Department Of Physics
Osmania University

Scheme of Instruction and Syllabus

M.Sc (Physics)

III and IV Semesters
under CBCS scheme

(Wef academic year 2016-2017)

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

REVISED SYLLABUS FOR M.Sc (PHYSICS)

III SEMESTER

With effect from the academic year 2016 -2017 onwards

S.No	Paper code	Paper	Paper title
1.	P301T	Paper I	Modern Optics
2	P302T	Paper II	Advanced solid state physics
Solid state physics (SSP)			
3	P303T/SSP	Paper III	Band Theory & electrical Properties
4	P304A/T/SSP	Paper IVA	Physics of phonons and structural phase transitions
5	P304B/T/SSP	Paper IVB	Crystal Physics and physical properties
Materials Science (MS)			
6	P303T/MS	Paper III	Mechanical Properties of materials
7	P304A/T/MS	Paper IVA	Thin films and their properties
8	P304B/T/MS	Paper IVB	Metal and Alloys
Electronic Instrumentation (EI)			
9	P303T/EI	Paper III	Electronic Instrumentation
10	P304A/T/EI	Paper IVA	Digital logic circuits
11	P304B/T/EI	Paper IVB	Microprocessors, DSP & interfacing
Nano Science(NS)			
12	P303T/NS	Paper III	Carbon nano tubes and applications
13	P304A/T/NS	Paper IVA	Synthesis and characterization of nano materials
14	P304B/T/NS	Paper IVB	Properties of nano materials
Electronic communication (EC)			
15	P303T/EC	Paper III	8051 Microcontroller and applications
16	P304A/T/EC	Paper IVA	Data Computer communications- I
17	P304B/T/EC	Paper IVB	Digital transmission techniques and information theory
Biophysics (BP)			
18	P303T/BP	Paper III	Molecular Biophysics
19	P304A/T/BP	Paper IVA	Physico-chemical techniques in Biophysics
20	P304B/T/BP	Paper IVB	Medical Biophysics
Microwaves (MW)			
21	P303T/MW	Paper III	Transmission lines – microwave passive devices
22	P304A/T/MW	Paper IVA	Microwave (active) devices and circuits
23	P304B/T/MW	Paper IVB	Information theory and computer communications
Condensed Matter Physics (CMP)			
24	P303T/CMP	Paper III	Electrical transport phenomena in solids
25	P304A/T/CMP	Paper IVA	Physics of Phonons and structural phase transitions
26	P304B/T/CMP	Paper IVB	Crystal Physics and physical properties

Opto-Electronics (OE)			
27	P303T/OE	Paper III	Introduction to optoelectronics
28	P304A/T/OE	Paper IVA	Optoelectronic devices
29	P304B/T/OE	Paper IVB	Laser Physics and applications
Applied Electronics (AE)			
30	P301T/AE	Paper I	Digital system design
31	P302T/AE	Paper II	Digital signal processing and digital signal processors
32	P303T/AE	Paper III	Data communication and networking
33	P304A/T/AE	Paper IVA	Optical fiber and mobile communications
34	P304B/T/AE	Paper IVB	Electronic instrumentation

Practical

35	P305P	Paper V	General Physics lab-I (Common to all specializations)
36	P306P	Paper VI	General Physics lab-II (Common to all specializations)
37	P307P	Paper VII	Special Lab - I
38	P308P	Paper VIII	Special Lab - II

Practical (Applied Electronics)

35	P305P/AE	Paper V	Lab-I
36	P306P/AE	Paper VI	Lab-II
37	P307P/AE	Paper VII	Lab-III
38	P308P/AE	Paper VIII	Lab-IV

Details of credits and marks	
Number instruction hours per each theory paper per week	4
Number of credits for each theory paper	4
Maximum marks for each theory paper	100(80 semester exam + 20 internal evaluation)
Number instruction hours per each practical paper per week	16 (3 x 5 + 1 Tutorial)
Number credits per each practical paper	2
Total Credits per semester	24

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

REVISED SYLLABUS FOR M.Sc. (PHYSICS)

IV SEMESTER

With effect from the academic year 2016 -2017 onwards

S.No	Paper code	Paper	Paper title
1.	P401T	Paper I	Nuclear Physics
2	P402T	Paper II	Spectroscopy
Solid State Physics(SSP)			
3	P403T/SSP	Paper III	Optical Phenomena in solids
4	P404A/T/SSP	Paper IVA	Resonance Phenomena in solids
5	P404B/T/SSP	Paper IVB	Studies on reduced dimensionality in solids
Materials Science (MS)			
6	P403T/MS	Paper III	Electronic Materials and devices
7	P404A/T/MS	Paper IVA	Engineering Materials
8	P404B/T/MS	Paper IVB	Advanced Materials
Electronics Instrumentation (EI)			
9	P403T/EI	Paper III	Instrumentation for measurement and data transmission
10	P404A/T/EI	Paper IVA	Embedded systems and their applications
11	P04B/T/EI	Paper IVB	Process control instrumentation
Nano Science (NS)			
12	P403T/NS	Paper III	Nano composites
13	P404A/T/NS	Paper IVA	Nano Sensors and Nano devices
14	P404B/T/NS	Paper IVB	Nano Photonics and Nano technology in energy conversion and storage
Electronics Communications (EC)			
15	P403T/EC	Paper III	Mobile cellular communications
16	P404A/T/EC	Paper IVA	Data and Computer communications -II
17	P404B/T/EC	Paper IVB	Optical fiber communications
Bio Physics (BP)			
18	P403T/BP	Paper III	Cell and membrane biophysics
19	P404A/T/BP	Paper IVA	Radiation Biophysics
20	P404B/T/BP	Paper IVB	Biophysical Techniques in medicine
Microwaves (MW)			
21	P403T/MW	Paper III	Antennas and radars
22	P404A/T/MW	Paper IVA	Communication theory
23	P404B/T/MW	Paper IVB	Signal conditioning
Condensed Matter Physics (CMP)			
24	P403T/CMP	Paper III	Optical Phenomena on solids
25	P404A/T/CMP	Paper IVA	Resonance Phenomena in solids
26	P404B/T/CMP	Paper IVB	Semiconductor devises and nano materials

Opto-Electronics (OE)			
27	P403T/OE	Paper III	Fiber Optics
28	P404A/T/OE	Paper IVA	Fiber Optic communication systems
29	P404B/T/OE	Paper IVB	Fiber optic communication technology
Applied Electronics (AE)			
30	P401T/AE	Paper I	Digital system design using VHDL
31	P402T/AE	Paper II	Microcontroller and applications
32	P403T/AE	Paper III	Control systems
33	P404A/T/AE	Paper IVA	Microwave systems
34	P404B/T/AE	Paper IVB	Local area networks & TCP/IP protocols

Practical

35	P405P	Paper V	General Physics lab-I (Common to all specializations)
36	P406P	Paper VI	General Physics lab-II (Common to all specializations)
37	P407P	Paper VII	Special Lab - I
38	P408P	Paper VIII	Special Lab - II

Practical (Applied Electronics)

35	P405P/AE	Paper V	Lab-I
36	P406P/AE	Paper VI	Lab-II
37	P407P/AE	Paper VII	Lab-III
38	P408P/AE	Paper VIII	Lab-IV

Details of credits and marks	
Number instruction hours per each theory paper per week	4
Number of credits for each theory paper	4
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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2016-2017 onwards)

P 401T

Paper - I Core (Common for all Specializations)

NUCLEAR PHYSICS

Unit I:
Nuclear Force And Nuclear Models: Systematics of nuclear force-strength, range, charge independence; Deuteron problem and its contribution to the definition of the Nuclear force. Exchange force theories- Majoranna, Bartlett, Heisenberg and Yukawa.

The liquid drop model, the semi empirical mass formula and its applications. The Shell model, states based on square well potential and harmonic oscillator potential. Predictions-spins and parities of nuclear ground states, magnetic moments, electric quadrupole moments.

Unit II:
Nuclear Decay Processes: α-decay, Gamow's theory, fine structure of α-spectrum, alpha decay,systematics, neutrino of hypothesis, Fermi's theory of β-decay, Fermi-Kurie plot, angular momentum, selection rules for β-decay, -decay, Multipole radiation, selection rules.

Unit III:
Nuclear Radiation Detection: Interaction of charged particles with matter, Bohr's theory, Bethe's formula. Range-energy relation. Stopping power. Measurements of range and stopping power. Interaction of gamma rays with matter-Photoelectric effect, Compton Effect and pair production. gamma ray detection using gas, scintillation and solid state detectors.

Unit IV:
Nuclear Reactions: Classification of nuclear reactions, Kinematics and Q-value of reactions. Basic theory of direct nuclear reactions-Born approximation, stripping and pick-up reactions, characteristics, cross-sections, examples and applications. Compound nucleus formation. Theory of Fission and fusion reactions. Nuclear structure information from nuclear reactions.

Particle Physics: Elementary Particles Classification and their Quantum Numbers (Charge, Spin, Isospin etc). Fundamental Forces, Conservation of Parity, Strangeness and Lepton and Baryon numbers, Quark model.

Recommended Books:

1. Concepts of Nuclear Physics; B.L.Cohen (TMH)
2. Introductory Nuclear Physics: Kenneth S.Krane (Wiley)
3. Nuclear and Particle Physics:Blin-Stoyle (Chapman and Hall)
4. Nuclear Physics;I.Kaplan (Narosa 2002)
5. Introductory Nuclear Physics: W.Wong
6. Introductory Nuclear Physics: S.B.Patel
7. Nuclear Physics: Tayal

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P 402T

Paper –II Core (Common for all Specializations)

SPECTROSCOPY

Unit I

Atomic Spectra: Different series in alkali spectra (main features), Ritz combination principle, Terms for equivalent & non-equivalent electron atom, Term values in alkali spectra and quantum defect, L-S and j-j coupling; Energy levels and spectra; Spectroscopic terms.

Spin-Orbit interaction, doublet structure in alkali spectra, selection rules, intensity rules, alkali-like spectra, Lamb shift, many electron atoms, isotope shift; hyperfine splitting of spectral lines, selection rules. Lande interval rule.

Unit II

Molecular Spectra: Types of Molecular spectra, Regions of the Spectrums, Salient features of rotational spectra, rotational spectra of diatomic molecule as a rigid rotator, Energy levels and spectra of a non-rigid diatomic molecule, effect of isotopic substitution on rotational spectra, salient features of Vibrational-Rotational spectra, vibrating diatomic molecule as a harmonic oscillator and as anharmonic oscillator. Diatomic molecule as rigid rotator and harmonic oscillator diatomic molecule as a non-rigid rotator and anharmonic oscillator.

Unit III:

Raman and Infrared (IR) Spectra: Raman effect and its salient features, classical and quantum theory of Raman effect, normal vibrations of CO_2 and H_2O molecules, vibrational and rotational Raman spectra, Infrared spectroscopy; infrared spectroscopy –basic concept of IR spectroscopy –IR spectrophotometer –Principle and Instrumentation –FTIR principle and working –interpretation of data from Raman and IR spectroscopy.

Unit IV:

Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) Spectroscopy: Nuclear spin and magnetic moment, origin of nuclear magnetic resonance (NMR) spectra, Theory of NMR spectra, relaxation process –Bloch equations –chemical shift, experimental study of NMR spectroscopy, Experimental technique, ESR spectroscopy, origin and resonance condition –quantum theory –design of ESR spectrometer –hyperfine structure of ESR absorptions, fine structure in ESR spectra, ESR instrumentation, Applications of ESR.

Books Recommended

1. Elements of Spectroscopy - Gupta, Kumar, Sharma
2. Atomic Spectra & Atomic Structure - Gerhard Hertzberg
3. Introduction to Molecular Spectroscopy - G.M.Barrow
4. Molecular Spectroscopy - J.D.Graybeal
5. Atomic and Molecular Spectroscopy - Raj Kumar
6. Molecular Structure & Spectroscopy - G.Aruldhas
7. Introduction to Atomic Spectra - H.E.white
8. Fundamentals of Molecular Spectroscopy - C.N. Banwell and EM Mc Cash
9. Spectra of Diatomic Molecules - Herzberg
10. Spectroscopy Vol. I, II, III - Walker and Straughen
11. Principles of Magnetic Resonance - C.P.Slitcher
12. Electron Spin Resonance: Their Applications - Wertz and Bolton

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(For the batch admitted from 2016-2017 onwards)

PEI 403/T/SSP

Paper – III

OPTICAL PHENOMENA IN SOLIDS

Unit I : Optical Properties Of Solids: Introduction, Relation between dielectric and optical properties (macroscopic theory), Kramers-Kronig relations, Absorption of electromagnetic radiation, Photon-Phonon transitions, Interband transitions, Direct and indirect band gap semiconductors - Absorption coefficients.
Optical Band Transitions: Frenkel and Wannier excitons and their absorption, Imperfections - exciton absorption below the bandgap, Intraband transitions - Absorption and reflection in metals, Hagen-Rubens relation, Raman, Brillouin and Rayleigh scattering, Magneto-optic effects: Faraday effect.

Unit II: Luminescence
General considerations of luminescence, exciton, absorption and emission processes of luminescence, Configuration coordinate diagram, Energy level diagram, radiative and non radiative processes, Decay mechanisms, Effect of doping and efficiency, Energy transfer and charge transfer, Different kinds of luminescence, Electro luminescence, Photoluminescence and Thermoluminescence, Defects and color centers, Different kinds of color centers in the context of luminescence in alkali halides, Thallium activated alkali halides, Zinc sulphide phosphors.

Unit III : Photodetectors
Photoconductors-dc and ac photo conductors, gain & band width, noise in photo conductors, junction photo diodes, PIN diodes, quantum efficiency & frequency response – hetero junction photo diodes, avalanche photo diodes, noise performance of avalanche photo diodes – comparision of avalanche and PIN diodes.

Unit IV : Photovoltaics
Photovoltaic effect, Types of interfaces, homo junction, hetero junction and Schottky barrier- Choice of semiconductor materials for fabrication of homo junction solar cells, equivalent circuit of a solar cell, Solar cell output parameters – Fill factor, conversion efficiency, quantum efficiency, effect of series and shunt resistance on the efficiency of solar cells, Variation of open-circuit voltage and short circuit current with intensity of incident light, effect of temperature on I-V characteristics. .

References:

1. Solar cells – Charles E. Backus, IEEE Press.
2. Fundamentals of Solar cells, Farenbruch and Bube.
3. Principles of theory of solids – Ziman, Vikas Publishing House, New Delhi.
4. Solid State Physics – G. Burns
5. Luminescence and Luminescent Materials – Blasse
6. Solid State Physics – Dekker.
7. Optoelectronic devices _ P. Bhattacharya
8. Physics of semiconductor devices – S. M. Sze.
9. Elementary solid state physics – M. Ali Omar

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2016-2017 onwards)

PEI 404A/T/SSP

Paper – IVA

RESONANCE PHENOMENON IN SOLIDS

Unit I : Magnetism In Solids

Ferromagnetism - Ferromagnetic coupling, Theory of spin waves, magnons in ferromagnets; Bloch T 3/2 law, **Anti-ferromagnetism** – Molecular field theory, susceptibility and Neel temperature; **Ferrimagnetism** – susceptibility variation with temperature, Neel's theory, **Ferrites** - Structure, properties and applications; Novel magnetic materials – GMR/ CMR materials.

Unit II : Nuclear Magnetic Resonance

Nuclear magnetic resonance (NMR), Basic principles of NMR, Resonance condition, Spin-lattice and Spin-spin relaxation mechanisms, Bloch's equations and complex susceptibility, Chemical shift, Bloch diagram of NMR spectrometer, Analysis of the spectra, Applications of NMR.

Unit III : Electron Spin Resonance

Principle of Electron spin resonance , Nuclear hyperfine interaction, crystal field theory, splitting of energy levels for octahedral and tetrahedral fields in transition metals; rare earth and actinide ions, Experimental details of Electron spin resonance spectrometer; Analysis of ESR spectra.
Elements of Nuclear Quadrupole Resonance (NQR), construction and working of NQR spectrometer.

Unit IV : Mossbauer Effect

Resonance fluorescence/Natural and Doppler broadening of lines, Qualitative theory of recoil less gamma ray emission, Mossbauer effect, Temperature dependence of recoilless process, Debye-Waller factor, Experimental study, Mossbauer spectroscopy, Quantum mechanical theory of Mossbauer effect, Isomer shift, Magnetic hyperfine interactions, Electric quadrupole interactions, Applications of Mossbauer effect.

Recommended books

1. Elementary theory of solid state Physics -- J.P. Srivastava.
2. Mossbauer effect- Principles and applications – G.K.Wertheim,
3. Mossbauer spectroscopy – N.N.Greenwood and T.C.Gibb,
4. Solid State Physics – Singhal;
5. Horizons of Physics, Vol. I, --Wiley Eastern Publishers

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - Semester-IV Syllabus

(For the batch admitted from 2016-2017 onwards)

PEI 404B/T/SSP

Paper – IV B

STUDIES ON REDUCED DIMENSIONALITY IN SOLIDS

Unit I

Two Dimensional Solids - Quantum-Well Device Structures

A review of quantum mechanics w.r.t . infinite deep rectangular potential well, Basic concepts of artificial structures; Introduction to Semiconductor hetero-junction superlattices, Properties of semiconductor superlattices - Optical absorption, Resonance tunneling, Negative differential conductivity, Modulation doped hetero-junction superlattices,n-i-p-i structures, Inversion layers in MOSFETS and MODFETS, Metallic superlattices and their preparation, characterization and properties.

Unit II

One And Zero Dimensional Solids

Definitions, Zero-dimensional systems, Fullerenes, Quantum dots and their optical and electronic properties; One-dimensional systems: one-dimensional metals, Peirls distortion, conjugated polymers, Nano-tubules, Quantum wires (elementary treatment only)

Unit III

Preparation Of Thin Films

Vacuum evaporation: Types of evaporation sources – Resistive heating, electron beam evaporation, Two source evaporation – Flash evaporation – Laser ablation.

Epitaxial deposition: Vapor-phase epitaxy, Liquid-phase epitaxy, molecular bean epitaxy- Thickness distribution of evaporated films (Point and Ring sources). Sputtering : Glow discharge, dc and RF sputtering, Reactive sputtering, magnetron sputtering, Ion beam deposition. Chemical methods: Chemical Vapor deposition (CVD), Plasma chemical vapor deposition(PCVD), Metal organic chemical vapor deposition (MOCVD).

Unit IV

Insulator Thin Films

Metal insulator contact-Mott-Gurney contact- Schottky contact- Conduction in insulator films-Schottky emission-Poole-Frenkel emission-Thermally activated hopping-Direct tunneling-Space charge limited current-Photo conduction-Photovoltaic effect-Voltage controlled negative resistance-Experimental techniques for photo conduction.

Recommended Books:

1. Fundamentals of thin films - Goswamy
2. Thin films - K.L.Chopra
3. Semiconductor Devices - Physics and Technology - S.M.Sze
4. Hand book of nanostructred materials and nanotechnology
   (Vol. 1-4) Ed. By Hari Singh Nalwa
5. Nano crystalline materials – H. Gleiter
6. Nanophase materials - R.W. Seigel
7. Solid State Physics – G.Burns
8. Physics and Chemistry of Solids - S.R.Elliott
9. Non-Conventional energy sources, B.H. Khan, Tata Mc Graw-Hill, 2006
10. Non-Conventional energy sources, G.D. Rai, Khanna Publishers, 4th Edn, 2000.

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P 403 T/MS

Paper – III
ELECTRONIC MATERIALS AND DEVICES

Unit I

Semiconductor Materials

Classification of semiconductors - Elemental and compound semiconductors, Direct band and indirect band gap semiconductors, Charge carriers in extrinsic semiconductors, Diffusion currents, Mobility and its dependence on temperature and doping, Excess carriers in semiconductors, Recombination of electron -hole pairs - various recombination mechanisms.

Unit II

Semiconductor Junctions

Types of junctions, abrupt and graded junctions, - potential distribution, space charge, built in voltage and junction capacitance, carrier concentration across the junctions, Recombination. Preparation of junctions wafer selection, Oxidation, lithography photolithography, doping, metalisation, terminals, packaging. Metal - semiconductor junctions: energy-band relation, surface states and depletion layer, Schottky-effect- current transport process –thermo ionic emission, tunneling, device structures.

Unit III

Optoelectronic Devices

The ideal hetero junction, current-voltage characteristics, Light emitting diodes - Electroluminescent process. LED materials, device configuration and efficiency, light out put, LED structures, Device performance characteristics, Manufacturing processes: semiconductor lasers – Emission and absorption of radiation in a two level system, Gain in a two level lasing medium, Lasing condition in a semiconductor, Threshold condition for lasing Junction laser - operating principle, threshold current, power output, hetero junction lasers, laser diode materials, Device fabrication, laser mounting and fiber coupling.

Unit IV

Photonic Devices

Photo detectors : photoconductors –absorption coefficient, D.C. and A.C. conductors. Junction photo detectors – Photodiodes, PIN diodes, quantum efficiency and frequency response, noise, hetero junction diodes, avalanche photo diode, Solar cells – basic principle, efficiency, spectral response, cascaded solar cells, thin film solar cells, materials and design considerations.

Recommended Books:

1. Introduction to Semiconductor materials and devices –MS .Tyagi , Wiley.
2. Semiconductor optoelecronic devices –Pallab Bhattacharya, PHI
3. Physics of semiconductor devices –S.M Sze, John Wiley.
4. Physics and technology of semiconductor devices –S.M. Sze, John Wiley.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2016-2017 onwards)

P 404A T/MS

Paper – IVA
ENGINEERING MATERIALS

Unit I
Ferroic Materials

Introduction to ferroics, Structural classification of ferroelectrics, hydrogen-bonded and non-hydrogen bonded ferroelectrics, Thermodynamics of ferroelectric phase transitions-proper, improper and pseudo-proper ferroelectric phase transitions, Ferroelectric diffuse transitions, Relaxor ferroelectrics, Domain structures in ferroelectric materials, Orientation of walls between domain pairs, Domain wall thickness, Domain switching, Hysteresis loop, Polycrystal ferroelectrics, size effects in ferroelectric powders, Applications of ferroic materials.

Unit II
Composites

Basic Concepts, Definition of Composite materials, reinforcements, Classification of composites- Particle reinforced, Fibre reinforced and structural composites, Particle reinforced composites- large particle composites, dispersion strengthened composites, Types of Fibers, Fiber-reinforced composites- influence of fibre length, orientation and concentration, Structural composites- Laminar Composites, sandwich panels, The Matrix phase, Matrix materials, Polymer matrix composites, Metal matrix composites, Ceramic matrix materials, Carbon-Carbon Composites, Hybrid Composites, Applications of composites.

Unit III
Polymers

Polymers: Classification of polymers**,** polymer molecules**,** chemistry of polymer molecules, molecular weight, molecular structure of polymers, thermoplastic and thermosetting polymers, polymer crystallinity, mechanical behaviour of polymers- stress strain behaviour, viscoelastic deformation, strengthening of polymers, crystallization, melting and glass transition phenomenon in polymers, polymerization, manufacturing of polymers, applications of polymers.

Unit IV
Ceramics & Glasses

Ceramics: Introduction to ceramics, classification of ceramics, Ceramic structures- oxide structures, silicate structures, Ceramic Phase diagrams- examples of two oxide systems, Different kinds of Ceramics- glass ceramics, refractories, Properties of Ceramics-Stress-Strain behavior, mechanism of plastic deformation, Microstructure of ceramics, Grain growth in ceramics, Sintering and vitrification of ceramics, applications of ceramics

Glasses – types of glasses, glass ceramics, structure of glasses, properties of glasses, synthesis of glasses and applications of glasses

Books Recommended:

1. Solid State Physics –A.J.Dekker, Macmillan India Ltd., 2003.
2. Introduction to Ferrioc Materials –V.K. Wadhawan,
3. Materials Science and Engineering an Introduction- W.D. Callister Jr, John Wiley and sons.
4. Introduction to Ceramics -- W.D.Kingery, H.K. Bowen and D.R. Uhlmann, John Wiley and Sons.
5. Luminescent materials –G.Blasse and C.Grabmaier, Springer-Verlog, 1994

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-IV Syllabus
(For the batch admitted from 2016-2017 onwards)

P 404B T/MS

Paper – IVB
ADVANCED MATERIALS

Unit I

Synthesis of Nanomaterials

Introduction, particle size, particle shape, surface interaction of nanoparticles, DLVO theory, Classical nucleation theory for cluster formation.

Physical methods: inert gas condensation, Chemical vapour deposition, sputtering , Arc discharge, PLD, mechanical milling, MBE, Electrodiposition, laser pyrolysis.

Chemical methods: Introduction, Sol-gel process, Hydrothermal process, Solvothermal synthesis, Metal reduction method, Photochemical synthesis.

Unit II

Characterization Of Nanomaterials

Introduction; XRD, Scanning probe microscopy (AFM, STM), SEM, TEM, Uv-visible-IR, Raman spectroscopy, mass spectroscopy

Properties of nanomaterials: Mechanical, electrical, Magnetic, optical properties.

Applications of nanomaterials: Carbon nanotubes, nano-coatings, quantum dots, nano –wires and other applications.

Unit III

Bio-Materials

Implant materials: Introduction, Conditions for implant materials, Classification of Implant materials: Polymers- synthetic and natural

Metals- S.S, Co and its alloys, Al and its alloys, Ti and alloys, Mg and its alloys Ceramics- Alumina, Zirconia, Bioglass-ceramics, Hydroxyapatites

Application biomaterials

Unit IV

Magnetic Materials

Hysteresis and its importance, Magnetic anisotropy, magnetostriction, magnetoresitance, GMR, CMR materials, Domain and magnetization process- Domain wall motion- Magnetostatic energy, Domain wall energy, observation of Domains,

Classification of magnetic materials, soft magnetic materials- crystalline alloys, soft ferrites , and amorphous alloys. Applications of soft magnetic materials,

Hard magnetic materials: alnico alloys, Nd-Fe-B magnets, Hard ferrites. Applications of hard magnetic materials.

Books Recommended:

1. Nanocrystalline materials- H. Gleiter
2. Biomaterials Science and Engg. –J.B. Park
3. Materials Science and Engg. –C. M. Srivastava
4. Nanoparticle Technology Hand book- Masuo Hosokawa, K. Nogi, M. Naito, T. Yokoyama, Pub: Elsevier
5. Hand book of nanotechnology- ed. Perag Diwan , Pentagon Press

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2016-2017 onwards)

PEI 403 T/EI

Paper-III

INTRUMENTATION FOR MEASUREMENT AND DATA TRANSMISSION

Unit I :Transducers: Classification of transducers – Active and Passive transducers- Electrical transducers- Displacement transducers -Digital transducers -Basic requirement of a transducer . **Displacement Measurement:** Variable resistance devices– Variable inductance devices - Variable capacitance devices.

Strain Measurement: Theory of operation of strain gauge –Types of strain gauges –Strain gauge circuits _ Quarter bridge- Half bridge and Full bridge –Temperature compensation – Calibration of strains gauges –Strain gauge load cell.

Unit II :Pressure Measurement: Bourdan Tube- Bellows - Diaphrams – Transduction methods-Potentiometer device- Straingauge transducer –LVDT type transducer –Variable capacitance device –Force- balance transducer –Piezoelectric transducer- Digital Pressure Transducer-Pressure calibration.

Temperature Measurement: Classification of temperature measuring devices-Resistance type temperature sensors (platinum resistance thermometer, thermistrors) –Resistance thermometer circuts- Thermocouples –Types of thermocouples -Cold junction compensation – Solid State Sensors – Temperature measurement by radiation methods – Calibration of thermometers.

Flow Measurement : Classification of flow meters –Head type flow meters-Orifice meter-Venturi Tube- Pitot tube –Rotameter- Anemometer –Electromagnetic flow meter - Ultrasonic flow meter.

Unit III :Process Control : Open loop control –Closed loop control –Examples- Block diagram algebra -Block diagram of Closed loop system - Closed loop transfer function –DC AND AC Servomotors-Stepper motor-Temperature Control-Liquid level control.

Analog and Digital Data Acquisition Systems: Interfacing transducers to electronic control and measuring systems –Digital to analog multiplexer - Analog to Digital multiplexer - IEEE 488 Bus.

Unit IV :Data Transmission and Telemetry : Methods of data transmission–General telemetry system-Functional blocks of telemetry system –Types of telemetry systems–Land line telemetering system-Voltage telemetering systems–Current telemetering system-Position telemetering system– Land line telemetry feedback system-Radio frequency telemetry - PAM, PCM Telemetering–Multiplexing in telemetering system- Transmission channels- Digital data transmission.

Recommended Books:

1. Modern Electronic Instrumentation and Measurement Techniques –A.O.Helfrick and W.D.Cooper, Prentice Hall India Publications.
2. Instrumentation Devices and Systems- C.S.Rangan, G.R. Sharma and VSV Mani, Tata Mc.Graw Hill Publications.
3. Introduction to instrumentation and Control- A.K.Ghosh –Prentice Hall India Publications.
4. Electrical and Electronics Measurement and Instrumentation –A.K.Sawhney.
5. Transducers and Instrumentation –DVS Murthy, PHI Publications.

DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

M.Sc. (Physics) - IV Semester Syllabus

(For the batch admitted from 2016-2017 onwards)

PEI 404A/T/EI

Paper –IVA

EMBEDDED SYSTEMS AND ITS APPLICATIONS

Unit I : The 8051 Microcontroller

Introduction to Microcontrollers : History of Microcontrollers and Microprocessors, Embedded Versus External Memory Devices, CISC and RISC Processors, Harvard and Von Neumann Architectures, Block diagram of the 8051; **Inside the 8051**, Assembling and Running an 8051 Program, The Program Counter and ROM space, Date Types and Directives, Flag Bits and PSW Register, Register Banks and Stack; **Pin Description**, I/O Programming, Bit Manipulation; **Addressing Modes-** Immediate and Register Addressing Modes, Accessing Memory using Various Addressing Modes

Unit II: Programming the 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Division of Signed and Unsigned and Unsigned Numbers; **Logical** Instruction and Programs- Logic, Compare, Rotate, Swap, BCD and ASCII Application Programs; **Single Bit** Instructions and Programming –Single Bit Instructions with CY; **Jump, Loop** and call Instructions, Time Delay Generation and Calculation; Timer/Counter Programming, Serial Communication an interrupts Programming.

Unit III : PIC Microcontrollers

Overview and Features, **PIC 16C6X/7X** Architecture (PIC 16C61/C71), Registers, Pin diagram, Reset action Memory Organization, **Instructions**, Addressing Modes, I/O Ports, Interrupts, Timers, Analog-to- Digital Converter (ADC).

Pin Diagram of PIC **16F8XX Flash Microcontrollers**, Registers, Memory organization, Interrupts, I/O Ports and Timers.

Unit –IV : Industrial Applications of Microcontrollers

Connecting of - Light Emitting Diodes (LEDs), Push Buttons, Relays and Latches. **Interfacing** of - Keyboard, 7-Segment Displays, LCD Interfacing, ADC and DAC with 89C51 Microcontrollers.

Measurement Applications of – Robot Arm, LVDT, RPM Meter, Digital Thermo Meter and Strain Gauges.

Automation and Control Applications of –PID Controllers, D C Motors and Stepper Motors.

Recommended Books:

1. Microcontrollers –Theory and Applications –By Ajay V Deshmukh, TMH, 2005
2. The 8051 Microcontrollers and Embedded Systems –By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, 4th Reprint, 2002
3. The 8051 Microcontroller - architecture, programming & applications –By Kenneth J. Ayala, Penram International Publishing, 1995
4. Design with PIC Microcontrollers - By J B Peatman, MH, Pearson Education Asia, 2003

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P 404B T/EI

Paper – IVB

PROCESS CONTROL INSTRUMENTATION

Unit –I :PROCESS CONTROL: Control Systems: Process-Control Principles, Servomechanism, Discrete-State Control System- Process- Control Block Diagram: Identification of Elements, Block diagram-Control System Evaluation: Stability, Steady-State Regulation, Transient Regulation, Evaluation Criteria- Analog and Digital Processing: Data representation, ON/OFF Control, Analog Control, Digital Control, Programmable Logic Controllers.

ANALOG AND DIGITAL SIGNAL CONDITIONING: Principles of Analog Signal Conditioning: signal-Level and Bias Changes, Linearization, Conversions, Filtering and Impedance Matching, Concept of Loading- Passive and Operational Amplifier Circuits in instrumentation-Digital fundamentals-Programmable Logic Controllers-Computer Interface-Converters: Digital-to-Analog Converters (DACs), Analog-to-Digital Converters (ADCs),Frequency –Based Converters.

Unit-II : DISCRETE STATE PROCESS CONTROL : Definition of Discrete state process control – characteristics of the system: Discrete state variables, process specifications, event sequence description – Process characteristics: Process equation, Process load, Process Lag, Self – regulation – Control System parameters: Error, variable range, Control parameter range, Control Lag, Dead Time, Cycling, Controller modes- Discontinuous controller Modes: Two – position Mode, Multi-position Mode, Floating control Mode - Continuous control mode: Proportional control Mode, Integral- Control Mode, Derivative – control Mode- Composite control Mode: Proportional-Integral Control (PI) , Proportional – Derivative control Mode (PD), Three Mode controller (PID).

Unit – III : ANALOG, LOGIC AND COMPUTER BASED CONTROLLERS: General features of analog controllers: Physical layout, front panel, side panel – Electronic controllers: Error detector, Single mode and composite controller mode – Pneumatic controllers: General features, Modes Implementation – Relay Controllers: Background, Ladder diagrams- Programmable Logic Controllers: Relay sequences, Programmable Logic Controller Design, PLC operation, Programming, Functions of PLC software.

Digital applications: Simple and multivariable Alarms, Two - position control – Computer based controllers: Hardware configuration, Smart sensors, multi-loop controllers-Software requirements-algorithms to implement the control equations: errors, proportional mode, integral mode, derivative mode, PID control mode- Data Loggers-Supervisory control-Process control system networks, field bus operations, General characteristics of buses.

Unit – IV : CONTROL LOOP CHARACTERISTICS: Control System configuration: Single variable, Cascade Control – Multivariable control system: analog control, supervisory and direct digital control – Control system quality: definition of quality, measure of quality – Stability: Transfer function frequency dependence, stability criteria - process Loop tuning: Open Loop Transient response Method, Ziegler-Nichols Method, Frequency Response Method.

TEXT BOOK

1. Curtis D. Johnson, Process Control Instrumentation Technology, 8th edition, PHI (2006)
2. Bela G. Liptak, Process Control Butterworth-Heinemann
3. Frank D. Petruzella, Programmable Logic Controllers, 3rd edition, Tata McGraw Hill (2010)
4. Micheal P. Lukas, Distributed Control Systems, Van Nostrand Reinfold Company (1995).

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P403/T/NS

PAPER –III

NANO COMPOSITES

Unit-I:
Definition of nano-composites, nanofillers, classification of nanofillers, carbon and non-carbon based nanofillers-synthesis and properties of fillers.

Properties of various polymer nanocomposites: Nanotube /polymer composites, layered filler polymer composite processing – polyamide matrices, polyimide matrices, polypropylene and polyethylene, matrices, liquid –crystal matrices, Epoxy and polyurethane matrices and rubber matrices.

Unit-II:

Synthesis of Nano composite: Direct Mixing ,Solution Mixing In –Situ Polymerization, In-Situ Particle processing ceramic / polymer composites, In-Situ particle processing, metal / polymer nanocomposites, modification of interfaces, modification of nanotubes, modification of nanoparticles.

Unit-III:

Properties of Nano composites : Mechanical properties, modulus and the Load –Carrying , capability of nanofillers, failure stress and strain Toughness, glass Transition and Relaxation Behavior, abrasion and wear resistance , permeability , dimensional stability constants, thermal stability and flammability, electrical and optical properties, resistivity, permittivity, and breakdown strength, refractive index, light emitting devices.

Unit-IV:

Nano composites containing functionalized nanoparticles : organic and polymer materials for light – emitting diodes, luminescent polymer for device applications, photo-oxidation of emitting polymers, nanoparticles approaches to enhance the lifetime of emitting polymers.

Barrier properties of polymer nanocomposites, permeation and diffusion models relevant to polymer nanocomposites, polymer nanocomposites diffusivity, polymer nanocomposites sorption, polymer nanocomposites permeability, wear resisting polymer nanocomposites: preparation and properties, surface treatment, composites manufacturing, wear performance and mechanism.

Reference Books:

1. Encyclopedia of Nanotechnology –Hari Singh Nalwa
2. Springer Handbook of Nanotechnology – Bharat Bhushan
3. Handbook of Semiconductor Nanostructures and Nanodevices,Vol1-5-ABalndin,K.L Wang.
4. Nanostructures and Nanomaterials- Synthesis, Properties and Applications –Cao,Guozho

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P404A/T/NS

PAPER –IVA

NANOSENSORS AND NANO DEVICES

Unit-I:

Quantum Devices: Quantum Electronic Devices- Electrons in mesoscopic structures- short channel , MOS Transistor-split Gate transistor – Electron wave transistor – Electron spin transistor-Quantum Dot array-Quantum computer –Bit- Qubit.

Unit- II:

Super Conducting Devices: Basics- Macroscopic model – super conducting switching devices –cryotron – Josephson tunnelling devices – elementary circuits –Associative or content- addressable memory –SQUID –Flux Quantum device –LC Gate –Magnetic Flux Quantum –Quantum cellular Automata-Quantum computer with single flux devices-SFQD-RSFQD- Application of super conducting devices.

Nanosensors: Introduction to sensors. Characteristics and terminology - static and dynamic characteristics. Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Sensors for aerospace and defense. Organic and inorganic nanosensors.

Unit-III:

Nanotechnology enabled devices: Nanomaterials and nanostructured films, Nanoscale electronic and ionic transport. Sensor for bio-medical applications. Nanoparticle-biomaterial hybrid systems for sensing applications. Gas sensor. Biosensors: Magnetic Nanoparticles for Imaging and Therapy, Photodetectors, Nanophotonics. Nanoelectronic Devices. Biosensors, generation of biosensors. Nanomaterial based biosensors. Biosensors based on nucleotides and DNA. Electron transfer of biomolecules.

Unit-IV:

NEMS: Inertial sensors –accelerometer-gyroscope –micromechanical pressure sensors-piezoresistive –capacitors –micro robotics –optical MEMS-Visual display –precision optical platform –optical data switching- RF MEMS-MEMS variable capacitors –MEMS switches –resonators.

Reference Books:

1. Nanoelectronics and Nanosystems –From Transistors to Molecular Quantum Devices K.Goser, P.Glosekottter and J.Dienstuhl , springer,2004.
2. NanoPhotonics Herve Rigneault ,Jean –Michel Lourtioz, Claude Delalande ,Ariel Levenson.
3. Nanotechnolgy and Nanoelectronics- Materials, Devices and Measurement Techniques W.R.Fahrner Springer ,2006.
4. Sensors: Micro& Nanosensors,Sensor Market trends (Part1&2) H.Meixner
5. Nanoscience & technology :Novel structure and Phenomena Ping Sheng(Editor)
6. MEMS & Microsystems Design and Manufacture Tai-Ran Hsu Tata McGraw –Hill
7. MEMS and MOEMS technology and applications PHI Learning private Ltd.2009
8. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.
9. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.
10. . Nanomaterials for Biosensors, Cs. Kumar, Wiley – VCH, 2007.
11. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006. nit-III
12. MS Handbook Mohammed Gad-el-Hak CRC Press 2002.

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P404B/T/NS

PAPER –IVB
NANOPHOTONICS
&
NANOTECHNOLOGY IN ENERGY CONVERSION AND STORAGE

Unit-I:

Foundations for Nanophotonics: photons and electrons: similarities and differences, free space propagation, confinement of photons and electrons, prorogation through a classically forbidden zone: tunneling, localization under a periodic potential Band gap. Cooperative effects for photons and electrons, nanoscale optical interactions axial and lateral nanoscopic localization, nanoscale confinement of electronic interactions: Quantum confinement effects, nanoscale interaction dynamics, nanoscale electronic energy transfer, Cooperative emissions.

Unit-II:

Photonic Crystals: Basics Concepts, Features of Photonic Crystals, wave propagation, photonic band gaps, light guiding. Theoretical modeling of Photonic crystals, methods of fabrication, Photonic Crystal Optical Circuitry. Nonlinear Photonic Crystals, Photonic Crystals and optical communications Application to high efficiency emitters, miniaturized photonic circuits and dispersion engineering Photonic crystal sensors.

Unit-III:

Renewable Energy: Energy conversion process. Introduction to Semiconductor physics, Conducting and semiconducting materials, Semiconductor nanostructures, Electronic structure and physical process, material aspect of solar cells, Thin film solar cells, Solar cell characteristics and characterization techniques. Nano-, micro-, and poly crystalline and amorphous Si for solar cells, Si deposition techniques.

Plastic/flexible solar cells: Organic solar cells, Polymer composites for solar cells, p-n junction, Device fabrication and characterization, Nanomaterials for solar cells, Dye-sensitized solar cells, Organic-inorganic hybrid solar cells, Current status and future prospects.

Unit-IV

Fuel Cells: Polymer membranes for fuel cells, Acid/ alkaline fuel cells, design of fuel cells, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, Use of nanoscale catalysts to save energy and increase the industrial productivity.

References Books:

1. Nanophotonics –ParasN. Prasad, John Wiley & Sons (2004)
2. Photonic crystals: Towards Nanoscale Photonic Devices –Jean Michel Lourtioz,Springer ISBN 354024431X
3. Photonic crystals –John D.Joannopoulos, Princeton University Press ,ISBN 0691037442
4. The Handbook of Photonics – Mool Chand Gupta,John Ballato.
5. Solar cells: Operating principles, technology and system applications by Martin A Green, Prentice Hall Inc, Englewood Cliffs, NJ, USA, 1981.
7. Semiconductor for solar cells, H J Moller, Artech House Inc, MA, USA, 1993.
9 Organic P hotovoltaics – Materials, Device Physics and Manufacturing Technologies, (eds. C. Brabec, V. Dyakonov, U. Scherf), 2nd Ed., Wiley-VCH, Germany, 2014.
10. Hand book of Batteries and fuel cells, Linden, McGraw Hill, 1984.

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P403/T/EC

Paper - III

MOBILE CELLULAR COMMUNICATIONS

Unit I Cellular Concepts: Mobile communications-évolution, International Mobile Satellite, Personnel Communication System [PCS], Standards, Mobile Personnel Computers, Speech Coder.

Fundamental Radio Propagation and System concepts, Antenna Gain, Propagation characteristics, model for multipath-faded radio signals, Instrumentation for lab testing.

Unit II Spread Spectrum Systems and Diversity Techniques: Concept of Spread Spectrum System, pseudo-noise sequences, performance of Direct Sequence Spread Spectrum Systems, Code Division Multiple Access, Direct Sequence and Frequency Hopping systems, Synchronization. Applications.

Concept of Diversity Branch and Signal Paths, Combining and Switching Methods, Carrier-to- Noise and Carrier- to- Interference Ratio, Performance Improvements.

Unit III: Medium Access Control: Motivation for a specialized MAC, Hidden and exposed terminals, Near and far terminals, SDMA, FDMA, TDMA, Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packer reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhabit sense multiple access, CDMA, Spread Aloha multiple access, Comparison of S/T/F CDMA

Telecommunication Systems: GSM, Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services.

Unit IV Satellite Systems: History, Applications, Basics, GEO, LEO, MEO, Routing, Localization, Handover, Examples.

Satellite applications: Communication satellites, surveillance satellite, navigation satellites. Global positioning system (GPS) space segment, control segment, GPS receivers, GPS applications.

Broadcast Systems: Overview, cyclic repetition of data, Digital audio broadcasting, Multimedia object transfer protocol, Digital video broadcasting,

Recommended Books

1.Wireless Digital Communications -- Kamilo Feher
2.Mobile Communications Jochen Schiller
3. Composite satellite and cable television . R .R Gulati (New Age International Pub)
4.Mobile Cellular Telecommunications W.C.Y. Lee [Second Edition]

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P404A/T/EC

Paper-IVA

DATA AND COMPUTER COMMUNICATIONS- II

Unit I :Protocol Architecture

Basic protocol functions. OSI Model: Model, standardization within the OSI framework. Service Primitives and Parameters. Functions of OSI layers. TCP/IP Model: TCP/IP layers and their functions, Operation of TCP/IP, TCP/IP application

Internetwork Protocols Principles of Internetworking: Requirements, architectural approaches. Connectionless Internetworking: Operation of a connectionless internetworking scheme, Design issues. Internet protocol: IP services, IP datagram format, IP addresses Network Classes, Subnets and Subnet masks, Internet Control Message Protocol (ICMP). IPV6: Motivation for new version, enhancements in IPV6 over IPV4, IPV6 structure, IPV6 header, IPV6 addresses, hop by hop option header, fragment header, routing header and destination option header.

Unit II: Internetwork Operation

Multicasting: Practical applications, multicasting in an internet environment, requirements for multicasting. Routing protocols: Autonomous systems, approaches to routing, Border Gateway Protocol (BGP) and Open Short Path First (OSPF) Protocol.

Transport Protocols

Connection Oriented Transport Protocol Mechanisms: Reliable sequencing network service, Unreliable network service. TCP: TCP services, TCP header format, TCP mechanisms. TCP congestion control: Retransmission Timer Management, window management. UDP.

Unit III :Network Security

Security Requirements and Attacks: Passive attacks and Active attacks. Confidentiality with Symmetric Encryption: Symmetric encryption, encryption algorithms, location of encryption devices, key distribution and traffic padding. Message Authentication and Hash Functions: Approaches to message authentication, secure hash functions, SHA-1 secure hash function. Public-Key Encryption and Digital Signatures: Public key encryption, digital signature, RSA public key encryption algorithm, Key management. IPV4 and IPV6 security: Applications of IPsec, scope of IPsec, security associations, authentication header and encapsulating security payload.

Unit IV Distributed Applications

Electronic Mail SMTP and MIME: SMTP and MIME. Hypertext Transfer Protocol (HTTP): HTTP overview, messages, request messages, response messages and entities. Network Management SNMP: Network management systems.

Recommended Books:

1.Data and Computer Communications William Stallings [SEVENTH & EIGHTH Edition]

2..Computer Networks A.S.Tanenbaum [Third Edition]

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P404B/T/EC

Paper-IVB
OPTICAL FIBER COMMUNICATIONS

Unit I: Optical Fibers: Fiber modes and Configurations**:** Fiber types and their structures. Ray optics representation. Mode theory for circular waveguides: Step index fibers, single mode fibers, and Graded index fibers - WKB Approximations for estimating number of modes.

Fiber Materials for glass fibers and plastic fibers. Fiber fabrication methods: Outside Vapor Pressure Oxidation; Vapor axial deposition; Modified chemical vapor deposition; Plasma activated chemical vapor deposition; Double crucible method. Fiber drawing processes.

Fiber optic cable design: Fiber to fiber joints, fiber splicing & Optical fiber connectors.

Unit II: Transmission Characteristics: Signal attenuation in optical fibers: Absorption, scattering and bending losses in fibers, core and cladding losses.

Signal distortion in optical wave guides: Material dispersion, wave guide dispersion, intermodes distortion. pulse broadening.

Unit III: Optical Sources And Detectors: Optical Sources: Basic semiconductor properties, materials, p-n junction hetrostructures. (a) Light Emitting Diodes (LEDs): Structures, light source materials, internal quantum efficiency, modulation capability, transient response, power bandwidth product. (b) Laser diodes: Modes and resonant frequencies, reliability.

Optical Detectors: Physical principles of PIN photo detectors, Avalanche photo detectors. Detector noise: Noise in PIN photo diodes and Avalanche photo diodes

Unit IV: Digital Transmission Systems: Optical receivers: Fundamental receiver operation, receiver structures, receiver performance. Point to point links, link power budget.

Review of multiplexing techniques: Optical Time Division Multiplexing (OTDM), Wavelength Division Multiplexing (WDM).

Coherent Optical Detection: Basic System, Practical constraint, Modulation and Demodulation Formats.

Recommended Books:

1.Optical Fiber Communications Gerad Keiser
2.Optical Fiber Communications John M. Senior (PHI)
3. Optical Fibres T. Gowar

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P 403 T/BP

Paper – III Cell and Membrane Biophysics

Unit I : Cellular Oscillations and Biological cell Magnetophoresis

Cell Division and Cellular Oscillations : The biophysicist's view of the living cell. Modifications of the living cell.Cell division. Electrical oscillatory phenomenon associated with cellular reproductive cycle. Electrical oscillations related to the contact inhibition of reproduction in cells. Origin of cellular spin resonance – A bipolar rotational conduction.Asymmetric cell to cell polarization.Cellular spin resonance (CSR). Evidences of oscillating electric fields from cells by CSR.

Magnetophoresis: Introduction to Magnetophoresis. Behaviour of charge and neutral matter in (a) uniform and (b) non – uniform magnetic field. Theory and experimental technique of magnetophoresis. Biological applications of magnetophoresis.

Unit II:Biological cell dielectrophoresis

A simple description of dielectrophoresis. Behaviour of charged and neutral matter in (a) uniform and (b) non-uniform electric fields.Types of polarization. Bunching effects or pearl chain formation of cells. Field geometries – spherical, cylindrical and isomotive. Dielectrophoretic force in radial field. Dielectrophoretic collection rate (DCR) of cells in radial field. Experimental technique for DCR of biological cells. Calculation of excess permittivity of cells. Single cell dielectrophoresis. Experimental technique for the determination retention voltage. Calculation of excess permittivity of lone cells using retention voltage.

Unit III: Physics of Sensory organs and Membrane

Physics of Muscle : Ultrastructure of muscle. Action potential, properties of action potential. Molecular basis of muscle contraction – sliding filament theory. Sarcomere and molecular mechanism of muscle contraction. Microscopic and X-ray diffraction. Studies on cross bridge structures. Electrophysiology of muscle.

Physics of Nerve : Chemical and electrical properties of mylinated and non-mylinated nerves. Charge distribution in resting nerve cell. Leakage current across the cell membrane. Electrotonus. Hodgkin-Huxley model for membrane current. Propagating nerve impulse. Properties of mylinated conduction.

Physics of Eye : Eye as an optical instrument. Structure of eye – Physicist's view. Photochemistry of visual process. Quantum effects in dark adapted vision. Refraction of the eye.

Physics of Ear : Human auditory system**.** Structure of choclea. Scanning electron micrographs of inner and outer hair cells of the organ of corti. Cochlear patterns. The growth of loudness. Audiometry.

Physics of charged membrane

Cell Membrane: Membrane models, membrane channels, membrane capacitance, relation among capacitance, resistance and diffusion between two conductors. Fick's first law of diffusion and Fick's second law of diffusion.

Movement of substance across membrane: Donnan equilibrium. Potential change at the equilibrium.

Ion movement in solution: the Nernst – Planck equation. Zero total current in a constant field membrane – Goldmann equation.

Unit IV: Physics of natural flying machine

Flight surface (wing); Flight muscles; Sensory organs; Physics of wing beat – Mechanical oscillator theory; Theory based on Newton's laws; Theory based on Dimensional analysis; Mass flow theory. Types of flight – Hovering; forward horizontal flight; gliding flight; Soaring flight. Aerodynamic forces – lift, thrust and drag. Power requirements of flight. Applications of natural flight to Micro Vehicles.

Recommended Books:

1. Dielectrophoresis – Pohl.
2. Electromechanics of particles – Thomas B.Jones.
3. Intermediate Physics for Medicine and biology – Russel K, Hobby.
4. Bio-physics of Bird Flight – N.Chari.

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P 404A T/BP

Paper – IV A

Radiation Biophysics

Unit I : Action spectra and Quantum yield

Introduction – Light sources and materials; monochromators; intensity measurements; Definition and theory of action spectra; Inactivation of proteins and DNA; Light action on respiratory pigments; Photosynthesis, examples. Cooperative events in light action - the Poisson's distribution, examples.

Unit II : Ionizing radiation of cellular constituents

Nature of ionizing radiation; Measure of radiation – the roentgen; Ionisation by X-rays, γ rays or neutrons; Bethe's equation - derivation and application; Dosimetry; Action of ionizing radiation on molecular systems; Target theory;Variable linear energy transfer; Radiation sensitivity of large molecules; Ionising radiation interaction with tissues and chromosomes.

Unit III: Physics of diagnostic x-rays

Production of X-ray beams – X-ray machine; Properties of X-rays; Absorption of X-rays; X-ray image intensifier T.V.; Radiation to patient from X-ray; Live X-ray imaging – fluoroscopy, Mamography; Principle, theory, instrumentation, working of CT scan, MRI scan and PET scan.

Unit IV: Nuclear medicine Physics

Radioactivity and radiation sources. Statistical aspects of nuclear medicine. Basic instrumentation and its clinical applications. Nuclear medicine imagingdevices. Physical principles of nuclear medicine imaging procedures and RIA. Therapy with radioactivity.

Biological effects of radiation - principles of radiation therapy, mega voltage therapy, Brachy therapy.

Recommended Books:

1. Molecular Biophysics – Richard B.Setlow and Ernest C.Pollard.
2. Medical physics - John R, Cameron & G Skefrenick.
3. Basic radiological physics – K. Thayalan,J B Medical Publishers.

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P 404B T/BP

Paper – IVB

Biophysical Techniques in Medicine

Unit I : Bio – instrumentation

Bioelectric signals and electrodes- Electrode and electrolytic interface; Surface and metal plate electrodes; Needle and wire electrodes; Microelectrodes. Physiological transducers – Variable resistance transducers; Variable inductance transducers; Variable capacitance transducers; thermo resistive transducers; Photoelectric transducers; Piezoelectric transducers. Biomedical amplifiers – Basic requirements; Differential amplifiers; Carrier amplifier; Chopper amplifier; Phase sensitive detector. Recording systems – Characteristics of recording systems; Moving coil recorder; moving iron recorder; Recording techniques – Heat stylus; optical light and ink jet.

Unit II:Image processing in medicine

Principle, description, working, analysis and clinical applications of ECG; EMG; EEG & ERG.

Unit III: Ultrasonic Imaging

Principle, theory, instrumentation, working and analysis of A scan, B scan and M scan; Doppler effect – 2D echo, color Doppler and analysis; Diagnosis of some cardiac, abdominal, renal diseases; Ultrasonic fetal monitoring.

Unit IV: Bio informatics

What is Bioinformatics? Various definitions of Bioinformatics; Bioinformatics in pharmaceutical industry**;** Skills required by bioinformatics professionals; Defining Bioinformatics: New perspectives. Nucleotide & Protein sequences. Structural Bioinformatics: Protein structure basis Protein structure Prediction. RNA structure Prediction.

Recommended Books:

1. Principles of medical electronics and Biomedical instrumentation - C Raja Rao& S K Guha, Universities Press.
2. Medical physics - John R, Cameron & G Skefrenick.
3. Essential Bioinformatics – Jin Xiong.

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P-403T/MW

Paper-III
ANTENNAS & RADARS

Unit I:

Antennas: Introduction – antenna equivalent circuits – coordinate system – radiation fields- polarization – isotropic radiator – power gain of an antenna – effective area of an antenna – effective length of an antenna. Hertzian dipole – Half wave dipole vertical antennas – Ground reflections – grounded vertical antennas – folded elements loop and ferrite rod receiving antennas – non-resonant antennas – long wire antenna – rhombic antenna Driven arrays – Broad side array – end-fire array – turnstile antenna Parasitic arrays- Parasitic reflectors – Parasitic directors – Yagi-Uda array – Plane reflector arrays UHF antennas – Discone Omni- Helical antenna – Log periodic antenna Microwave antennas – Horns – Parabolic reflector antenna – variations on the parabolic reflector – Dielectric lens antennas – slot antennas

Unit II:

Introduction- Radar principle, Range, Resolution ,RCS , Doppler Shift, Clutter, Noise, False alarm probabilities, Radar equation. Tracking system properties and parameters. Conical scan angle tracking, Lobing angle tracking, Amplitude Comparison monopulse Angle tracking, tracking accuracy, receivers and displays.

Unit III:

Introduction - Time signals and systems, Frequency domain representation, Z-transform and its properties , Inverse Z-transform methods. Fourier transform of a sequence, relationship between Z-transform, Fourier Transform and discrete transform. Signal Integration, correlation, convolution Spectrum Analysis. Processing errors and windows (cosine family windows and clipped windows)
Recovery from samples – Interpolation, Doppler and moving target indicator (MTI) fundamentals, MTI principles and methods, Blind Doppler shifts, and PRF, Stagger, Destaggering and processing.

Unit IV:

Introduction - Evaluation of waveforms for Range and Doppler Resolution, Analog pulse compression, Digital pulse compression, High cross range resolution. Doppler beam sharpening (DBS) , Side looking synthetic Aperture Radar(SSAR), Airborne Surveillance Radar for Air Traffic control – Doppler processing to combat clutter problems.

Recommended Books:

1. Electronic communications – D. Roddy & J. Coolen 4th edition (PHI) , 16th chapter
2. RADAR Principles, Technology, Applications – Byran Edde (Prentice-Hall)
3. Theory and Application of Digital Signal Processing – L.R. Rabiner and Bernard Gold (Prentice-Hall) 98
4. Electronic communications 4th edition – D. Roddy & J. Coolen

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P-404A/T/MW

Paper – IVA
Communication Theory

Unit I

Noise: introduction – thermal noise – shot noise – partition noise – low frequency noise – burst noise – avalanche noise – bipolar transistor &FBT noise – equivalent input noise generators – signal to noise ratio - cascaded amplifiers - s/n ratio of a tandem connection – noise factor – amplifier input noise in terms of noise factor (f) – noise factor of amplifier in cascade – noise factor and equivalent input noise generators – noise temperature – measurement of noise temperature and noise factor – narrow band pass noise .

Unit II

Digital Communications – Synchronization, Asynchronous Transmission – Probability of Bit error in Base band Transmission – The Matched Filter – Bit-timing recovery –
Eye diagrams – Digital carrier systems – Carrier recovery Circuits – Differential Phase Shift Keying (DPSK) - Hard and Soft Decoders – Error control coding

Unit III

Radio-Wave Propagation : Propagation in free space – Tropospheric Propagation -Ionospheric Propagation – Surface Wave – Low Frequency Propagation and Very Low Frequency Propagation – Extremely Low-Frequency Propagation

Unit IV

Satellite Communications: Introduction – Kepler's Laws – Orbits – Geostationary orbit – Power systems – Attitude Control – Satellite Station keeping – Antenna Look Angles – Limits of visibility – Frequency plans and polarization – Transponders – Uplink power budget calculations – Down link power budget calculations – Overall link budget – Digital carrier Transmission – Multiple-access Methods

Recommended books:

1. Principles of communication systems – Taub &Shilling (TMH) 1999
2. Communications - Dennis Roddy & John Coolen (PHI) 2000
3. Electronic communication systems – George Kennedy (Tata McGraw Hill)

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P-404B/T/MW

Paper – IVB
Signal Conditioning

Unit I:
Introduction: Measurement of errors: accuracy, precision, resolution, sensitivity – absolute and relative errors, types of errors – gross error, systematic error and random error - Statistical Analysis - Probability of errors - Limiting errors. Standards of measurements – classification of standards, time and frequency standards, electrical standards, standards of temperature and luminous intensity. IEEE - standards

Unit II:
Classification of electrical transducers – basic requirement of a transducer - active and passive transducers – Strain gauge – Gauge Factor, Metallic sensing elements, gauge configuration, unbounded strain gauge.
Displacement transducers –inductive, LVDT, Capacitive, Ionization, Oscillation, Photoelectric, PZT, Potentiometric, Velocity transducers. Temperature Measurements - thermocouple.

Unit III:
Signal Conditioning Circuits:
Phase locked loops & applications**:** introduction, basic principle of phase lock loop, phase detector comparator, voltage controlled oscillator – low pass filter – PLL applications
D/A & A/D conversion: methods of D/A (R-2R type) and A/D conversions (successive approximation, dual slope integration and flash types) conversion specifications.

Unit IV:
Methods Of Data Acquisition: interfacing and control for data acquisition - **on-line** and **off-line** data acquisition - case studies (block diagram approach) – software techniques in signal processing and analysis using virtual instruments **(LABview)**

Recommended Books:

1. Modern electronic instrumentation – W.D. Cooper
2. Instrumentation – Rangan, Sarma & Mani.
3. Transducers and instrumentation – DVS murthy.
4. Linear integrated circuits - Roy Choudary and Jain(New age international private ltd.)
5. Labview Software Manual

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PEI 403/T/CMP

Paper – III

OPTICAL PHENOMENA IN SOLIDS

Unit I : Optical Properties Of Solids: Introduction, Relation between dielectric and optical properties (macroscopic theory), Kramers-Kronig relations, Absorption of electromagnetic radiation, Photon-Phonon transitions, Interband transitions, Direct and indirect band gap semiconductors - Absorption coefficients.
Optical Band Transitions: Frenkel and Wannier excitons and their absorption, Imperfections - exciton absorption below the bandgap, Intraband transitions - Absorption and reflection in metals, Hagen-Rubens relation, Raman, Brillouin and Rayleigh scattering, Magneto-optic effects: Faraday effect.

Unit II: Luminescence
General considerations of luminescence, exciton, absorption and emission processes of luminescence, Configuration coordinate diagram, Energy level diagram, radiative and non radiative processes, Decay mechanisms, Effect of doping and efficiency, Energy transfer and charge transfer, Different kinds of luminescence, Electro luminescence, Photoluminescence and Thermo luminescence, Defects and color centers, Different kinds of color centers in the context of luminescence in alkali halides, Thallium activated alkali halides, Zinc sulphide phosphors.

Unit III : Photo detectors
Photoconductors-dc and ac photo conductors, gain & band width, noise in photo conductors, junction photo diodes, PIN diodes, quantum efficiency & frequency response – hetero junction photo diodes, avalanche photo diodes, noise performance of avalanche photo diodes – comparision of avalanche and PIN diodes.

Unit IV : Photo voltaics
Photovoltaic effect, Types of interfaces, homo junction, hetero junction and Schottky barrier- Choice of semiconductor materials for fabrication of homo junction solar cells, equivalent circuit of a solar cell, Solar cell output parameters – Fill factor, conversion efficiency, quantum efficiency, effect of series and shunt resistance on the efficiency of solar cells, Variation of open-circuit voltage and short circuit current with intensity of incident light, effect of temperature on I-V characteristics. .

References:

1. Solar cells – Charles E. Backus, IEEE Press.
2. Fundamentals of Solar cells, Farenbruch and Bube.
3. Principles of theory of solids – Ziman, Vikas Publishing House, New Delhi.
4. Solid State Physics – G. Burns
5. Luminescence and Luminescent Materials – Blasse
6. Solid State Physics – Dekker.
7. Optoelectronic devices _ P. Bhattacharya
8. Physics of semiconductor devices – S. M. Sze.
9. Elementary solid state physics – M. Ali Omar

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PEI 404A/T/CMP

Paper – IVA

RESONANCE PHENOMENON IN SOLIDS

Unit I : Magnetism In Solids

Ferromagnetism - Ferromagnetic coupling, Theory of spin waves, magnons in ferromagnets; Bloch T 3/2 law, **Anti-ferromagnetism** – Molecular field theory, susceptibility and Neel temperature; **Ferrimagnetism** – susceptibility variation with temperature, Neel's theory, **Ferrites** - Structure, properties and applications; Novel magnetic materials – GMR/ CMR materials.

Unit II : Nuclear Magnetic Resonance

Nuclear magnetic resonance (NMR), Basic principles of NMR, Resonance condition, Spin-lattice and Spin-spin relaxation mechanisms, Bloch's equations and complex susceptibility, Chemical shift, Bloch diagram of NMR spectrometer, Analysis of the spectra, Applications of NMR.

Unit III : Electron Spin Resonance

Principle of Electron spin resonance , Nuclear hyperfine interaction, crystal field theory, splitting of energy levels for octahedral and tetrahedral fields in transition metals; rare earth and actinide ions, Experimental details of Electron spin resonance spectrometer; Analysis of ESR spectra.
Elements of Nuclear Quadrupole Resonance (NQR), construction and working of NQR spectrometer.

Unit IV : Mossbauer Effect

Resonance fluorescence/Natural and Doppler broadening of lines, Qualitative theory of recoil less gamma ray emission, Mossbauer effect, Temperature dependence of recoilless process, Debye-Waller factor, Experimental study, Mossbauer spectroscopy, Quantum mechanical theory of Mossbauer effect, Isomer shift, Magnetic hyperfine interactions, Electric quadrupole interactions, Applications of Mossbauer effect.

Recommended books

1. Elementary theory of solid state Physics -- J.P. Srivastava.
2. Mossbauer effect- Principles and applications – G.K.Wertheim,
3. Mossbauer spectroscopy – N.N.Greenwood and T.C.Gibb,
4. Solid State Physics – Singhal;
5. Horizons of Physics, Vol. I, --Wiley Eastern Publishers

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PEI 404B/T/CMP

PAPER – IVB
SEMICONDUCTOR DEVICES AND NANO MATERIALS

Unit : I : SEMICONDUCTOR MATERIALS :-

Direct band and indirect band gap semiconductors, Charge carriers in extrinsic semiconductors, Effect of heavy doping, Diffusion currents, Mobility and its dependence on temperature and doping , Excess carriers in semiconductors – low level and high level injection, Recombination of electro – hole pairs – various recombination mechanism. Types of junctions, abrupt and graded junctions, - potential distribution, space charge, built in voltage and junction capacitance, carrier concentration across the junction, Recombination.

Unit:II: QUANTUN WELL DEVICES

Review of the quantum mechanics of infinitely deep coupled potential wells. Artificial structures resembling such coupled potential wells; semiconductor hetero junction super lattices; their preparation by various epitaxial techniques; Properties of semiconductor super lattices-optical absorption, resonance tunneling, negative differential conductivity, modulation doped semiconductors; n-i-p-i structures; Inversion layers in MOSFETS and MODFETS; metallic super lattices -their preparation,characterisation and properties.

Unit : III : NUCLEAR MAGNETIC RESONANCE :-

Nuclear Magnetic Resonance(NMR), Basic principles of NMR, resonance conditions, Spin-lattice and spin–spin relaxation mechanism, Bloch's equations and complex susceptibility, chemical shift, block diagram of NMR spectrometer, analysis of the spectra, application of NMR.

Unit : IV : OPTOELECTRONIC DEVICES :-

The ideal heterojunction, current – voltage characteristics, common anion rule. Light emitting diodes – Electroluminescent process. Excitation and emission, LED materials, Device configuration and efficiency, light out put, LED structures, Manufacturing process; semiconductors lasers – lasing condition in a semiconductor, threshold condition 87
for lasing junction laser – operating principle, threshold current, power output, hetrojunction lasers, losses, laser diodes material, Device fabrication, laser mounting and fibre coupling.

Recommended Books

1. Semiconductors material and devices – Thyagi , John Wiley
2. Semiconductors optoelectronic devices – Pallab Bhattachary
3. Physics of semiconductor devices – Sze , John Wiley
4. Physics and Technology of semiconductor devices – Sze , John Wiley
8. Solid state Physics – G.Burns
9. Hand Book of nanostructured materials and Nanotechnology (Vols 1-4)
Ed: Hari Singh Nalwa
10. Nano crystalline materials -H.Gleiter
11. Nanophase materials – R.W.Seigel

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P 403 T/OE

Paper-III - FIBER OPTICS

Unit I

Optical fiber Guide: Ray theory transmission: total internal reflection, numerical aperture, planar wave guides, classification of modes, TE and TM modes in a symmetric step-index planar wave guide, radiation modes, Goos-Haenchen shift, Nonplanar waveguides, skew rays, modes in cylindrical waveguides, modal analysis for a step-index and parabolic index fibers, single mode fibers.

Unit II

Transmission Characteristics of Optical Fibers: Attenuation, material absorption losses, linear and nonlinear scattering losses, fiber bend loss, fiber alignment and joint losses, Dispersion, intermodal dispersion in step and graded index multimode fibers, intramodal dispersion, dispersion modified single-mode fiber, fiber birefringence, polarization-mode dispersion.

Unit III

Nonlinear effects of optical fibers: Fiber nonlinearities, nonlinear refraction, group velocity dispersion, cross phase modulation, self-phase modulation, Four wave mixing, stimulated Raman scattering, stimulated Brillouin scattering, concept of solitons - Nonlinear Schrödinger equation, formation of solitons, fundamental solitons, dark solitons.

Unit IV

Fabrication of Optical Fibers: Glass fiber drawing. Liquid-phase technique, vapor-phase deposition techniques: outside vapor-phase oxidation process, vapor axial deposition, modified chemical vapor deposition, plasma-activated chemical vapor deposition.

Measurements: Fiber attenuation, dispersion, refractive index profile, cutoff wavelength, numerical aperture, outer and inner diameters, mode field diameter, Eye patterns

Reference Books:

1. Optical Fiber communications: principles and practice - John M.Senior, Pearson Education, 3rd edition.
2. Optical Fiber communications - Gerd Keiser, McGraw-Hill, 4th edition.
3. Fiber Optics communications - Govind P.Agarwal, Academic Press, 3rd edition.
4. Introduction to Fiber Optics - A.Ghatak and K.Thyagarajan, Cambridge University Press
5. Fiber optic measurement techniques - Rongqing Hui and Maurice O'Sullivan, Elsevier/Academic Press.

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P 404A T/OE

Paper-IVA
FIBER OPTIC COMMUNICATION SYSTEMS

Unit I

Optical Fiber Systems: Elements of fiber optic system, analog and digital signals, noise effects, analog systems – signal-to-noise ratio, digital systems - power budgeting, bit error ratio, sampling and quantizing the analog signal, line coding, optical transmitter circuit - source limitations, drive circuits for LED and LASER; optical receiver circuit-preamplifier; direct modulation techniques.

Unit II

Coherent Optical Fiber Systems: Detection principles, practical constraints, modulation formats, demodulation schemes - heterodyne synchronous and nonsynchronous, homodyne detection, receiver sensitivities. Advanced multiplexing systems: optical time division multiplexing, subcarrier multiplexing, orthogonal frequency division multiplexing, wavelength division multiplexing, optical code division multiplexing

Unit III

Fiber Connection: Cable Design, fiber splices, fiber connectors, expanded beam connectors, fiber couplers, optical isolators.

Optical Sensor Systems: Intrinsic and extrinsic sensors, Intensity modulation sensors, frequency modulated sensors, wavelength sensitive sensors, phase modulation sensors, multiplexing of phase sensors, polarization modulation, interferometric sensors, Fiber Bragg gratings, fiber-optic gyroscopes.

Unit IV

Optical Networks: Network topologies – bus, ring, star, mesh; performance features of networks, local area networks – ATM, SONET, FDDI, Fiber net, SOLAR net, Ethernet, broadband ISDN, WDM light wave networks – single-hop and multi-hop operations, ultrahigh capacity networks, wavelength conversion, performance features.

Reference Books:

1. Optical Fiber communications: principles and practice - John M.Senior, Pearson. Education, 3rd edition.
2. Optical Fiber communications - Gerd Keiser, McGraw-Hill, 4th edition.
3. Fiber Optic Communications - Joseph C. Palais, Pearson, 5th Edition.
4. WDM optical Networks – C. Siva Ram Murthy and Mohan Guruswamy, Prentice Hall, 2002.
5. WDM Technologies: Optical Networks - Achyut K. Dutta, Niloy K. Dutta, Masahiko Fujiwara, Academic Press, 2004.

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P 404B T/OE

Paper IVB
OPTICAL FIBER SENSOR TECHNOLOGY

Unit I: Introduction, light waves in optical fiber sensors, advantages and general features of optical fiber sensors, fields of applications, components of OFS - illuminating sources; types of fibers, detectors; modulation schemes (intensity, polarization, phase and wavelength); measurands, classification of OFS –intrinsic and extrinsic sensors; single point and distributed measurement, simple fiber sensors for displacement, temperature and pressure measurements.

Unit II: Intensity modulated fiber sensors: general features, intensity modulation through light interruption between two multimode fibers, reflective fiber optic sensor, fiber optic liquid level sensing, fiber optic refractometer, fiber optic sensor based on side polished fiber half-couplers, light transmission in micro bend fibers – micro bend OFS- measurements with micro bend sensors- evanescent wave phenomenon- evanescent wave FOS- chemical sensors using EWFOS

Unit III: Interferometric FOS: basic principle, interferometric configurations - Mach-Zander, Michelson, Fabri-Perot and Sagnac- applications of interferometric FOS.
Phase modulated fiber sensors: general features, Fiber optic acoustic sensors, Fiber optic current sensor, fiber-optic gyroscopes, Polarization modulated sensor.

Unit IV: Distributed optical fiber sensor – basic principle, Rayleigh, Raman and Brillouin scattering based techniques and applications, quasi-distributed optical fiber sensor. Fibre Bragg grating sensors - Fibre Bragg gratings, Bragg grating into interferometer, FBGS interrogators, applications, fiber optic sensor arrays.

Reference books:

1. Fibre optic sensors, principles and applications - B D Gupta, New India publishing agency, 2006.
2. Fundamentals of fibre optics in telecommunications and sensor systems - B.P. Pal, Wiley Eastern, 1994.
3. Handbook of optical sensors - edited by Jose Louis Santos and Faramarz Farahi, CRC press.
4. Optical fibre sensor technology- devices and technology, vol. 2- K.T.V.Grattan and B.T.Meggitt, Springer science, 1998.
5. Optical Fibre sensors, components and subsystems Vol. 3- Brain Culshaw and John Dakin, Artech House Inc.,1996.

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P 401T/AE

Paper - I

DIGITAL SYSTEM DESIGN USING VHDL

Unit I :Basic Language Elements : Identifiers, Data objects, Data types, Operators.

Behavioural Modeling : Entity declaration, Architecture body, Process statement, Variable assignment statement, Signal assignment statement , Wait statement, If statement, Case statement, Null statement, Loop statement, Exit statement, Next statement, Assertion statement, Report statement, other sequential statements, Multiple processes, Postponed processes.

Unit II :Data Flow Modeling

Concurrent signal assignment statement, Concurrent versus sequential signal assignment, Delta delay revisited, Multiple drivers, Conditional signal assignment statement, selected signal assignment statement. The unaffected value block statement, concurrent assertion statement, Value of a signal.

Structural Modeling : An Example, Component declaration, Component instantiation and examples, Resolving signal values.

Generics, Configuration specification, Configuration declaration, Default rules, Conversion functions, Direct instantiation, Incremental binding.

Unit III:Subprograms and Overloading : Subprograms - Subprogram overloading, Operator overloading, Signatures, Default values for parameters.

Packages and Libraries : Package declaration, Package body, Design file, Order of analysis, Implicit visibility, Explicit visibility.

Advanced Features : Entity statements, Generate statement, Aliases, Qualified expressions, Type conversions, Guarded signals, Attributes, Aggregate targets, More details on block statements, Shared variables, Groups, More details on ports.

Unit IV :Model Simulation: Simulation - Writing a Test Bench - Converting real and integer to time - Dumping results into a text file - Reading vectors from a text file - A test bench example - Initializing a memory -Variable file names.

Hardware Modeling Examples : Modeling entity interfaces, Modeling simple elements, Different styles of modeling, Modeling regular structures, Modeling delays, Modeling conditional operations, Modeling synchronous logic. State machine modeling, Interacting state machines, Modeling a Moore FSM, Modeling a Measly FSM.

Recommended Books :

1. A VHDL Primer- By J.Bhasker., Pearson Education Asia, 11th Indian Reprint, 2004.
2. VHDL Programming by Example - By Douglas L. Perry, 4th Ed., TMH., 2002.
3. Introductory VHDL : From Simulation to Synthesis-By Sudhalar Yalamanchili., Pearson Education Asia 2001..
4. Fundamentals of Digital Logic with VHDL Design-ByStephen Brown & Zvonko Vranesic., THM 2002.
5. Digital Systems Design usingVHDL by Charles H.Roth Jr.PWS Pub., 1998.
6. VHDL –Analysis & Modeling of Digital Systems-By Zainalabedin Navabi., 2nd Ed., MH., 1998.

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P 402T/AE

Paper –II

MICROCONTROLLER AND APPLICATIONS

Unit I :The 8051 Microcontroller

Microcontrollers and Embedded processors, overview and Block diagram of the 8051; Inside the 8051, Assembling and Running an 8051 Program, The Program Counter and ROM space, Date Types and Directives, Flag Bits and PSW Register, Register Banks and Stack; Pin Description, I/O Programming, Bit Manipulation; Addressing Modes- Immediate and Register Addressing Modes, Accessing Memory using Various Addressing Modes

Unit II: Programming the 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Division of Signed and Unsigned and Unsigned Numbers; Logical Instruction and Programs- Logic, Compare, Rotate, Swap, BCD and ASCII Application Programs; Single Bit Instructions and Programming –Single Bit Instructions with CY; Jump, Loop and call Instructions, Time Delay Generation and Calculation; Timer/Counter Programming, Serial Communication an interrupts Programming

Unit III: Interfacing and Applications of 8051

Interfacing and LCD, ADC and Sensors with the 8051; Interfacing a stepper Motor, Keyboard and DAC to generate waveforms on CRO with the 8051

Unit IV: Programming, RTOS and Development Tools

Assembly and C programming - programming basics –Structure of the CPU registers and Internal RAMs –Programming in Assembly language –assemblers –saving CPU Status During Interrupts –Passing Parameters –Control Computing Branch Destination at Run time – Programming in C and use of GNU tools - Stacks –Queue –Table –Strings –State Machine – Key parsing.

Real Time Operating System for System Design- Real Time Operating System, Exemplary RTX51, RTOS of Keil, Uses of RTOS in Design, Microcontroller Application Development Tools- Development Phases of Microcontroller- Based System, Software Development Cycle and Applications, Software Development Tools, Exemplary IDE- Microvision and Tools from Keil, Emulator and In-circuit Emulator(ICE), Target Board, Device Programmer.

Recommended Books:

1. The 8051 Microcontrollers and Embedded Systems- By Muhammad Ali Mazidi and Janice Gillispie Mazidi, Persong Education , Asia, 4th Reprint, 2002
2. The 8051 Microcontroller- Architecture, Programming & Applications –By Kenneth J. Ayala, Penram International Publising , 1995
3. Microcontrollers Architecture, Programming Interfacing and System Design- By Raj Kamal, Pearson Education.

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P 403T/AE

Paper - III

CONTROL SYSTEMS

Unit – I :General concepts and Mathematical techniques:
Introduction, Open loop control system, Closed loop control systems, Modern control system applications .Transfer function concept, transfer function of common networks (RC, RL & RLC), Transfer function of physical systems, Block Diagram Representation of Control System, Block Diagram reductions, Signal Flow Graph and Masons Gain formula, Reduction of signal flow Graphs, Applications of signal flow Graph - .

Unit – II :State equations and Transfer Function representation of Physical control system elements:
State Space Concepts, the State Variable Diagram. State Equations Of Electrical Networks, Transfer Function And State Space Representation Of Typical Mechanical, Electrical, Hydraulic, Thermal Systems.

Time domain analysis of control systems: Typical Test Signals for the Time Response of Control Systems – Steady State Error – Unity Feedback Systems. Steady State Error For A Unity Feedback System With Step Input, Ramp Input And Parabolic Input – Unit Step Response And Time Domain Specifications – Transient Response of a Prototype Second Order System – Effect Of Adding Poles And Zeros To Transfer Functions

Unit – III : The Concept of Stability – Routh Hurwitz Stability Criterion - The Stability of State Variable Systems – Root Locus method, Root Locus Concept – Properties and Construction of Root Loci – Frequency Plots – Polar and Bode plots – Frequency Domain Specifications – resonant peak , resonant angular frequency and band width of 2^{nd} Order System - Nyquist Stability Criterion – Applications.

Unit – IV : Design of Control Systems – Introduction, Cascade Compensation Techniques, Minor loop feedback compensation techniques, and example of the design of a linear feedback control system – Design with PD controller – Time Domain interpretation of PD controller – Design with PI controller – Time domain interpretation and design of PI controller – Design with PID controller – Design with phase lead controller – Time domain interpretation and design of phase lead controller – Design with phase lag controller – Time domain interpretation and design of phase lag controller – Design with lead and lag controller – Polo zero cancellation compensation.

Recommended Books

1. Automatic Control systems – Benjamin C. Kuo, (PHI)
2. Modern Control systems – Richard C.Dorf and Robert H. Bishop, Addison Wesley Publications
3. Control systems principles and design - by M.Gopal 2^{nd} edition 2002 (MGH)
4. Control and Systems Engineering – I J Nagarath and M Gopal, (New Age Int Pub)
5. Modern control engineering – Katsuhiko Ogata –PHI

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P 404A-T/AE

Paper - IVA

MICROWAVE SYSTEMS

Unit I : Microwave Waveguides And Components

Rectangular Waveguides , Solutions of Wave equations in Rectangular coordinates , TE modes in Rectangular Waveguides , TM modes in Rectangular Waveguides , Circular Waveguides , Solutions of Wave equations in Cylindrical coordinates , TE modes in Cylindrical Waveguides , TM modes in Cylindrical Waveguides , TEM modes in Cylindrical Waveguides , Microwave cavities , Rectangular cavity resonator , Circular cavity resonator, Semicircular cavity resonator , Q Factor of a Cavity Resonator.

Unit II: Passive Microwave Devices

Scattering Matrix formulation , Properties of S-matrix, Symmetry of Scattering Matrix, Scattering Matrix for lossless junction, Scattering Matrix for a two-port junction, S-matrix of E-plane and H-plane Magic Tee, Hybrid Rings, Directional Couplers and Circulators. Termination, Phase Shifters , Rotary Phase Shifters , Electronically controlled Phase shifters , Hybrid Ring , Power Dividers - Farady rotation and its applications : Gyrator, Isolator and Three-port Circulator.

Unit III : Strip Lines

Microstrip Lines , Characteristic Impedance of Microstrip lines , Losses in Microstrip lines , Quality Factor Q of Microstrip lines , Parallel strip lines : Distributed parameters , Characteristic impedance , Attenuation losses , Coplanar strip lines , Shielded strip lines.

Monolithic Microwave Integrated Circuits [MMICs] , Materials (Substrate, Conductor, Dielectric and Resistive) , MMIC Fabrication Technique.

Unit IV : Avalanche Transit-Time Microwave Devices

Negative resistance devices , Tunnel diode, Avalanche effect , IMPATT , TRAPATT and BARITT Diodes, Parametric devices : Physical Description , Non-linear reactance and Manley-Rowe power relations Parametric Amplifiers **,** Parametric Up and Down – Converters.

TEXT BOOKS :

1. Microwave Devices and circuits - By S.Y.Liao
2. Fundamentals of Mcrowave Engineering - R.E.Collin -Megraw-Hill International
3. Composite Satellite and Cable Television - R.R.Gulati - New Age International Publishers
4. Electronic Cominunication - IV Edition - Dennis Roddy and John Coolen
5. Electronic Communications Systems - G.Kennedy - Tata-MacGraw-Hill Series

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P 404B-T/AE

Paper - IVB

Local Area Networks & TCP/IP Protocols

Unit-I:
Local Area Network Overview : Topologies and Transmission Media, LAN Protocol Architecture, Bridges ,Layer 2 and Layer 3 Switches ,**High-Speed LANs:** The Emergence of High-Speed LANs ,Ethernet, Fibre Channel , **Wireless LANs :**Overview, Wireless LAN Technology , IEEE 802.11 Architecture and Services , IEEE 802.11 Medium Access Control ,IEEE 802.11Physical Layer, IEEE 802.11 Security Considerations

Unit-II:
Internetwork Protocols : Basic Protocol Functions ,Principles of Internetworking , Internet Protocol Operation ,Internet Protocol ,IPv6 586, Virtual Private Networks and IP Security ,
Internetwork Operation : Multicasting, Routing Protocols, Integrated Services Architecture ,Differentiated Services, Service Level Agreements, IP Performance Metrics ,

Unit-III:
Transport Protocols : Connection-Oriented Transport Protocol Mechanisms ,TCP ,TCP Congestion Control ,UDP
Network Security : Security Requirements and Attacks ,Confidentiality with Conventional Encryption , Message Authentication and Hash Functions , Public-Key Encryption and Digital Signatures ,Secure Socket Layer and Transport Layer Security , IPv4 and IPv6 Security ,Wi-Fi Protected Access ,

Unit-IV:
Internet Applications—Electronic Mail and Network Management : Electronic Mail: SMTP and MIME7,Network Management: SNMP
Internet Directory Service and World Wide Web : Internet Directory Service: DNS , Web Access: HTTP

Multimedia : Audio and Video Compression ,Real-Time Traffic , Voice Over IP and Multimedia Support—SIP , Real-Time Transport Protocol (RTP) ,

Recommended Text Books

1. Data and Computer Communications - William Stallings (Seventh & Eighth edition)
2. Data Communication and Networking, Behrouz A. Forouzan, 3/e, THM
3. Computer Networks –A.S.Tanenbaum (Third edition)