplitude modulation, frequency shift keying, FSK transmitter and receiver. Phase shift keying, BPSK, QPSK, Quadrature Amplitude modulation (8-QAM), bandwidth efficiency
Pulse code modulation (PCM): Sample and hold circuit, dynamic range, companding.
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, single mode and multi mode slip index fiber, graded-index fiber, Acceptance angle and cone, numerical aperture, losses in optical fiber, Light sources and detectors

Reference Books:

- Electronic Communication System; George Kennedy TMH.
- Electronic Communications, Dennis Roddy & John Coolen. PHI
- Modern Electronic Communication, Gray M. Miller & Jeffrey S. Beasley, PHI
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper: ET-10: Nuclear Radiation Detectors & Accelerators

Title of Course: Nuclear Radiation Detectors & Accelerators
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs
Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester and Examination:
Maximum marks: 70
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 )

Detailed Syllabus:

Unit-I
09 hours

Ionizing radiations ; Ionization and transport phenomena in gas – Avalanche multiplication.
Unit-2


Unit-3


Unit-4

Historical Developments: Different types of accelerators – Layout and components of accelerators – Accelerator applications. Linear Accelerators: Historical milestones. Fundamental properties of accelerating structures Particle acceleration by EM waves.

Unit-5

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

Reference Books:

- Principles of Cyclic Particle Accelerators, J.J. Livingood, D. Van Nostrand Co. 1961
- Particle Accelerators and Their Uses, W. Scharf, Harwood Academic Publishers
- Theory of Resonance Linear Accelerators, I.M. Kapchinskyn, Harwood Academic Publishers
- Linear Accelerators, P. Lapostole and A. Septier, North Holland
M. Sc. (Physics)
CBCS
Semester-III / IV
Elective Theory Paper: ET-11: Neutron Physics and Nuclear Reactor Theory

Title of Course: Neutron Physics and Nuclear Reactor Theory
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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)

Detailed Syllabus:

Unit-1
06 hours
Neutrons and its interaction with matter: Nuclear cross section – Microscopic cross section – Macroscopic cross section – Cross section for mixtures.

Unit-2
09 hours
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


Unit-4


Unit-5


Reference Books:

• Nuclear reactor engineering, S.Glassstone and A. Sesonske, CBS publisher & distributors.
• Introduction to nuclear reactor theory, J.R. Lamarash, Addison Wesely.
M. Sc. (Physics)  
CRCS  
Semester-III / IV  
Elective Theory Paper: FT-12: Nuclear Reactions, Nuclear Energy and Nuclear Models

<table>
<thead>
<tr>
<th>Title of Course:</th>
<th>Nuclear Reactions, Nuclear Energy and Nuclear Models</th>
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<tr>
<td>No. of Credits:</td>
<td>03 + 01 (Tutorial &amp; Assignment) = 04</td>
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<td>Teaching hours:</td>
<td>40 hrs</td>
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<tr>
<td>Maximum marks:</td>
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</tr>
<tr>
<td>Time:</td>
<td>2½ hours</td>
</tr>
<tr>
<td>All FIVE questions are of equal weightage:</td>
<td>14 marks</td>
</tr>
</tbody>
</table>

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 )
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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 )

Detailed Syllabus:

**Unit-1**  
08 hours


**Unit-2**  
10 hours

Unit-3

07 hours

Fundamental interactions & elementary particles, Strong, Weak & Electromagnetic interactions.

Unit-4

08 hours


Unit-5

07 hours

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 even-even nuclei – Collective spectra of even-even nuclei.

Reference Books:

- Structure of the Nuclei, M.A. Preston and R.K. Bhaduri, Addison Wesley.
- Nuclear and Particle Physics, W.S.C. Williams, Clarendon Press.
M. Sc. (Physics)
CBCS
Semester-III / IV
Interdisciplinary Theory Paper: ID-1 Electronic Gadgets and Appliances

Title of Course: Electronic Gadgets and Appliances
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination
Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks : 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
Time: 2¾ 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)

Detailed Syllabus:

Unit-1

08 hours

Telecommunication systems: Line system characteristics, Radio system characteristics, telephone receivers and hand sets, signaling, modes of operation, station interconnections, The RS-232 interconnecting cable, Various switching systems for telephony
**Unit-2**

08 hours

Modulation techniques: Analog methods, Amplitude modulation, Frequency modulation, digital methods, ASK, FSK, PSK. Pulse methods: PAM, PWM, PPM, Pulse code modulation (PCM), Multiplexing, Carrier systems: Submarine cables

**Unit-3**

06 hours

Fiber optics: The telephone network, fiber in local loop, optical systems, types of optical fiber, optical fiber advantages and disadvantages

**Unit-4**

08 hours

Why digital? Digital exchanges, local distribution networks, data services, message services, message switching network, packet switching, packet format, LAN, MAN, WAN, ISDN. The internet, Air-line reservations, BAR codes, Automatic Teller Machines (ATMs)

**Unit-5**

10 hours

Mobile radio systems: WLL, Radio paging service, call centres, VHF/UHF radio system, Cellular communications, Digital cellular phone block diagram, Facsimile (FAX), Xerography, Calculators, Digital clocks, Microwave ovens, Washing machines

**Reference Books:**

- **Consumer Electronics**  
  S. P. Bali, Pearson Education
- **Modern Electronic Communication**  
  Gray M. Miller and Jeffrey S. Beasley, PHI
M. Sc. (Physics)
CRCS
Semester-III / IV
Interdisciplinary Theory Paper: ID-2
Physics and Chemistry of Nano-materials

Title of Course: Physics and Chemistry of Nano-materials
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester and Examination:
Maximum marks: 70
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)

Detailed Syllabus:

Unit -1 06 hours
Nanomaterials and Nanotechnology: Introduction, Definitions, Emergence, Fabrication Techniques, Challenges, Size Effects, Classification and Applications

Unit -2 08 hours
Unit -3

Nanomaterial Systems - II: (a) Two-Dimensional Nanostructures (Thin Films): Fundamentals of Film Growth, Vacuum Science, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Super Lattices, Self Assembled Monolayers, Electrochemical Deposition, Sol-Gel Synthesis (b) Special Nanomaterials: Carbon - Fullerenes and Nanotubes, Micro and Mesoporous Materials, Core - Shell Structures, Organic - Inorganic Hybrids, Nanocomposites and Nanograined Materials

Unit -4


Unit -5


Reference Books:

- Nanostructures and Nanomaterials: Synthesis, Properties and Applications by Guozhong Cao, Imperial College Press (Distributed by World Scientific Publishers, Singapore)
- Nanophysics and Nanotechnology by Edward C-Wolf, Wiley – VCH
- Introduction to Nanotechnology by Charles P. Poole Jr. and Frank J. Owens, Wiley Interscience
- Introduction to nano-science & nano-technology by K.K.Chattopadhyay and A.N. Banerjee, PHI

08 hours

10 hours

08 hours
M. Sc. (Physics)  
CBCS  
Semester-III / IV  
Interdisciplinary Theory Paper: ID-3  
Experimental Techniques with Interdisciplinary Applications

Title of Course: Experimental Techniques with Interdisciplinary Applications
No. of Credits: 03 + 01 (Tutorial & Assignment) = 04
Teaching hours: 40 hrs
Internal examination, Preparation and evaluation: 05 hrs

Total Contact hours: 45

Total Marks: 100
External marks: 70
Internal marks: 30

Structure of Semester end Examination:
Maximum marks: 70
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.4 Answer the following: a,b,c/a,b , 5,5,4 OR 7 marks each (all compulsory)
Q.5 Answer the following: Any two out of four questions (7 marks each)

Detailed Syllabus:

Unit-1  
09 hours

Radiation sources, Radiation interactions, Radiation detectors- gas filled detectors – scintillation detectors – semiconductor detectors.

Unit-2  
09 hours

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 hours

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 hours

Mass spectroscopy: principle, spectrometer, and its operation, resolution, Mass spectrum, applications.

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

**Unit-5**

08 hours

Mosbauer Spectroscopy: Mosbauer effect, spectrometer, 57 Fe Mosbauer spectroscopy, nuclear hyperfine interactions.

Neutron diffraction, neutron diffractometer (position sensitive diffractometer).

**Reference Books:**

- Mosbauer Spectroscopy: Leopold May, Plenum Press, N.Y.
- Neutron Diffraction: G.C. Becon
- X-Ray diffraction: B.D. Cullity, Edinson Weisley
- Radiation Detection & Measurement: Glenn F. Knoll
M. Sc. (Physics)  
CBCS  
Semester-III / IV  
Inter Disciplinary Paper: ID-4 : Treatment of Experimental Data

Title of Course: Treatment of Experimental Data  
No. of Credits:03 + 01 (Tutorial & Assignment) = 04  
Teaching hours: 40 hrs  
Internal examination,  
Preparation and evaluation: 05 hrs  

Total Contact hours: 45  
Total Marks : 100  
External marks: 70  
Internal marks: 30  
Structure of Semester end Examination:  
Maximum marks: 70  
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)

Detailed Syllabus:

Unit-1  
Types of data series, time series, plotting and presentation of data, chart types, X-Y scatter, bar, line and pie charts, contours plotting

Unit-2  
10 hours

Characteristics of probability distribution, cumulative distribution, expectation value, standard deviation, distribution moments, the mean variance, the covariance, Binomial distribution, Poisson distribution, Gaussian distribution, Chi Square distribution, Measurements of errors
Unit 3  
04 hours

Sample and parameter estimation, sample moments, the maximum likelihood method, estimator for various distributions, the weighted mean

Unit 4  
10 hours

Example of applications, mean and errors from a series of measurements, combining data with different errors, determination of count rate and errors, use of standard software package with examples

Unit 5  
06 hours

Curve fitting, the least square method, linear fits, linear fit with both variables having errors, non-linear fits, spectral analysis of time series data

Reference Books:

- Techniques of Nuclear and Particle Physics Experiments - W R Leo, Springer-Verlag 1992
- Any reference book on MS Office for chart plotting

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7/3/2011

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