

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. (Tech) Part - II

Applied Physics

(In force from June–2001)

Each paper will be for 75 marks (52/54 external, 23/21 internal) and of three hours duration. There will be three practicals and project work with total marks 200. Each student will have to undergo industrial training for 8 weeks and submit duly certified project report.

Paper – I : Section-I : Subatomic Physics and its applications
Section-II : Instrumentation systems

Paper – II : Section-I : Communication
Section-II : Photonics, Fiber Optics Communication

Paper-III : Section-I : Microwaves
Section-II : Physics in Industry

Paper-IV : Section-I : Microprocessor-I
Section-II : Solid State Devices

Practical, Project Work, Industrial Training.

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Paper – I

Subatomic Physics and Its Applications, Instrumentation Systems

Section - I

Subatomic Physics and Its Applications

Motivation for studying nuclear and particle physics, brief history of development of nuclear and particle physics, study of nuclear physics, cosmology and particle physics.

Fundamental interactions, classification of particles, fermions, bosons, leptons, hadrons (Mesons and baryons), excited states, resonance.

Nuclear properties, nomenclature, symbols, charge, mass, change and potential radii, spin, statistics, isospin, magnetic dipole moment, electric quadrupole moment, binding energy, semiempirical mass formula, nuclear stability.

Symmetries, symmetry breaking and removal of degeneracy, parity charge conjugation, time reversal, G-parity, strangeness and other quantum numbers, CPT theorem (Statement).

Nuclear structure, quarks and leptons, static quark model of hadrons, magnetic dipole moment of baryon, hadron mass and quark – quark interaction.

Application of Dirac's theory to beta decay, Fermi theory and its generalization, double beta decay.

Nuclear models evidence of shell structure, single particle shell model, magic numbers, spin-orbit coupling, Schmidt lines, evidence for collective motion, brief introduction to vibrational and rotational states.

Nuclear reactions, CN formation and breakup, discrete resonances in CN, continuation states of CN, fission, spontaneous fission, fission theories.

Nuclear force saturation property, charge independence, exchange forces, tensor force, symmetry and nuclear force.

Non-conservation parity, need for charm, need for gluons.

Tracer technique, nuclear activation analysis, radiation dose, dose rates from natural and man made sources, effects of radiation, calculation of exposure dose, shielding of radioactive sources, chain reaction, thermal neutron, six factor formula, neutron life cycle, main parts of nuclear reaction, types of

reactors, Gas cooled reactors, LMFBR, heavy water reactor, DOIGR, CANOU, nuclear waste disposal, India's nuclear power programme, fusion power reactor.

Recommended Books

1. H. Enge, Introduction to nuclear physics, Addison Wesley, 1982.
2. W.H. Burcham and M. Jacobs, Nuclear and Particle Physics, Addison Wesley 1998.
3. S.S.M. Wong, Introductory Nuclear physics, PHI, 1996.
4. M.P. Khanna, Introduction to Particle Physics, PHI, 1999.
5. M. Sayer and A. Mansingh, Measurement, Instrumentation and Experiment Design in physics and Engineering PHI, 2000.
6. P. Nag. Power low Engineering, TMH, 1998.
7. M.V. Deshpande, Elements of Electrical Power Indian Design, Wheeler 1998.

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Paper – I

Section - II

Instrumentation Systems

PH, principle of PH measurement, electrodes for PH measurement (glass, hydrogen and reference electrode).

Biomedical instrumentation, biometrics, man-instrument system, physiological systems of body, problems encountered in a living system, bioelectric signals, electrodes, biomedical transducers, ECG, EEG, electrodes for ECG, EEG, non-invasive diagnostic instrumentation, temperature measurement, ultrasound measurement, x-ray and radiation instrumentation, brief introduction to computed tomography, NMR imaging systems, instrumentation for clinical laboratory.

Analytical instruments, working principles, operation and data analysis of spectrophotometers, atomic AAS, electron microscope.

NMR, instrumentation and applications of NMR, Gas chromatography, instrumentation and applications of gas chromatography.

Environmental instrumentation, general introduction to physical environment aspects, noise, visibility, air quality and water quality.

Data acquisition system design, a mining problem, turbine monitor, data acquisition system, a programmable DAS, distributed DAS.

Microprocessor based system development, system specification microprocessor selection, design cycle development tools.

Recommended Books

1. R.S. Khandpur, Hand Book of Biomedical Instrumentation, TMH, 1987.
2. L. Crimwell, F.J. Weibell, E.R. Pfeifter, Biomedical Instrumentation and measurements, Prentice Hall, 1980.
3. H. Willard, L.L. Merrit, J.A. Dean, Industrial Instrumentation method of Analysis.
4. R.S. Khandpur, Handbook of Analytical Instruments, TMH.
5. I.J. Frichtschen and L.W. Gay, Environmental Instrumentation.
6. K. Krishnakant, Microprocessor Based Data acquisition system Design, 1987.

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Applied Physics

Paper – II

Communication, Photonics, Fiberoptics Communication

Section – I

Communication

Communication system, information, transmitter, channel, noise, receiver, need for modulation, bandwidth requirements.

Spectral analysis, sampling function, response of a linear system, normalized power in a Fourier expansion, power spectral density, effect of transfer function on power spectral density, convolution, power and energy transfer through a network, band limiting of waveforms, power and cross correlation, autocorrelation, autocorrelation of periodic and non-periodic waveforms autocorrelation of other waveforms.

Probability, random variables, transformation of random variables, random processes, stationarity, correlation and covariance functions, regularity and ergodicity, Gaussian process, central limit theorem, transmission of a random process through a linear filter.

Frequency translation, a method of frequency translation, recovery of baseband signal, double sideband suppressed carrier modulation, generation of DSBSC waves, coherent detection of DSBSC waves, vestigial sideband modulation, comparison of various amplitude modulation systems, multiplexing, FDM.

Spectrum of an FM signal, FM generation, parameter variation method, stereophonic FM broadcasting, spikes, occurrence, characteristics, suppression, phase locked loop, analysis of phase locked loop, second order phase locked loop.

Noise, external and internal noise, noise calculations, noise figure, noise temperature, frequency domain representation of noise, spectral components of noise, narrow band noise, response of a narrow band filter to noise superposition and mixing of noise, linear filtering, noise in amplitude modulated systems, advantage of superhetrodyne principle, DSBSC, square law and envelop demodulator, noise in FM, calculation of output signal and noise power, preemphasis and deemphasis: signal channel, in commercial FM broadcasting.

Elements of digital communication systems, information source, source encoder/ decoder, modulator/demodulator, channel encoder/decoder, other functional blocks.

Sampling theorem, low pass signals, pulse amplitude modulation, channel bandwidth for a PAM signal, signal recovery through holding, pulse time modulation.

Noise communication channel, quantization of signals, quantization error, companding, pulse code modulation, PCM system, Delta and adaptive delta modulation, digital carrier modulation schemes, PSK, DPSK, FSK.

Smith chart and its applications, transmission line components, colour television, transmission and reception, pulse radar, radar range equation, Doppler radar, radar signal processes, estimation error, passive systems.

Introduction to satellite communication, EPABX, TELEX, facsimile cellular telephone and telemetering.

Recommended Books

1. H. Taub and D.E. Schilling, Principles of Communication system, McGraw Hill-Kogakusha, 1986.
2. S. Haykin, Communication Systems, New Age International, 1983.
3. G. Kennedy, Electronic Communication Systems, McGraw Hill, International Book Co., 1985.
4. B. P. Lathi, Modern Digital and Analog Communication Systems, John Wiley and Sons, 1998.
5. H. Strok and F.B. Tuteur, Modern Electrical Communications, Prentice Hall, 1979.
6. D. Roddy and J. Coolen, Electronic Communications, PHI, 1988.
7. K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley & Sons, 1979

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Paper – I

Section - II

Photonics and Fiber Optics Communication

Optical fibers, comparison with conventional metallic wires, step index single and multimode, graded index and other types of fibers, fiber propagation using ray model, material dispersion, combined effect of material dispersion and multipath dispersion.

Electromagnetic wave propagation in step index fibers, modes and rays, electromagnetic wave propagation in graded index fiber, transmission loss, measurement of scattering and absorption losses, non-destructive loss measurement.

Fiber and Preparation, Fiber Splicing, Fiber Connectors, Connection Losses, Fiber Couplers, Fiber Materials, Fiber Fabrication, Mechanical Properties of Fibers, Fiber Cables, Fiber Cable Installation.

Fiber Optic Communication System, Basic System Components, Coupling to and from the Fiber, Modulation, Multiplexing and Coding, Repeaters, Bandwidth and Rise time Budgets, Noise, Bit Error Rate and Eye Pattern evaluation of fiber optic systems, elements of optical fiber transmission link.

Photodiode, PIN and avalanche photodiode, phototransistor, optocouplers.

Introduction to digital transmission systems, long haul communication, Application of fiber optics to local area networks under sea communication.

Recommended Books

1. G. Keiser, optical fiber communication, McGraw Hill International Edition, 2000.
2. N. Sharma, Fiber optics in communication.
3. A.H. Cherian, An Introduction to optical fiber, McGraw Hill (Int. Ed.), 1995.
4. H. Zanger and C. Zanger, Fiber optics – communication and other Applications, Maxwell McMillan International Edition.
5. A. Yari, Optical Electronics, Holt, Rinehart and Wilson, 1991.
6. J. Gowar, Optical Communication Systems, PHI.
7. J. Wilson and D.F.B. Hawker, Opto electronics, Prentice Hall International.

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Paper – III

Microwaves and Physics in Industry

Section - I

Microwaves

Microwave Frequencies, Microwave transistor, Microwave field effect Transistors, Tunnel Diode, Backward Diode. MIS Tunnel Diode, Transferred Electron Devices, Gunn Diode.

Avalanche Transit Time Devices: IMPATT Diode, BARRITT Diode, DOVETT Diode, TRAPATT Diode.

Microwave Integrated Circuits (MICs): Introduction, Circuit Forms, Transmission lines for MICs, Lumped Elements for MICs, Materials for MICs, Substrate, Conductor, Dielectric and Resistive Materials, Fabrication Techniques, Typical Example of fabrication, Hybrid Integrated Circuit Fabrication.

Circular waveguides, microwave cavities, microwave hybrid circuits, directional couplers, circulators and isolators.

Microwave Tubes: Klystron, Reflex Klystron and Magnetron, Traveling wave Tubes, Microwave Detection Diodes, Applications of Microwave. (a) Electronic Navigation: Overview, DME, TACAN, Instrument Landing System, GCA, Doppler Navigation, Satellite Navigation, Global Positioning System. (b) Microwave Communication: Simplified Microwave system, Microwave Repeaters, Diversity, Microwave Radio Stations (Terminal Station, Repeaters Station), System Gain Calculations.

Recommended Books

1. S.M. Sze, Physics of Semiconductor Devices, Willy Eastern Limited.
2. Samuel Y. Liao, Microwave Devices and Circuits, Prentice-Hall of India Pvt. Ltd.
3. T.R. Ishii, Practical Microwave Electron Devices, HP.
4. W. Tomasi, Advanced Electronic Communication System, Prentice Hall.
5. E. Collin, Foundations of Microwave Engineering, McGraw Hill, (Int. Ed.) 1996.
6. N.D. Deshbando, D.A. Despande and P.K. Rangole, Communication Electronics, TMH.
7. D. Roody and J. Coolen, Electronic Communication, PHI.

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Paper – I

Section - II

Physics in Industry

Physics and industry, academic vs industrial physics, industrial use of physics, physics education in relation to small industries, introduction, social consequences, qualitative programming and quantitative suggestions, case studies of physics in industry, optical method of tele-measurement of helicopter propeller blades, physics in environmental protection, energy R&D, physics in agricultural research.

Non-destructive testing, basic test methods, leakage testing, penetrant method, magnetic methods, ultrasonic testing, radiogram physics and applications, eddy current methods, use of radioactive isotopes in non-destructive testing, recent developments in non-destructive testing, holography, Non-invasive diagnostic instrumentation, ultrasonic measurement, ultrasonic diagnosis.

Methods of crystal growth (solution, gel, melt, hydrothermal etc.) high pressure growth of diamond, hydrothermal growth of emerald, laser technology in diamond industry, laser, laser growing etc.

Vacuum techniques, measurement, characteristic of vacuum, vacuum pumps, rotary, diffusion and turbomolecular pumps, cryo pumps, vacuum gauges, joints, traps, speed of a vacuum system evaporation plant, thin film production methods, film thickness measurement, thickness monitor, applications of thin films, antireflection coating, thin solar cells, thin microelectronics, thin film coating on plastics, thin film transducers.

Recommended Books

1. E. Mongain and C.P.U. Toole (Ed) Physics in Industry Pergamon Press, 1976.
2. J.H. Lambie, Principle and practice of NDT Herwood 1962.
3. R. Hartshaw, NDT, Edward Arnold, 1987.
4. B. Pamplia, Crystal Growth, Pergamon, Press.
5. Crystal Growth, Properties and Applications, Vol. 4, Springer.

6. P. Santran Rashun and P. Ramaswamy, Crystal Growth, Kurp Publication 1998.
7. S. Dushman and J.H. Lafferty, Scientific Foundation of Vacuum techniques, Wiley, 1962.
8. K.L. Chopra and L.K. Malhotra, Thinfilm technology and Applications.
9. L.I. Maisol and R. Glang, Handbook of Thin film technology.
10. L. Cromwell, F.J. Weinell, F.A. Pfeifer, Biomedical Instrumentations and Measurements, PHI, 1991.
11. M. Sayar and A. Mansingh, Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI, 2000.

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Paper – IV

Micro Processor and Solid State Devices

Section - I

Microprocessor

Microprocessors and microcomputers, explanation of terms, evolution of the microprocessor, microcomputer programming languages, typical practical applications, Basic block of a microcomputer, typical microcomputer architecture, single-chip microprocessor, memory (RAM, ROM, ERROM) memory array design and memory interfacing. Programmed and interrupt I/O, DMA, summary of I/O methods coprocessor, Details of 8085, Register structure, memory, addressing, addressing mode, instruction set, timing methods, CPU pins and associated signals instrumentation timing and execution, programmed I/O, interrupt system, DMA, SID and SOD lines, system design using 8085.

Assembly of language programming for 8085, single stepping and single cycle utility routines in microprocessor kits, simple programming technique like looping, counting, indexing subroutines, parameter passing and software delays.

Block diagram, pin configuration and operating modes of 8251, 8254, 8255, 8259, 8279 (for their currently available functionally equivalent/upgrade) and DMA controllers, asynchronous receiver/transmitter (UART) etc. ADC and DAC chip, 8086 Architecture, addressing mode, instruction set, assembler dependent instructions, typical assembler pseudo instruction, program I/O, IOP, interrupts, DMA, system design using 8086, 8087 processor, 8086 family assembly language programming, program development with assembler and other development tools like compilers, debugger etc. Data transfer instructions, branch instructions, NOP, HLT and flag manipulation instructions, string instructions, stack manipulations.

Introduction to microcontroller, 8031/8051 architecture, instruction set, addressing modes, programming of 8031/8051, Peripheral interfacing, parallel Vs. serial transmissions, synchronous and asynchronous serial data transmission, DAC and DAC interfacing, DMA controller interfacing, Interface standards, parallel and serial interface, IEEE 488 interface bus, S100 bus standard, RS232C, RS422, RS423, current loops. Brief introduction to typical applications of microprocessors.

Recommended Books

1. M. Rafiquzzaman, Microprocessor, PHI (fifth Indian reprint) 1999.
2. D.V. Hall, Microprocessors and Interfacing, TMH, 1999.
3. R.S. Gaonkar, Microprocessor, Architecture, Programming and Applications with the 8085, Penram Int. 2000.
4. G.A. Gibson and L.Y. Chens, Microcomputer systems, PHI.
5. W.A. Triebel and A. Singh, 8085 and 8086 microprocessor, Programming, Interfacing, Software, Hardware and Applications PHI, 1991.
6. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2000.
7. B.B. Brey, The Intel Microprocessors, 8086, 8088, 80/86, 80286, 80386 Architecture, Programming and Interfacing, PHI, 1997.

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Paper – I

Section - II

Solid State Devices

Classification of semiconductor devices, specific remarks, carrier transport phenomena, phonon spectra, optical, thermal and high field properties of semiconductor, basic equation for semiconductor device operation.

p-n junction diode, depletion region and depletion capacitance, current-voltage characteristics, junction breakdown, transient behaviour and noise, terminal functions, heterojunction.

Tunnel diode and backward diode, effect of high doping, tunneling process, excess current, equivalent circuit, backward diode.

Junction transistors, microwave transistors, power transistors, switching transistor, unijunction transistor.

p-n-p-n and junction field effect devices, Schottky diode and semiconductor-controlled rectifier, junction field-effect transistor and current limiter.

Metal semiconductor devices, Schottky effect, energy band relation and metal semiconductor contact, current transport theory in schottky barriers, measurement of schottky barrier height, clamped transistor, schottky gate FET and metal semiconductor IMPATT diode, MOTT barrier, point contact rectifier and ohmic contact, space charge effect diode, SCR, Triac, Diac, IGBT, Power MOSFET. Optoelectronic devices, electroluminescent devices, solar cell, opto detectors.

Bulk-effect devices, bulk differential negative resistance, Ridley-watkins-Hilsum (RWH) mechanism, gunn oscillator and various modes of operation, associated bulk effect devices.

Recommended Books

1. S.M. Sze, Physics of semiconductor devices, Wiley-Interscience, 1969.
2. D.A. Frazar, The Physics of semiconductor Devices, Clarendon Press, 1977.
3. T.H. Beeforthan and J.H. Goldsmid, Physics of Solid State Devices, Plenum, 1970.
4. R.M. Warnar and B.Z. Grang, Transistors, John Wiley, 1983.

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Laboratory Work (Total 19 hrs./week)

Total marks for practicals and project will be 200. 70 marks will be for project work. 70 marks will be for two experiments (Group-A) at the university evaluation. 60 marks will be for internal assessment consisting of tests and laboratory reports, drawing sessions. Each student must submit two copies of his / her project report. There will be training in industrial Establishment / Research organization for 08 weeks on completion of training each student must submit duly certified training report.

Group -A

06 hrs/week

- 1 Geiger Counter (Plateau, half life)
- 2 Growing single crystal (Different methods)
- 3 Study of defects /testing of hardness.
- 4 Study of thin films.
- 5 Experiments on laser kit (Convergence, Speed of light etc.).
- 6 Experiments on Fiber Optic kit (Setting up analog, digital)
- 7 Writing and testing assembly language programmes for micro processor (To light and flicker LED, music generation etc.)
- 8 Interfacing of microprocessor with CKT, Keyboard etc.
- 9 Writing and testing assembly language programming on 8086.
- 10 Study of time-division multiplexing.
- 11 To design, build and test PCM encoder / decoder.
- 12 Experiments of microwave trainer system.
- 13 Speed measurement and study of RTD.
- 14 Study of LVDT and strain gauge.
- 15 Study of angular displacement, control LDR.

Group-B

03 hrs/ week.

- 1 Familiarisation with drawing for electrical engineer and a few practice sessions.
- 2 Project work (Preferably industrial project)