DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY

REVISED SYLLABUS FOR M.Sc. (PHYSICS)

III SEMESTER

With effect from the academic year 2023 – 2024onwards

S.No	Paper code	Paper	Paper title	Instructions Hrs / Week	Credits	Max Marks
1.	P301T	Core Paper- I	Modern Optics	3	3	100*
2	P302T	Core Paper- II	Advanced solid state physics	3	3	100*
Solid State Physics(SSP)						
3	P303T/SSP	Elective Paper- I	Band Theory & electrical Properties	3	3	100*
4	P304T/SSP	Elective Paper - II	Crystal Physics and Physics of Phonons	3	3	100*
Materials Science (MS)						
5	P303T/MS	Elective Paper- I	Mechanical Properties of materials	3	3	100*
6	P304T/MS	Elective Paper - II	Thin films and their properties	3	3	100*
Electronics& Instrumentation (E&I)						
7	P303T/EI	Elective Paper- I	Electronic Instrumentation	3	3	100*
8	P304T/EI	Elective Paper - II	Embedded Systems and its applications	3	3	100*
Nano Science (NS)						
9	P303T/NS	Elective Paper- I	Synthesis and Characterization of Nanomaterials	3	3	100*
10	P304T/NS	Elective Paper - II	Properties of Nanomaterials	3	3	100*
Electronics Communications (EC)						
11	P303T/EC	Elective Paper- I	8051 Microcontroller &its applications	3	3	100*
12	P304T/EC	Elective Paper - II	Data and Computer communications	3	3	100*
Bio Physics (BP)						
13	P303T/BP	Elective Paper- I	Molecular and Environmental Biophysics	3	3	100*
14	P304T/BP	Elective Paper - II	Physico-chemical techniques in Biophysics	3	3	100*
Condensed Matter Physics (CMP)						
15	P303T/CMP	Elective Paper- I	Lattice Dynamics in Crystals	3	3	100*
16	P304T/CMP	Elective Paper - II	Optical Phenomena in Solids	3	3	100*

Opto Electronics (OE)						
17	P303T/OE	Elective Paper- I	Introduction to optoelectronics	3	3	100*
18	P304T/OE	Elective Paper - II	Semiconductor Optoelectronics	3	3	100*
			PRACTICALS			
19	P 305P	V	General Physics lab	4	2	50
20	P 306P	VI	Special lab	8	4	100
			Seminar		2	50
Total					**20**	**600**

Applied Electronics (AE)					Credits	Marks
21	P301T/AE	Core Paper- I	Digital System Design	3	3	100*
22	P302T/AE	Core Paper- II	Digital signal processing and digital signal processors	3	3	100*
23	P303T/AE	Elective Paper- I	Data communication and networking	3	3	100*
24	P304T/AE	Elective Paper - II	Microcontroller and applications	3	3	100*
			PRACTICALS			
25	P 305P	V	Analog/Digital/Microcontroller Lab	8	4	100
26	P 306P	VI	DSP Lab	4	2	50
			Seminar		2	50
					20	**600**

Details of credits and marks	
Number instruction hours per each theory paper per week	3
Maximum marks for each theory paper	100(70 semester exam + 30 internal evaluation)
Number of credits for each theory paper	3
Number instruction hours per each practical paper per week	8/4
Maximum Marks per each practical paper	100/50
Number credits per each practical paper	4/2
Total Credits per semester	20

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DEPARTMENT OF PHYSICS, OSMANIA UNIVERSITY
M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2023-2024 onwards)
Core Paper – I(Common for all Specializations)

Course Code	Course Title	L	T	P	C
P-301T	**MODERN OPTICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To identify conditions for lasing phenomenon and properties of the laser.
COB2	To classify different types of lasers with respect to design and working principles.
COB3	To understand the basics of holograms and able to differentiate between holography and Photography.
COB4	To understand the concept of Fourier transforming properties of lenses.
COB5	To understand the concept of non-linear optical process in which photons of intense incoming laser radiation interact with a non-linear material and how radiation with corresponding harmonic frequencies are generated.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to evaluate conditions for lasing phenomenon and properties of the laser.
COC2	Able to appraise different type of lasers with respect to design and working principles.
COC3	Able to identify the parameters which differentiate holograms from photographs
COC4	Able to distinguish between various types of holograms and to analyze the different parameters of holographic recording materials.
COC5	Able to evaluate intensity dependent material properties like refractive indices, optical mixing and self-focussing of light.

Unit I: Lasers: Emission and absorption of Radiation, Einstein Relations, pumping Mechanisms, Optical feedback, Laser Rate equations for two, three and four level lasers, pumping threshold conditions, Laser modes of rectangular cavity, Properties of Laser beams. He- Ne, CO_2 Gas lasers, Excimer laser, Ruby, Nd-YAG laser and their applications.

Unit II: Holography: Basic Principles of Holography- Recording of amplitude and phase, the recording medium, reconstruction of original wave front, image formation by wave front reconstruction, Gabor Hologram, limitations of Gabor Hologram, Off axis Hologram, Fourier transform Holograms, Volume Holograms, Applications of Holograms- Spatial frequency filtering.

Unit III: Fourier and Non-Linear Optics: Fourier optics- Thin lens as phase transformation, Thickness function, Fourier transforming properties of lenses, Object placed in front of the lens, Object placed behind the lens.
Non-Linear Optics, Harmonic generation, Second harmonic generation, Phase matching condition, Optical mixing, Parametric generation of light, Self focusing of light.

Recommended Books:

1. Opto Electronics- An Introduction–Wilson & JFB Hawkes 2nd Edition.
2. Introduction to Fourier optics –J.W. Goodman
3. Lasers and Non-Linear optics –B.B. Laud
4. Optical Electronics –Ghatak and Thyagarajan.
5. Principles of Lasers –O. Svelto
6. Laser fundamentals Silfvast Cambridge

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M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2023-2024 onwards)
Core Paper –II (Common for all Specializations)

Course Code	Course Title	L	T	P	C
P-302T	**ADVANCED SOLID STATE PHYSICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understand the electronic properties of metals by studying the Brillouin zones and Fermi surfaces.
COB2	To study the effect of electric and magnetic fields on Fermi surfaces in metals.
COB3	To understand the basic concept of Dielectrics and Magnetic properties of solids and different types of polarizabilities, ferroelectrics and their properties.
COB4	To understand the classification of magnetic materials and the theories to explain Ferromagnetism, Anti-ferromagnetism and Ferri-magnetism and their applications.
COB5	To study the superconductivity and their properties and to understand theories to explain the superconductivity and their applications.

Course Outcomes: After the completion of this course the student will be:

COC1	Able tounderstand and gain the knowledge of electrical, dielectric and magnetic properties of solids and superconductivity and its applications.
COC2	Able to construct the Brillouin zones and Fermi surfaces and to identify the energy bands in solids.
COC3	Able to distinguish different types of polarizabilities and their behavior in AC fields and to classify the ferroelectric materials and their properties
COC4	Able to identify different types of magnetic materials and their applications.
COC5	Able to understand superconductivity its properties and applications.

Unit I: Electronic Properties: Introduction to band theory of solids. Fermi surface and Brillouin zones.Construction of Fermi surfaces. Extended, periodic and reduced zone schemes. Fermi surfaces in simple cubic, bcc and fcc lattices. Effect of electric and magnetic fields on Fermi surfaces.Anomalous and skin effects.Cyclotron frequency, energy levels and density of states in magnetic field, De Haas-van Alphen effect.

Unit II: Dielectrics and Magnetic properties of solids: Introduction to Dielectrics, Concept of local field. The electronic, ionic and orientationalpolarizabilities.Clausius-Mosotti relation.Behavior of dielectrics in an alternating field, Classification of ferroelectrics- Ba TiO_3 and KDP.Theory of ferroelectrics, ferroelectric hysteresis.

Origin of permanent magnetic moment, Spontaneous magnetization,Weiss theory of spontaneous magnetization.Nature and origin of Weiss molecular field, Heisenberg exchange interaction.Spin waves, Ferromagnetic domains and hysteresis.The Bloch wall, Neel's theory of anti-ferromagnetism.Ferrimagnetism, ferrites and their applications.

Unit III: Superconductivity: Introduction to type-I and type-II superconductors,Isotope effect, entropy, heat capacity and thermal conductivity. Energy gap, London equations, penetration depth, Coherence length, Cooper pairs and elements of BCS theory, BCS ground state.Giaver tunneling, DC and AC Josephson effects.SQUID,Elements of high temperature superconductors and applications.

Recommended Books:

1.Solid State Physics	--A.J.Deckker
2.Introduction to Solid State Physics	--Kittel
3.Solid State Physics	--R.L.Singhal
4.Elements of Solid State Physics	--J.P.Srivastava
5.Solid State Physics	--M.A.Wahab

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

(For the batch admitted from 2023-2024 onwards)

Elective Paper –I

Course Code	Course Title	L	T	P	C
P-303T/SSP	**BAND THEORY AND ELECTRICAL PROPERTIES**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understanding the structure of crystals structures with examples, and the study of Energy versus wave vector relations.
COB2	To define Brillouin zones in one, two and three dimensions and how the density of states are distributed and to understand the energy versus wave vector representations in in one, two and three dimensions.
COB3	To understand the behavior of an electron in cellular method, APW method, Pseudo potential method, OPW method and the studying the variation of energy with momentum vector in the above mentioned methods.
COB4	To understand the transport properties of semiconductors and metals limited by electric current density J in the presence of electric field.
COB5	To understand the electrical conduction from the hopping of electrons from one site to another site in the crystal.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the structure of crystals in 1, 2 and 3 dimensions. It also helps to understand the variation of energy (E) of an electron with its moment vector (K). E vs K variation is not linear but is discontinuous at the boundaries of the Brillouin zones defined as first, second, third etc. separated by certain values of K. .
COC2	Able to determine the quantities such as such as electrical conductivity, current density for an electron in the presence of electric field.
COC3	Able to determine the electrical conduction is from the hopping of electrons from one site to another site in hoppers or electron transfer materials.
COC4	Able to identify the phenomena of conductivity in ionic crystals are due to the movement of ions from one site to another site.
COC5	Able to understand the structures of α-AgI and β-alumina unit cell and the defects present in their structures and the properties of super ionic conductors.

Unit I : Band Theory Of Solids : Brillouin zones.- Brillouin zones in one, two and three dimensions., Density of states, Extended, reduced and periodic zone schemes; Nearly free electron model, Tight binding approximation and its application to simple cubic lattice, Calculation of energy bands- Cellular method, APW method, Pseudo potential method, OPW method.

Unit II : Transport Phenomenon In Metals: The Boltzmann transport equation, Electrical conductivity, Definition and experimental features – The Drude Lorentz theory, The Sommerfeld theory- Calculation of the relaxation time, The electrical conductivity at low temperatures, Matheissen's rule, Thermal conductivity, Wiedemann-Franz law, Hall-effect-Hall coefficient and Hall angle.

Unit III : Electrical Transport Properties of Insulators : Hopping conduction; Temperature variation of electrical conductivity; Seebeck coefficient; Polarons- small polaron band conduction; large polaron band conduction; small polaron hopping conduction; Mott transitions; Ionic Conductivity- conductivity, mobility,Nernst-Einstein relation; Superionic Conductivity-structure, structures of α-AgI and β-alumina unit cell;Defects- defect equilibria and conductivity; Properties of super ionic conductors

Recommended books

1. Principles of the theory Solids – Ziman
2. Solid state Physics - Singhal
3. Solid state Physics – H.C. Gupta
4. Elementary SolidState Physics – M.Ali Omar
5. SolidState Physics – M.A. Waheb
6. SolidState Physics – Kachava,

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(For the batch admitted from 2023-2024 onwards)

Elective Paper– II

Course Code	Course Title	L	T	P	C
P-304T/SSP	**CRYSTAL PHYSICS AND PHYSICS OF PHONONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To study the basic crystallographic point groups and space groups of crystal structures.
COB2	To learn Mullikan symbolism and rules of crystal symmetry .
COB3	To understand the concept of phonons.
COB4	To learn phenomenological description of diffusion.
COB5	To study the theoretical concepts of ionic conductivity in detail.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the complete concepts of crystal structure and symmetry operations.
COC2	Able to draw characteristic tables, which describes the complete set of irreducible representations of a symmetry group.
COC3	Able to determine the role of phonons in the conductivity and interaction processes.
COC4	Able to identify different types of diffusion process with the help of phenomenological theories like Nernst-Einstein relations.
COC5	Able to understand the effect of divalent impurities on ionic conductivity.

Unit I : Elements of group theory: Introduction to crystallographic point groups, the five platonic solids, procedure for symmetry classification of molecules, class, matrix notation for geometrical transformations, matrix representation of point groups, reducible and irreducible representations, great orthogonality theorem and its consequences, Character tables for C_{2V} and C_{3V} point groups, Mullikan symbolism, Symmetry species.

Development of theoretical formalism, tensors, Physical property and its tensorial representation.Quotient theorem, Symmetry in crystals - point groups and space groups.

Unit II: **Phonon Physics** :Theoretical background of lattice vibrations – Phonons and their properties – Crystal momentum – Conservation – Neutron diffraction from phonons – Experimental verification of dispersion relations – Thermal conductivity – Role of phonons – Thermal conductivity – Normal and Umklapp processes – Photon –Phonon interaction – TO and LO phonons – Lyddane– Sach–Teller's (LST) relation – Applications – Infrared measurements, Raman effect – Theory of polaritons – Experimental measurement.

Unit III: **Diffusion in solids** :Solid state diffusion, Diffusion mechanisms, Self-diffusion, Impurity diffusion coefficient, Fick's second law, Diffusion coefficient, Experimental determination of diffusion coefficient, Various methods, Random walk diffusion, Diffusion in a simple cubic structure, Diffusion under external field, Nernst-Einstein relation, Kirkendall shift.

Ionic conductivity, Ionic conductivity of alkali halides and effect of divalent impurities on ionic conductivity.

Recommended Books

1. Solid State Physics - G. Burns;
2. Intermediate Quantum Theory of Crystalline Solids – Alexander O E Animalu
3. Solid State Physics – H .Ibach and H. Luth
4. Fundamentals of Solid State Physics – J.R. Christman,
5. Solid State Physics, Solid State Device and Electronics, Kachhava, C. M..
6. Solid State Physics – A.J. Dekker
7. Solid State Physics –M A Wahab.
8. Chemical applications of group theory F.A. Cotton
9. Physical properties of crystals J.F.Nye;
10. Physics of crystals S.Bhagavantam and S.Radhakrishna,

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Elective Paper– I

Course Code	Course Title	L	T	P	C
P-303T/MS	**MECHANICAL PROPERTIES OF MATERIALS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To study the basic dislocations and their interactions.
COB2	To study mechanical behavior of materials.
COB3	To understand the concept of elastic behaviour of materials.
COB4	To learn about creep resistant materials.
COB5	To study the deformation of poly crystalline materials.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the complete concepts of dislocations in materials.
COC2	Able to understand the stress-strain curves.
COC3	Able to determine the activation energy.
COC4	Able to measure mechanical parameters of materials.
COC5	Able to understand the re-crystallization, grain growth and grain sixe on dislocation motion..

Unit I: Dislocations: Dislocations - Edge and screw dislocations, Mixed dislocation, Burgersvector and Burgers circuit, Stress field of dislocation, Force on a dislocation, Line tension,Forces between dislocations, Interaction of dislocations, Elastic energy of dislocations,Movement of dislocations, Glide motion, Slip vector and slip plane, Climb of an edgedislocation, creation of jogs, - Jogs and kinks, Grain Boundaries, Small angle boundaries –Tiltandtwist boundaries, energies.

Unit II: Elastic Behavior of Materials: Mechanical behavior of crystalline materials: Elasticdeformation - Thermo elastic effect, An-elasticity, Relaxation, Plastic deformation. TensileTest,Mechanicalparameters,Hardness(Brinell, Vickers andRockwell)tests,Pierl's force, Stress – strain curves of crystals, Differentstages, Dislocation mechanisms in easy glide stage, Multiplication of dislocations – Frank-Readsource,Creep,creepcurve,Mechanismofcreep,activationenergy,Dislocationmechanisms ,Creep resistant materials.

UnitIII:StrengtheningMechanisms: StrengtheningMechanisms:WorkhardeningorStrain hardening – Degree of cold working, Dislocation mechanisms-creation of Partial dislocations in f.c.c crystals, sessile dislocations, dislocation locks, dislocation pileups; Deformation ofpoly crystalline materials; Annealing – Re-crystallization, grain growth, recovery, effect ofgrain size on dislocation motion.

Recommended Books:

1. MaterialsScienceandEngineering –W.D.CallisterJohn Wiley&Sons
2. PhysicalMetallurgyprinciples –ReedHill,RobertMc-GrawHill
3. ElementsofPhysical Metallurgy –A.G.GuyAddison-Wesley
4. PhysicalMetallurgy –R.W.Cahn.andPeterHaasen,NorthHolland
5. MaterialScience Kakani.S.L,AmitKakaniNewage

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M.Sc. (Physics) - III Semester Syllabus

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Elective Paper– II

Course Code	Course Title	L	T	P	C
P-304T/MS	**THINFILMSANDTHEIRPROPERTIES**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To study the basic techniques of thin film deposition and preparation.
COB2	To learn about various types of gauges.
COB3	To study the thin film thickness measurement.
COB4	To learn about ellipsometry.
COB5	To study the properties of thin films.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the complete concepts of thin film preparation
COC2	Able to measure thickness of thin films.
COC3	Able to determine dielectric constant of thin films.
COC4	Able to identify different types of reflection, transmission and absorption by thin films
COC5	Able to understand the dielectric thin films and their properties.

UnitI

Vacuum Techniques & ThinFilm Deposition Methods

Productionofvacuum,vacuumpumps,Oilsealrotaryandrootspumps,diffusionpumps,turbom olecular pump, cryogenic, cryosorption and getter pumps, measurement of vacuum-various types of gauges, Bourdon gauge, Piranigauge, Penninggauge.

Methodsofthinfilmpreparation,thermalevaporation,electronbeamevaporation,pulsedlaserd eposition, magnetron sputtering, MBE, Chemical vapor depositionmethods,Solgelspincoating,spraypyrolysis.

UnitII

ThinFilm Formation and Thickness Measurement

Nucleation, film growth and structure - various stages in thin film formation, thermodynamicsofnucleation,nucleationtheories,CapillaritymodelandAtomisticmodelandt heircomparison. Structure of Thin film,roll of substrate, roll of film thickness, film thicknessmeasurement-interferometry,ellipsometry,microbalance,quartzcrystaloscillatortechniques.

UnitIII

Properties of ThinFilms

Electrical conduction in metallic films- Continuous and discontinuous films, conduction incontinuousmetalfilms,conductionindiscontinuousmetalfilms,Dielectricthinfilms-experimental techniques capacitor preparation and setup, measurement of dielectric constant,effect of frequency and temperature. Optical properties of thin films – reflection, transmissionand absorption by thin films –reflection and transmission by a single film; Applicationsofthinfilms.

Bookssuggested:

1. Materialsscienceofthinfilms,M.Ohring,Elsevier,2006.
2. Thinfilmfundamentals–A.Goswami,NewAgeInternationalpublishers,2006.
3. Thinfilmphenomena-K.L.Chopra,McGraw–HillBookCompany1969.

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M.Sc. (Physics) - Semester-III Syllabus
(For the batch admitted from 2023-2024 onwards)

P 303 T/EI

Elective Paper – I

Course Code	Course Title	L	T	P	C
P-303T/EI	**ELECTRONIC INSTRUMENTATION**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To study the basic measurement of errors.
COB2	To study characteristics of instrumentation system.
COB3	To understand the concept of instrumentation amplifier and attenuators.
COB4	To learn about signal generation and analysis.
COB5	To study the electronic measuring instruments.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the accuracy and precision in measurement.
COC2	Able to understand the response of the system.
COC3	Able to measure power and voltage measurement.
COC4	Able to read oscilloscope measurements.
COC5	Able to understand LED and seven segment display systems..

Unit I: Measurement and Error:

Accuracy and Precision–significant figures –Types of error –Statistical analysis-Probability of errors –Limiting errors.

Performance characteristics of an instrumentation system: Zero, First and Second Ordersystems –Response of first and second order systems to STEP, RAMP and IMPULSE inputs-Frequency response of first and second order systems.

Unit II: Amplifiers and Signal Conditioning:

Instrumentation amplifiers- Isolation amplifiers- Logarithmic amplifiers-Attenuators-Second order active filters –Low pass, High pass, Band pass, and Band stop filters- All pass filters. Phase sensitive detector (PSD).

Signal Generation:

Frequency synthesized signal generator- Frequency divider generator- Function generator –Noise generator. **Signal Analysis:** Wave Analyzer- Heterodyne wave analyzer-Harmonic distortion analyzer- Spectrum analyzer-Spectra of CW, AM, FM and PM waves.

Unit III

Electronic Measuring Instruments:

Digital frequency meter–Digital voltmeter–Phase meter – RF power and voltage measurement.

Display and Recording: Magnetic tape Recorders- Laser printers–Storage oscilloscope.
Characteristics of digital displays: LED and seven segment displaysystems.

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 McGraw Hill Publications.
3. Introduction to Instrumentation and Control –A.K Ghosh –PHI Publications.
4. Electrical and Electronics Measurement and Instrumentation –A.K.Sawhney.
5. Transducers and Instrumentation- D.V.S Murty PHI Publications.

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M.Sc. (Physics) - III Semester Syllabus

(For the batch admitted from 2023-2024 onwards)

Elective Paper –II

Course Code	Course Title	L	T	P	C
P-304T/EI	**EMBEDDED SYSTEMS AND ITS APPLICATIONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To study the functional block diagram of microcontroller 8051.
COB2	To study memory and programming aspects of microcontroller 8051.
COB3	To understand the concept of PIC microcontrollers.
COB4	To learn about interfacing with microcontroller 8051.
COB5	To study the PID and Stepper motors.

Course Outcomes: After the completion of this course the student will be:

COC1	It enables the students to understand the working of microcontroller 8051.
COC2	Able to program microcontroller 8051.
COC3	Able to interface microcontroller 8051 with keyboard, LED, 7-Segment displays.
COC4	Able to measure Strain gauge.
COC5	Able to understand working of LVDT; PID and Relay systems.

Unit I

The 8051 Microcontroller

Block diagram of the 8051;Program Counter and ROM space, Date Types and Directives, PSW Register, Register Banks and Stack; **Pin Description**, I/O Programming, Addressing Modes of 8051.Arithmetic instructions and programming: Add, Subtract, Multiplication and Division of Signed and Unsigned numbers; LogicalInstruction and Programs- Logic, Compare, Rotate, Swap, BCD and ASCII Application Programs;Single Bit Instructions with CY; Jump, Loop and CALL Instructions, Time Delay Generation and Calculation; Timer/Counter Programming, Serial Communication an interrupts Programming.

Unit II

PIC Microcontrollers

PIC 16C6X/7X Architecture (PIC 16C61/C71), Registers, Pindiagram, 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 –III

Applications of Microcontrollers

Interfacing of - Light Emitting Diodes (LEDs), Push Buttons, Relays and Latches.
Interfacingof - Keyboard, 7-Segment Displays, LCD Interfacing, ADC and DAC with 89C51Microcontrollers.

Measurement Applicationsof–Robot Arm, LVDT andStrain Gauges
Automation and Control Applicationsof–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 GillispieMazidi, Pearson Education Asia, 4th Reprint, 2002
3. The 8051 Microcontroller - architecture, programming & applications –By Kenneth J. Ayala, Penram International Publishing, 1995.
4. Microcontroller 8051 by D. KarunaSagar, Narosa Publishing House, New Delhi, 2011.
5. Design with PIC Microcontrollers - By J B Peatman, MH, Pearson Education Asia, 2003.

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

(For the batch admitted from 2023-2024 onwards)
Elective Paper –I

Course Code	Course Title	L	T	P	C
P-303T/NS	**SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Study the classification of nanomaterials.
COB2	Study the various synthesis methods of nanomatrials.
COB3	Understand optical and thermal properties of nanomaterials.
COB4	Understand lithographic technique used in nanomaterials.
COB5	Study various characterization techniques for nanomaterials.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to demonstrate the concepts of nano structured materials, their size dependent properties, various examples in zero, one, two and three dimensions
COC2	Able to synthesize various routes which could be bottom-up and top-down approaches.
COC3	Able to develop skills in the preparation of nanomaterials by Physical and Chemical methods
COC4	Able to compare the lithographic techniques for the nanomaterial fabrication with the other techniques.
COC5	Able to use the knowledge of characterization techniques which include X-ray diffractometry and spectroscopy for studying more novel materials.

Unit –I
Properties of nanomaterials:
Classification of Nano structured materials , density of states for 0D,1D,2D and 3D ,nanoparticles, nano-wires, nano-clusters, quantum wells -Size dependent properties of nanomaterials – optical and thermal properties
Synthesis of nanomaterials-I
Synthesis routes: Bottom –Up Approaches, Top –Down Approaches, consolidation of Nano powders
Physical methods: Inert gas condensation, Arc discharge, RF Plasma, plasma organic spraying sputtering and thermal evaporation, laser pyrolysis, ball milling, molecular beam epitaxy, chemical vapour deposition method, electro deposition.

Unit –II
Synthesis of nanomaterials-II
Chemical methods: chemical nucleation theory for cluster formation, metal nanocrystal synthesis by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, sonochemical routes, liquid-liquid interface , hybrid methods, solvated metal atom dispersion, sol-gel, micelles and micro-emulsion technology.
Lithographic techniques: AFM based nanolithography, e-beam lithography and SEM based nanolithography, ion beam lithography, deep UV lithography, X-ray based lithography.

Unit-III

Characterization methods :**Electron Microscopy** : Introduction , Working of SEM,TEM,AFM, applications.
X-ray Crystallography: Introduction, Structure of nano materials, X-ray diffraction (XRD) ,The powder method- Determination of grain size/crystallite using Scherrer's formula, Determination of Crystallite size distribution, Small angle X-ray scattering (SAXS).
Spectroscopy Techniques: Introduction, Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, DSC, UV visible spectroscopy.

Recommended Books:

1. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj, BBRath and James Murday Universities press,IIM, Metallurgy and Materials Science
2. Principles of Nanoscience&Nanotechnology M.A.Shah, Tokeer Ahmad, Narosa Publishing House.
3. Nanocrystals: Synthesis ,Properties and Applications C.N.Rao,P.J.Thomas,G.U.Kulkarni.
4. Springer Handbook of Nanotechnology – Bharat Bhushan.
5. Nano materials Handbook – YuryGogotsi.

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

(For the batch admitted from 2023-2024 onwards)

Elective Paper –II

Course Code	Course Title	L	T	P	C
P-304T/NS	**PROPERTIES OF NANOMATERIALS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the electronic properties of nanomaterials.
COB2	Study the dielectric properties of nanomatrials.
COB3	Understand optical and thermal and mechanical properties of nanomaterials.
COB4	Understand concept of phonons in nanomaterials.
COB5	Study about magnetic nanofluids.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to identify the nanocomposites, nanofillers, their classification, properties and applications.
COC2	Able to develop skills in the preparation of nanocomposites such as polymer nanocomposites by Physical and Chemical methods..
COC3	Able to use the knowledge of synthesis techniques for studying more novel materials and apply in daily life or further research.
COC4	Able to analyze the mechanical properties of nanocomposites in general and also while they are used in devices.
COC5	Able to use the knowledge of characterization techniques which include X-ray diffractometry and spectroscopy for studying more novel materials.

Unit-I

Electronic properties: Classification of materials - metal, semiconductor, insulator-bandstructures, brillouin zones, mobility, resistivity, relaxation time, recombination centers, Hall effects, Confinement and transport in nanostructures: current , reservoirs and electron channels, conductance, local density of states, ballistic transport, Hopping transport, coulomb blockade, diffusive transport and Fock space.

Unit-II

Dielectric and magnetic properties: Dielectric properties: Polarization, Clausius-Mossotti relation, Debye's equations, ferroelectric behavior, Curie Weiss law, Polarons, Dielectric nanofluids and applications.

Magnetic properties: different kinds of magnetism in nature: dia, para, ferro, antiferro, ferri, superpara, and important properties in relation to nanomagnetism, magnetic nanofluids-characteristics and applications.

Unit- III

Optical, thermal and Mechanical properties:

Optical properties: photoconductivity, optical absorption & transmission, energy gap determination, photoluminescence, phosphorescence, electroluminescence.

Thermal properties: concept of phonons, thermal conductivity, specific heat, exothermic & endothermic processes.

Mechanical properties: tensile testing and tensile strength, breaking strength, plastic deformation, statistical analysis of failure data, true stress and strain, bend testing flexural strength and modulus, Brinell's, Viker's hardness-testing, impact testing –toughness, resilience and scratch test.

Recommended Books:

1. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj, BBRath and James Murday Universities press, IIM, Metallurgy and Materials Science
2. Principles of Nanoscience&Nanotechnology M.A.Shah, Tokeer Ahmad, Narosa Publishing House
3. Nanocrystals: Synthesis ,Properties and Applications C.N.Rao,P.J.Thomas,G.U.Kulkarni
4. Springer Handbook of Nanotechnology – Bharat Bhushan
5. Nano materials Handbook – YuryGogotsi
6. Introduction to Nano science and Nano technology – K KChatopadhayya&Banerjee,PHI
7. Introduction of Nano technology-CahrlesP.PooleJr and Franks J.Qwens
8. Physics of Magnetism-S.Chikazmi and S.H.Charap
9. Encyclopedia of Nanotechnology –Hari Singh Nalwa

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P303T/EC

Elective Paper- I

Course Code	Course Title	L	T	P	C
P-303T/EC	**8051 MICRO-CONTROLLER & ITS APPLICATIONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the architecture of 8051 microcontroller.
COB2	Study the addressing modes of 8051 microcontroller.
COB3	Understand timer and counter in 8051 microcontroller.
COB4	Understand concept of interfacing of 8051 microcontroller.
COB5	Understand programming of serial communication in 8051 microcontroller

Course Outcomes: After the completion of this course the student will be:

COC1	Able to program using 8051 microcontroller.
COC2	Able to program timers and counters in different modes in 8051 microcontroller.
COC3	Able to program serial communication RS-232 with 8051 microcontroller.
COC4	Able to program interrupts in 8051 microcontroller.
COC5	Able to interface LED/LCD; ADC and DAC with 8051 microcontroller.

Unit -I: Architecture of Microcontroller 8051: Input/output pins, ports and circuits, external memory, counter and timer, serial data input and output, interrupts.

Addressing modes of 8051: immediate and register addressing modes, accessing memory using various addressing modes; unsigned addition and subtraction, unsigned multiplication and division, signed numbers concepts and arithmetic operations.Logic and compare instructions rotate and swap instructions. Jump,Loop and Call instructions, time delay generation and calculation; single bit operation with carry; reading input pins versus port latch and I/O programming.

Unit-II: **8051 Timer / Counter, Serial Communication and Interrupts Programming**:
Timer / Counter programming: programming 8051 timers, counter programming, pulse frequency and pulse width measurements.Basics of serial communication, 8051 connection to RS232, 8051 serial communication programming.Interrupts of 8051; programming timer interrupts, programming external hardware interrupts, and programming serial communication interrupts.

Unit-III: **Interfacing of 8051 Microcontroller**: Programmable peripheral interface (PPI)-8255, programming 8255, 8255 interfacing with 8051. Interfacing Key board. Interfacing LED / LCD, Interfacing A/D & D/A converters, Interfacing stepper motor and temperature sensor.

Recommended Books:

1. 8051 Micro controller and Embedded systems by Mazidi and Mazidi, Pearson Education Asia (2002).

2. The 8051 Microcontroller Architecture. Programming and Applications by Kenneth Ayala: Penram International Pub (1996).

3. Microcontroller 8051 by D. KarunaSagar, Narosa Publishing House (2011).

4. The concepts and features of micro controllers (68HC11, 8051, 8096) by Rajkamal: Wheeler Pub (2000).

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Elective Paper-II

Course Code	Course Title	L	T	P	C
P-304T/EC	**DATA AND COMPUTER COMMUNICATIONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the data communication networks.
COB2	Study the physical layer in communication.
COB3	Understand data link layer and different topologies.
COB4	Understand concept of network layer.
COB5	Understand transportation and application layer.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to communicate through LAN network.
COC2	Able to understand the TCP/IP layers and their functions.
COC3	Able to understand the flow control and error control in data link layer.
COC4	Able to understand packet switching principles.
COC5	Able to understand the HTTP and SNMP protocol.

Unit I:

Data Communication Networks:

LANs: PANs, MANs, Wireless LANs. Internetworks: WANs, Third-Generation Mobile Phone Networks, RFID and Sensor Networks. Protocol Hierarchies, Connection-Oriented Versus Connectionless Service, Service Primitives, Relationship of Services to Protocols. OSI Model: Functions of OSI layers. TCP/IP Model: TCP/IP layers and their functions.

The Physical Layer: Analog and Digital transmission, Transmission Impairments, Channel Capacity. Transmission Media: Guided transmission media, Wireless transmission, Wireless Propagation, Line of sight transmission. Signal Encoding Techniques: Digital Data, Digital Signals; Digital Signal Encoding Formats. Digital Data, Analog Signals; ASK, PSK, FSK. Analog Data, Digital Signals; PCM & DM. Error Detection & Error Correction: Types of Errors,Error Detection, Parity Check, Checksum, CRC.

Unit II:

The Data Link Layer: Flow Control, Error control, HDLC. Multiplexing: FDM, STDM. Asymmetric Digital Subscriber Line, xDSL. LANs: Topologies, LAN Protocol Architecture, Layer 2 & Layer 3 switches, Virtual LANs. High Speed LANs: Traditional Ethernet, High-Speed Ethernet, IEEE 802.1Q VLAN Standard. Wireless LANs: IEEE 802.11 Architecture and Services, IEEE 802.11Medium Access Control, IEEE 802.11 Physical layer,IEEE 802.11 Security Considerations. WANS: Circuit Switching Networks, Circuit Switching Concepts, Soft Switch Architecture, Packet Switching Principles. Asynchronous Transfer Mode (ATM): ATM architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service categories, ATM Adaptation Layer.

Unit III:

The Network Layer: Principles of Internetworking: Connectionless Internetworking. 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.Multicasting: Practical applications, multicasting in an internet environment, requirements for multicasting. Routing protocols: Autonomous systems, Approaches to Routing, Open Short Path First (OSPF) Protocol and Border GatewayProtocol (BGP).
Transport Layer: Connection Oriented Transport Protocol Mechanisms: TCP and UDP.
Application Layer: Electronic Mail, SMTP and MIME. Internet Directory Service: Domain Name System (DNS). Hypertext Transfer Protocol (HTTP). Simple Network Management Protocol (SNMP).

Recommended Books

1. Data and Computer Communications , William Stallings [Tenth Edition]
2. Computer Networks, A.S.Tanenbaum [Fifth Edition]
3. Data Communications and Networking, Behrouz A. Forouzan [Fourth Edition]

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Elective Paper – I

Course Code	Course Title	L	T	P	C
P-303T/BP	**Molecular and Environmental Biophysics**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the structure and function, stability of biological macromolecules (enzyme, protein, lipids, nucleic acids and biocatalysts. .
COB2	Study the different biological systems and biological process through statistical thermodynamic principles.
COB3	Understand the importance of environment and life.
COB4	Understand electromagnetic radiation and environment; conductance of heat and temperature, mass transfer etc.
COB5	Understand optical activity in detail.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about basic functions of macromolecules.
COC2	Able to understand enzymes classification of different models.
COC3	Able to understand the statistic thermodynamics, entropy, application to biological system.
COC4	Able to understand Optical activity: CD and ORD, Proteins.
COC5	Able to student will able to familiar with environment and its importance to human being.

Unit I: Structure and functions of macromolecules and Biocatalysis:

Structure and function of disaccharides and polysaccharide.Classification of proteins.Primary and secondary structures of proteins.Chemistry of nucleic acids.DNA duplication.Protein synthesis.Structure and functions of lipids. Classification of enzymes.Michaelis-Menten model for enzyme catalysed reactions. Lineweaver-Burke plots. Inhibitors- specific and non-specific. Modified Michaelis-Menten model for fully competitive and non-competitive inhibited enzyme catalysed reactions. Enzyme specificity. Enzyme structure and function relation.

Unit II: Statistical thermodynamics: CD & ORD

Statistical thermodynamics: Intramolecular and intermolecular forces, Types of bonds, Debye- Huckel theory. Statistical thermodynamics and biology.Entropy transfer of living organisms.Information theory – relation between information and entropy.Information content of some biological systems.

CD & ORD: Polarisation (basics), nature and origin of optical activity, chiral molecules. Optical rotation and circular dichorism, relation between CD & ORD. Drude'sequation. Moffit's equation.Cotton effect.Optical activity in native proteins and conformation.Determination of helical content.

Unit III: Environmental Biophysics

Introduction: Microenvironments, Energy exchange, Mass and momentum transport, conservation of energy and mass, continuity in the biosphere, models, heterogeneity and scale.
Temparature: Typical behavior of atmosphere and soil temperature, Random temperature variation, Modeling vertical variation in Air temperature, Modeling Temporal variation in Air temperature, soil temperature changes with depth and time, Temperature and Biological Development, Thermal time and calculation from weather data, Temperature extremes and the computation of thermal time, Normalization of thermal time, Thermal time in relation to other environmental variables.
Heat and Mass Transport: Molar Fluxes, Integration of the transport equations, Resistances and Conductances, Rsistors and Conductors in series, Resistors in Parallel, Calculation of Fluxes. Conductance for molecular diffusion, Molecular Diffusivities, Diffusive conductance of the integuments, Turbulent transport, Fetch and Bouyancy, Conductance of the atmospheric surface layer, conductance for heat and mass transfer in laminar forced convection, cylinders, spheres and animal shapes.
Humans and their environment: Area, Metabolic rate and evaporation, survival in cold environments, wind chill and standard operative temperature, survival in hot environments, the humid operative temperature, Comfort, Dosimetry and variable linear energy transfer.

Recommended Books:

1. Essentials of biological chemistry - by Fairley &Kilgour
2. Molecular Biophysics - by Setlow& Pollard
3. Life chemistry - An introduction to Biochemistry - by Steiner
4. Intermediate Physics for medicine and biology - by Russel K, Hobby
5. Biophysical Chemistry - by A G Marshall
6. An Introduction to Environmental Biophysics – Gaylon S. Campbell and John M. Norman.
7. Experimental methods in Biophysical Chemistry - by C Nicolau
8. An introduction to spectroscopy for biochemists – by Brown

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Elective Paper – II

Course Code	Course Title	L	T	P	C
P-304T/BP	**Physico – Chemical Techniques in Biophysics**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand physicochemical techniques such as viscosity..
COB2	Study the different biological systems and biological process through statistical thermodynamic principles.
COB3	Understand the students familiar with some separation techniques such as electrophoresis and various chromatographic techniques.
COB4	Understand various Imaging techniques such as Fluorescence microscope; Ultraviolet microscope; Interference microscope; Polarizing microscope.
COB5	Understand phase contrast microscope; electron microscope; scanning probe microscopy – atomic force microscope (AFM), scanning tunneling microscope ((STM). scanning near field optical microscope (SNOM).

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about different techniques in order to get information aboutpolymers and biomolecules.
COC2	Able to understand methods and techniques like: molecular weight determination,sedimentation and scattering.
COC3	Able to gain the knowledge of different separation techniques, will understand basics principles, instrumentation, working and applications in biology and medicine.
COC4	Able to gain the knowledge of different Imaging techniques, instrumentation, working and applications in biology and medicine.
COC5	Able to understand techniques used in biological applications of bio-molecules.

Unit I: Molecular weight determination

Viscosity: Specific and intrinsic viscosities and their determination by Ostwald's method. Determination of molecular weight from intrinsic viscosity.

Sedimentation: Theory of sedimentation. Determination of sedimentation coefficient by sedimentation equilibrium method and sedimentation velocity method.Calculation of molecular weight from sedimentation equilibrium and velocity methods.

Rayleigh's Scattering: Rayleigh's equation for scattering for dilute gas. Theory for particles small compared with wavelength of light. Theory of large particles with dimensions approaching the wavelength of light. Expression for the particle scattering factor P (ϕ) and its relation to radius of gyration

Unit- II: Separation Techniques

Electrophoresis: Introduction to Electrophoresis. Principle of electrophoresis. Electrophoretic Mobility (EPM) estimation, factors effecting EPM, Supporting media. Types of electrophoresis - Disc electrophoresis: Isoelectric focusing, Isotachophoresis, Paper electrophoresis, Gel electrophoresis; Capillary electrophoresis. Applications of electrophoresis in biology and medicine.

Chromatography: Introduction to chromatography. Principle, Instrumentation, working and biological applications of Column chromatography, liquid chromatography, Thin layer chromatography (TLC), Paper chromatography, Ion exchange chromatography, Gel chromatography, Affinity chromatography, Gas chromatography.

Unit-III: Microscopy

Principle, description, working and biological applications of Fluorescence microscope; Ultraviolet microscope; Interference microscope; Polarizing microscope; Phase contrast microscope; Electron microscope; Scanning probe microscopy – Atomic Force microscope (AFM), Scanning tunneling microscope ((STM). Scanning near field optical microscope (SNOM).

Recommended Books:

1. Experimental methods in biophysical chemistry – Nicolau
2. Intermediate Physics for Medicine and biology – Russel K, Hobby
3. Basic Biophysics for biologist – M.Daniel.
4. Molecular Biophysics – Richard B.Setlow and Ernest C.Pollard.
5. Electrophoresis in Practice - Reiner Westermeier.

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ElectivePaper– I

Course Code	Course Title	L	T	P	C
P-303T/CMP	**LATTICE DYNAMICS IN CRYSTALS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the lattice vibrations of crystals.
COB2	Study the effect of lattice vibrations on the intensity of the scattered radiation
COB3	Understand the methods of X-ray diffraction.
COB4	Understand theory of small vibrations.
COB5	The absorption and Emission in optical crystals and phonons.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to learn about density of phonon modes, Normal modes of vibration.
COC2	Able to understand Hamiltonian for lattice vibrations in the Harmonic approximation
COC3	Able to gain the knowledge of Laue method, Bragg method and Debye-Scherrer method.
COC4	Able to gain the knowledge of deformation potential scattering, piezoelectric scattering andFrohlichscattering.
COC5	Able to understand Hartree-Fock theory of free electrons- Ground state energy, exchange energy, correlation energy.

Unit-I

Lattice Vibrations of Crystals: The infinite and finite linear crystal, Vibrational modes for linear chain with basis and in higher dimensions,. - Lattice vibrations in Three dimensions: The equation of motion, Allowed values of k: Density of phonon modes, Normal modes of vibration, Energy levels.

Group Theory and Lattice vibrations: Properties of Normal coordinates, the frequency of Eigen values and the polarization vectors, Time-Reversal Degeneracy.Group theoretical analysis of the lattice vibrations of a linear crystal- case of one atom per unit cell, case of two atoms per unit cell; Ex: Lattice vibrations of a two dimensional crystal with symmetry C^1_{4v}..

Born-Oppenheimer Approximation, Hamiltonian for Lattice Vibrations in the Harmonic Approximation, Normal Modes of the System and Quantization of Lattice Vibrations - Phonons.

Unit-II

Effect of lattice vibrations on the intensity of the scattered radiation: The intensity of scattered radiation, effect of lattice vibrations-Einstein model, Normal mode treatment.

Scattering of X-rays: from a single electron, single atom and crystal; Interpretation of Laue equations in Reciprocal space. Methods of X-ray Diffraction: Laue method, Bragg method and Debye-Scherrer method. Theory of Neutron scattering, Elastic Neutron scattering, Inelastic Neutron scattering, Applications of Neutron scattering to the study of lattice Vibrations.

Unit-III

Theory of small vibrations (Classical & quantum mechanical), Harmonic and Anharmonic relaxation in solids, the effect of impurities on lattice vibrations, The Franck-Condon principle.

The absorption and Emission in optical crystals, Phonons: Properties of phonons and momentum of phonons; Zero-Phonon (electronic) transitions, Characteristics of Zero-Phonon lines, Phonon-assisted transitions- Electron–phonon interactions:- The rigid-ion model. Electron–phonon matrix elements for metals, insulators and semiconductors. Deformation Potential Scattering, Piezoelectric Scattering, Frohlich Scattering. Polarons.- Deviations from the Franck-Condon Approximation, Deviations from the Adiabatic Approximation-Radiationless Transitions- The Hartree equations, Exchange: The Hartree-Fock approximation, Hartree-Fock theory of free electrons- Ground state energy, exchange energy, correlation energy (only concept).

Recommended books

1. Principles of the Theory of Solids : J. M. Ziman
2. Elementary Solid State Physics : M. A. Omar
3. Introduction to Solid State Physics : C. Kittel
4. Advanced Solid State Physics : Philip Phillips
5. The Wave Mechanics of Electrons in Metals : Stanley Raimes
6. Solid State Physics : Neil W. Ashcroft and N. David Mermin
7. Introduction to Modern Solid State Physics : Yuri M. Galperin
8. Solid State Physics: An Introduction to Principles of Materials Science (4^{th} Ed.) : H. Ibach and H. Luth
9. Principles of Condensed Matter Physics :Chaikin and Lubensky
10. Solid State Physics, Essential Concepts : David W. Snoke
11. Condensed Matter Physics, M. P. Marder, John Wiley & Sons, Inc. 2000.
12. Group Theory and its Application to the Quantum Mechanics of Atomic Spectra : E.P. Wigner, (1959), Academic Press
13. Quantum Chemistry : . I.N. Levine, (1994), Prentice-Hall of India, Pvt. Ltd.
14. Initio Molecular Orbital Theory : W.J. Hehre, L.Radom, P.V.R. Schleyer, J.A. Pople, John Wiley, (1986).
15. Modern Quantum Chemistry : A. Szabo and N.S. Ostlund, (1996), Mc-Graw Hill.

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Elective Paper – II

Course Code	Course Title	L	T	P	C
P-304T/CMP	**OPTICAL PHENOMENA AND MOSSBAUER EFFECTS IN SOLIDS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the interaction of radiation and matter with the help of quantum theory.
COB2	Study the dielectric and optical properties of materials.
COB3	Understand the Kramers-Kronig relations and Photon-Phonon transitions.
COB4	Understand the Mossbauer Effect.
COB5	Understand different kinds of luminescence.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to the processes of absorption and emission of radiative fields.
COC2	Able to understand principles of magneto-optic effect and optical transitions
COC3	Able to differentiate the direct and indirect band gap semiconductors.
COC4	Able to analyze the Mossbauer spectroscopy, Isomer shift and Magnetic hyperfine interactions.
COC5	Able to explain energy level diagrams of radiative and non-radiative processes.

UNIT-I

Interaction of Radiation with matter

Classical and Quantum theory of radiative field. The Hamiltonian of a charged particle in an electromagnetic field, The interaction between a charged particle and a radiative field. First order process:- Absorption and Emission of Radiative field; Second order process:- Matrix elements due to H_1 and H_2, Effective matrix element, Transition rates of Scattering processes.

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.Frenkel and Wannierexcitons and their absorption, Imperfections - exciton absorption below the band gap, Intra band transitions - Absorption and reflection in metals. Hagen-Rubens relation, Magneto-optic effects: Faraday effect.

UNIT-II

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.

UNIT-III

Luminescence and Color centers

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.

Recommended books

1. Principles of Theory of Solids :Ziman, Vikas Publishing House, New Delhi.
2. Solid State Physics : G. Burns
3. Luminescence and Luminescent Materials : Blasse
4. Solid State Physics : Dekker.
5. Elementary Solid State Physics : M. Ali Omar
6. Crystal Symmetry, Lattice Vibrations, and Optical Spectroscopy of Solids: A Group Theoretical Approach :Baldassare Di Bartolo and Richard C Powell
7. Laser Spectroscopy, Basic concept and Instrumentation : W. Demtroder, (2004), Springer.
8. Infrared and Raman Spectroscopy : B. Schrader, (1993), John Wiley & Sons
9. Group Theory and its Application to the Quantum Mechanics of Atomic Spectra : E.P. Wigner, (1959), Academic Press

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Elective Paper- I

Course Code	Course Title	L	T	P	C
P-303T/OE	**INTRODUCTION TO OPTOELECTRONICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the fundamentals of optical theories.
COB2	Compare the light wave propagation through different media.
COB3	Understand and identify the importance of optical anisotropy.
COB4	Understand describe the effect of external fields on light.
COB5	Understand the elementary concepts of quantum theory of optics.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to describe the light given by different optical theories.
COC2	Able to differentiate the behavior of light propagating through different media.
COC3	Able to understand the concept of optical anisotropy.
COC4	Able to compare the effect of external fields on light.
COC5	Able to explain the elementary concepts of quantum optics.

Unit I:Introduction: Ray optics: postulates, differential equation of a light ray; wave optics: postulates, monochromatic waves, elementary waves, eikonal equation; electromagnetic optics: plane waves in a dielectric, polarization of light, uniaxial and biaxial crystals, dielectric tensor, birefringence, plane waves in anisotropic media, the phase velocity and ray velocity, wave refractive index, index ellipsoid.

Unit II: Modulation of light: Index ellipsoid in the presence of an external electric field, electrooptic effect - Kerr effect, Pockels effect, electro-optic retardation, electro-optic phase and amplitude modulation, modulator design considerations, Photoelastic effect, Acousto-optic effect - Acousto-optic modulation, Raman-Nath and Bragg regimes and their modulators. Magneto-optic effect - Faraday effect, optical activity.

Unit III: Quantum Optics: Quantization of free electromagnetic field - mode expansion, quantization in finite one-dimensional cavity, quantization in unbounded free space, creation and annihilation operators, number states, vacuum fluctuations and the zero-point energy, coherent states - generation and properties, squeezed states: uncertainity relation, squeeze operator, generation of squeezed states, entangled states and their properties.

Reference Books:

1. Fundamentals of Photonics – B. E. A. Saleh and M. C. Teich, wiley, 2nd edition.
2. Principles of Optics - M. Born and E. Wolf , Cambridge university press, 7th edition.
3. Optical Electronics - A.Ghatak and K.Thyagarajan, Cambridge University Press.
4. Lasers and Electro-optics: Fundamentals and Engineering - Christopher C. Davis, Cambridge University Press, 2nd Edition.
5. Quantum Optics - MarlanO.Scully and M.SuhailZubairy, Cambridge university press
6. Introductory quantum optics - Christoper C. Gerry and Peter L.Knight, Cambridge University Press.

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Elective Paper- II

Course Code	Course Title	L	T	P	C
P-304T/OE	**SEMICONDUCTOR OPTOELECTRONICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of optical transitions in semiconductor materials.
COB2	Describe the structures and working of different optical sources & detectors.
COB3	Understand to compare different optoelectronic devices.
COB4	To identify the applications of optoelectronic devices.
COB5	Analyze the need of optoelectronic integrated devices.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to explain the optical transition processes in semiconductor materials.
COC2	Able to differentiate the different type of optical sources & detectors.
COC3	Able to identify different optoelectronic devices.
COC4	Able to evaluate varied applications of optoelectronic devices.
COC5	Able to appreciate the applications of optoelectronic integrated devices.

Unit I: Optical Processes in Semiconductors: Alloy semiconductors, Electron-hole pair formation and recombination, radiative and nonradiative recombination, band-to-band recombination.

Absorption in semiconductors - indirect intrinsic transitions, exciton absorption, donor-acceptor and impurity-band absorption, effect of electric field on absorption, absorption in quantum wells, the Kramers-Kronig relations.

Radiation in Semiconductors - Relation between absorption and emission spectra, near band gap radiative transitions, Auger recombination, luminescence from quantum wells.

Unit II: Sources and detectors:

Light Emitting Diodes: Electroluminescent process, choice of LED materials, device configuration and efficiency, LED structures: heterojunction LED, surface emitting LED, edge-emitting LED, device performance characteristics.

Junction lasers: Operating principle, threshold current, heterojunction lasers, modulation of lasers - rate equations, steady state solution, mode-locking of semiconducting lasers.

Photodetectors: Photoconductor, junction photodiodes - PIN photodiodes, phototransistor, Schottky-barrier photodiode.

Unit III: Optoelectronic Integrated Devices: Optical amplifiers - Erbium-doped, Raman and Brillouin amplifiers, Beam splitters, Direction couplers and switches, bistable optical devices, fiber splicers, fiber connectors, fiber couplers, fiber optic sensors, fiber Bragg gratings.

Optoelectronic Integrated Circuits: Need for integration, materials for optoelectronic integrated circuits (OEICs), front end photo receivers, optical control of microwave oscillators.

Reference Books:

1. Semiconductor optoelectronic devices - Pallab Bhattacharya, Pearson Education, 2nd edition.
2. Semiconductor optoelectronics: Physics and Technology- J.Singh, McGraw-Hill.
3. Semiconductor physics and devices - Donald A. Neamen, McGraw-Hill, 3 rd edition.
4. Integrated optics: theory and technology - Robert G.Hunperger, Springer, 6th edition.
5. Optical Fiber communications: principles and practice – John M.Senior, Pearson Education, 3rd edition.

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P 301T/AE

Core Paper - I

Course Code	Course Title	L	T	P	C
P-301T/AE	**DIGITAL SYSTEM DESIGN**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of Boolean functions and Boolean algebra.
COB2	Describe the logic design and the digital circuits.
COB3	Understand the working of CPLD and FPGA.
COB4	To understand the sequential logics and counters.
COB5	Analyze the TTL, ECL, MOS andCMOScircuits .

Course Outcomes: After the completion of this course the student will be:

COC1	Able to explain the Boolean algebra.
COC2	Able to apply logic design using adders, subtractors and code converters.
COC3	Able to identify different logic families.
COC4	Able to evaluate varied applications of combinational logic.
COC5	Able to appreciate the applications of sequential logic circuits and counters.

Unit I: Boolean Functions: Binary, Octal, Hexadecimal Numbers, Binary Codes and Logics**;** Boolean Algebra, Basic Theorems and Functions, Canonical, Digital and Integrated Circuits**;** Simplifications of Boolean Functions, Two to Six Variable Map Simplification, NAND and NOR Implementation, Tabulation method, Determination and Selection of Prime Implicants.

Unit II: Logic Design: Combinational Logic –Adders, Subtractors, Code Conversion, Multilevel NAND, NOR and Ex-OR functions**;** MSI and PLD Components – Decimal, Binary Adder and Subtractor, Comparators, Decoders, Encoders, Mux and De-Mux, ROM, PLA and PAL**; GAL, CPLD andFPGA.** Over view of Digital Integrated Circuits with allLogic Families–TTL, ECL, MOS,CMOS.

Unit III: Sequential Logics and Counters: Synchronous Sequential Logics – FFs, Analysis, State Reduction and Assignment, FF Excitation Tables, Design Procedure and Design of Counters**;** Asynchronous Sequential Logics – Analysis, Circuits with Latches, Registers, Shift Registers, Ripple and Synchronous Counter.

Text Books:

1. Digital Design –M. Morris Mano
2. Switching theory & Logic Design –R.P. Jain TMH 2003
3. Digital System Principles & Applications - Ronald J. Tocci

Reference Books:

1. Computer Architecture and Logic Design –Thomas C. Bartee
2. Digital Principles & Applications – Albert Paul Malvino andDonald P. Leach
3. Digital Computer Design –V. Rajaraman and T.Radhaknan
4. Digital Electronics - An Introduction to Theory and Practice – William H. Gothman
5. Digital Computer Electronics –A.P. Malvino and J.A. Brown
6. Digital Integrated Circuits –A Design Perspective –Jan M Rabae
7. ICs & Microprocessors –Data Hand Book, BPB Publications, India
8. Digital Logic and Microprocessors –F.J. Hill and G.R. Peterson
9. Digital Circuits and Microprocessors –Herbert Taub
10. Switching and Finite Automata Theory –ZviKohavi and Niraj K. Jha
11. Digital Design – John F Wakerly

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Core Paper –II

Course Code	Course Title	L	T	P	C
P-302T/AE	**DIGITAL SIGNAL PROCESSING AND DIGITAL SIGNAL PROCESSORS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of Discrete Time Signal and Linear Systems.
COB2	Describe the Discrete Fourier Transform.
COB3	Understand the concept of Fast-Fourier Transform.
COB4	To understand the Design of Digital Filters.
COB5	Understand the architecture of TMS320C5X.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to appreciate the use of FFT in digital signal processing.
COC2	Able to apply frequency analysis of discrete time signals.
COC3	Able to design FIR filter using windows.
COC4	Able to program TMS320C5X in terms of central architecture logic unit(CALU)-auxiliary register (AR) and index register.
COC5	Able to apply pipelining in TMS320C5X and its operation.

Unit I : Discrete Time Signal And Linear Systems –Introduction-Advantages of DSP-Classification ofSignals-Signal representation-Standard signals discrete –time signals- Operation on signals Discrete time system- Classification of Discrete time system- Convolution- Correlation of Two sequences-Inverse systems and Deconvolution, frequency analysis of Discrete time signals.

Z-Transform- Introduction –ROC- Properties of ROC- Inverse Z-Transform- Discrete Fourier Transform-Discrete Fourier Series-Properties-DFT-Properties- Comparison between linear and circular convolution- filtering long duration sequence.

Unit II: Fast-Fourier Transform- direct evaluation of DFT-Decimation-in-Time and Frequency-Differences andsimilarities between DIT and DIF-IIR filters- Introduction-Design of Digital Filters from analog filters-Analog low pass filter design-Butterworth-Chebyshev- filters-Design of IIR filters from analog filters-Frequency transformation on digital domain-realization of Digital Filters.

FIR Filter- Introduction-Linear Phase FIR filters-their frequency response-Location of the zeros of LPFIR filters-Fourier series method of designing FIR filter-Design of FIR filter using windows-Frequency sampling method of designing FIR filters-Realization of FIR filters-Finite word length effects in digital filters-Introduction-Rounding and truncation errors-Quantization in A/D signals-Quantization effects in the computation of DFT.

Unit III: Digital Signal Processor-Architecture of TMS320C5X-Bus structure-Central Architecture logic unit(CALU)-Auxiliary Register (AR)-Index register (INDX)-ARCR-Block move address Register-Block Repeat Register-Parallel logic unit-memory mapped registers-program controller-some flags in status register-On-chip memory-On-chip peripherals.

TMS320C5XLanguage-Assembly language syntax-Addressing modes-Instructions-Load/Store-Addition/Subtraction-Move-Multiplication NORM-Program control-Peripheral control.

Instruction Pipelining in C5X-Pipeline structure-Operation-Application programs in C5X-C50 basedDSP starter Kit (DSK)-Programs for familiarization of arithmetic instructions-Programs in C5X for processing Real Time signals.

Recommended Text Books:

1**.**Digital Signal Processing by Prokaies (PHI)
2. Digital Signal Processing by Sanjit K Mitra
3. Digital Signal Processing by Ramesh Babu- Sci-Tech Pub
4. Digital Signal Processers by B.VenkataRamani et al (TMH)
5. Digital Signal Processers by Sen M Kuo et al –Pearson Education

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Elective Paper - I

Course Code	Course Title	L	T	P	C
P-303T/AE	**Data Communications & Networking**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of TCP/IP Protocol Architecture.
COB2	Describe the guided transmission media and wireless transmission.
COB3	Understand the concept of Digital Data Communication Techniques.
COB4	To understand the Data Link Control Protocols.
COB5	Understand the Circuit Switching and Packet Switching.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to use OSI model for digital data transmission.
COC2	Able to apply signal encoding techniques.
COC3	Able to design data flow control, error control and HDLC.
COC4	Able to frequency-division multiplexing, synchronous time-division multiplexing of digital data.
COC5	Able to apply effects of congestion , **c**ongestion control and traffic management.

UNIT-I

TCP/IP Protocol Architecture, OSI Model,Standardization within a Protocol Architecture, Traditional Internet-Based Applications,Multimedia.

Data Transmission:Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity.

Transmission Media: Guided Transmission Media,Wireless Transmission,Wireless Propagation,Line-of-Sight Transmission.

Signal Encoding Techniques: Digital Data, Digital Signals,Digital Data, Analog Signals,Analog Data, Digital Signals,Analog Data, Analog Signals.

Digital Data Communication Techniques: Asynchronous and Synchronous Transmission,Types of Errors,Error Detection,Error Correction,Line Configurations.

Unit-II

Data Link Control Protocols: Flow Control,Error Control,High-Level Data Link Control (HDLC).

Multiplexing: Frequency-Division Multiplexing,Synchronous Time-Division Multiplexing,Statistical Time-Division Multiplexing,Asymmetric Digital Subscriber Line,xDSL

Circuit Switching and Packet Switching: Switched Communications Networks,Circuit Switching Networks,Circuit Switching Concepts,Softswitch Architecture,Packet-Switching Principles,X.25,Frame Relay.

Asynchronous Transfer Mode: Protocol Architecture,ATM Logical Connections,ATM Cells,Transmission of ATM Cells,ATM Service Categories.

Unit-III

Routing in Switched Networks: Routing in Packet-Switching Networks, Least-Cost Algorithms. **Congestion Control in Data Networks :** Effects of Congestion ,Congestion Control, Traffic Management Congestion Control in Packet-Switching Networks,Frame Relay Congestion Control,ATM Traffic Management,ATM-GFR Traffic Management.

Recommended Books:

1. William Stallings, Data & computer communications 8/e Pearson education.
2. BehrouzA.Forouzan, Data communications &networking 3/e TMH.
3. Fred Hasal, Data communications computer network and open systems 4/e Pearson education 2005.
4. R.P.Singh, S.D.Sapre Communication Systems, Analog and Digital. 3/e, McGraw Hill.2017.

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Elective Paper –II

Course Code	Course Title	L	T	P	C
P-304T/AE	**MICROCONTROLLER AND APPLICATIONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the architecture of 8051 microcontroller.
COB2	Study the addressing modes of 8051 microcontroller.
COB3	Understand timer and counter programming of 8051 microcontroller.
COB4	Understand concept of interfacing of 8051 microcontroller.
COB5	Understand interfacing using aurdino.

Course Outcomes: After the completion of this course the student will be:

COC1	Able to program using 8051 microcontroller.
COC2	Able to program timers and counters in different modes in 8051 microcontroller.
COC3	Able to interface LCD; ADC; DAC and stepper motor with 8051 microcontroller.
COC4	Able to program interrupts in 8051 microcontroller.
COC5	Able to interface using aurdino.

Unit I: The 8051 Microcontroller

Microcontrollers and Embedded processors, overview and Block diagram of the 8051; Insidethe 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; PinDescription, I/O Programming, Bit Manipulation; Addressing Modes- Immediate and RegisterAddressing Modes, Accessing Memory using Various Addressing Modes

Unit II: Programming and Interfacing 8051

Instruction Set- Arithmetic instruction Programs- Add, Subtract, Multiplication and Divisionof Signed 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 and interrupts Programming.

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

Unit III: Interfacing using Aurdino

Types of Arduino boards, Arduino Uno Architecture, Sensors and Actuators, Interfacing of Sensors with Arduino- Temperature, Humidity, Motion, Ultrasonic Sensor, PIR Motion

Sensor, Light, Moisture Sensor and Gas Sensor.Interfacing of Actuators- Relay Switch and Servo Motor, Introduction to Node MCU.

Recommended Books:

1. The 8051 Microcontrollers and Embedded Systems- By Muhammad Ali Mazidi and Janice GillispieMazidi, Persong Education , Asia, 4th Reprint, 2002.
2. The 8051 Microcontroller- Architecture, Programming & Applications –By Kenneth J. Ayala, Penram International Publising , 1995.
3. Microcontroller 8051 –By D. KarunaSagar, Narosa Publishing House,2011.
4. C Programming for Arduino, Jelien Bayle, Packt Publishing, Bermingham, UK.
5. Arduino Made Simple by AshwinPajankar, BPB Publications.

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REVISED SYLLABUS FOR M.Sc. (PHYSICS)

IV SEMESTER

With effect from the academic year 2023 -2024 onwards

S.No	Paper code	Paper	Paper title	Instructions Hrs / Week	Credits	Max Marks
1.	P401T	Core Paper -I	Nuclear Physics	3	3	100*
2	P402T	Core Paper- II	Spectroscopy	3	3	100*
Solid State Physics(SSP)						
3	P403T/SSP	Elective-III	Optical Phenomena in solids	3	3	100*
Materials Science (MS)						
4	P403T/MS	Elective-III	Material Science	3	3	100*
Electronics& Instrumentation (E&I)						
5	P403T/EI	Elective-III	Instrumentation for measurement and data transmission	3	3	100*
Nano Science (NS)						
6	P403T/NS	Elective-III	Nano composites	3	3	100*
Electronics Communications (EC)						
7	P403T/EC	Elective-III	Mobile cellular communications	3	3	100*
Bio Physics (BP)						
8	P403T/BP	Elective-III	Cell and membrane biophysics	3	3	100*
Condensed Matter Physics (CMP)						
9	P403T/CMP	Elective-III	Transport Phenomena in solids	3	3	100*
Opto Electronics (OE)						
10	P403T/OE	Elective-III	Fiber Optic Technology	3	3	100*
PRACTICALS						
11	P 405P	V	General Physics lab	8	4	100
12	P 406P	VI	Special lab	4	2	50
13			Project		5	150

20 600

Applied Electronics (AE)					Credits	Marks
14	P401T/AE	Core Paper I	Digital system design using VHDL	3	3	100*
15	P402T/AE	Core Paper II	Feedback Control Systems	3	3	100*
16	P403T/AE	Elective Paper -III	Guided and Unguided media communication	3	3	100*
	P404/AE	Project			5	150
PRACTICALS						
17	P405P/AE	V	Fiber Optics Communication & Microwaves Lab	4	2	50
18	P406P/AE	VI	VHDL Lab	8	4	100

Details of credits and marks	
Number instruction hours per each theory paper per week	3
Maximum marks for each theory paper	100(70 semester exam + 30 internal evaluation)
Number of credits for each theory paper	3
Number instruction hours per each practical paper per week	8/4
Maximum Marks per each practical paper	100/50
Number credits per practical paper	4/2
Total Credits per semester	20

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P 401T **Core Paper - I (Common for all Specializations)**

Course Code	Course Title	L	T	P	C
P-401T	**NUCLEAR PHYSICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of nuclear forces.
COB2	Study the nuclear models and its magnetic moments.
COB3	Understand nuclear decay and nuclear detection.
COB4	Understand concept of interaction of charged particles with matter.
COB5	Understand applications of nuclear physics.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Demonstrate the concepts of nuclear force, nuclear decay processes, detection mechanism and reactions.
COC2	Analyze the Deuteron problem, exchange force theories, α-decay, β-decay, Bethe's formula Photoelectric effect, Compton effect and pair production.
COC3	Understand the neutrino hypothesis, Bohr's theory, working of gamma ray detectors, kinematics of nuclear reactions, nuclear reactors.
COC4	Evaluate the importance of knowledge of handling radioactive materials for various applications in day to day life like food irradiation, radiation therapy and diagnosis.
COC5	Develop skills in critical thinking and problem-solving and apply them effectively in both academic and professional contexts.

Unit I:

Nuclear Forces: 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.

Nuclear Models: 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 quadruple moments.

Unit II:

Nuclear Decay:α-decay, Gamow's theory, fine structure of α-spectrum, alpha decay, systematics, neutrino of hypothesis, Fermi's theory of β-decay, Fermi-Curie plot, angular momentum, selection rules for β-decay,

Nuclear 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 III:

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, Compound nucleus formation; Theory of Fission and fusion reactions. Nuclear Reactors: Fission reactors - fusion reactors -

Particle Physics: Elementary Particles, Classification and their Quantum Numbers (Charge, Spin, iso-spin etc.). Fundamental forces, Conservation of Parity, Strangeness and Lepton and Baryon numbers,

Applications of Nuclear Physics: Food irradiation, Medical physics- radiation therapy - radiation dosimetry, radioactive tracers, Tomography (PET)

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: TayalDC
8. John Lilley, Nuclear Physics: Principles and Applications, Wiley (2001)

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Core Paper –II (Common for all Specializations)

Course Code	Course Title	**L**	**T**	**P**	**C**
P-402T	**SPECTROSCOPY**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of atomic and molecular spectra.
COB2	Study the spin-orbit interaction.
COB3	Understand Raman and IR spectra.
COB4	Understand concept of nuclear spin and magnetic moment.
COB5	Understand ESR instrumentation and applications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Determinethe spectroscopic terms for equivalent and non-equivalent electron atom.
COC2	Analyze the hyperfine splitting of spectral lines.
COC3	Understand the nuclear spin and magnetic moment, origin of nuclear magnetic resonance.
COC4	Evaluate the vibrational and rotational Raman spectra.
COC5	Develop skills in estimating the hyperfine structure of ESR absorptions.

Unit I

Atomic Spectra: Different series in alkali spectra (main features), Ritz combination principle, L-S and j-j coupling; Spectroscopic terms for equivalent and non-equivalent electron atom- Energy level diagrams- Spin-Orbit interaction, doublet structure in alkali spectra, selection rules, intensity rules, alkali-like spectra, Lamb shift, isotope shift; hyperfine splitting of spectral lines, Lande interval rule.

Unit II

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

Raman and Infrared (IR) Spectra: Raman effect, classical and quantum theory of Raman effect, normal vibrations of CO_2 and H_2O molecules, vibrational and rotational Raman spectra. Basic concept of IR spectroscopy –IR spectrophotometer –Principle and Instrumentation, FTIR principle and working.

Unit III:

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, 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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Elective Paper – III

Course Code	Course Title	L	T	P	C
P-403T/SSP	**OPTICAL PHENOMENA IN SOLIDS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of optical properties of solids.
COB2	Study the direct and indirect band gap semiconductors.
COB3	Understand absorption and emission processes of luminescence.
COB4	Understand concept of quantum efficiency & frequency response of photo diodes.
COB5	Understand semiconductor materials for fabrication of homo junction solar cells.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Determine the photon-phonon transitions and inter band transitions.
COC2	Analyze the radiative and non radiative processes and decay mechanisms.
COC3	Understand the different kinds of color centers in the context of luminescence in alkali halides.
COC4	Evaluate different kinds of luminescence.
COC5	Develop skills in estimating the Fill factor, conversion efficiency, quantum efficiency of solar cells.

Unit I: Optical Properties of Solids:
Relation between dielectric and optical properties (macroscopic theory), Kramer-Kronig relations, Absorption of electromagnetic radiation, Photon-Phonon transitions, Inter band transitions, Direct and indirect band gap semiconductors -Si and Ge; Absorption coefficients- Infrared absorptions in semi-conductors.Frenkel and Wannierexcitons and their absorption, Imperfections - exciton absorption below the band gap, Intra-band 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- The Gudden-Pohl effect, Destraiu effect, Carrier injection luminiscence, 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 and Photo-voltaics:

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 – comparison of avalanche and PIN diodes.

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.

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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P 403T/MS

Elective Paper – III

Course Code	Course Title	L	T	P	C
P-403T/MS	**MATERIALS SCIENCE**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of ferroic materials.
COB2	Study the classificationofpolymers.
COB3	Understand molecular structure of polymers.
COB4	Understand concept of composite materials.
COB5	Understand applications of hybrid composites.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the structuralclassificationofferroelectrics.
COC2	Compare the domain structures in ferroelectric materials.
COC3	Evaluate the mechanicalbehaviorofpolymers.
COC4	Explain crystallization,meltingandglasstransitionphenomenoninpolymers
COC5	Appreciate the applications of Ceramicstructures and glass ceramics.

UnitI

Ferroic Materials

Introductiontoferroics,Structuralclassificationofferroelectrics,hydrogen-bondedandnon-hydrogenbondedferroelectrics,Thermodynamicsofferroelectricphasetransitions-proper,improperandpseudo-properferroelectricphasetransitions,Ferroelectricdiffusetransitions,Relaxor ferroelectrics, Domain structures in ferroelectric materials, Orientation of walls betweendomainpairs,Domainwallthickness,Domainswitching,Hysteresisloop,Polycrystallineferroelectrics, size effects in ferroelectric powders,Applications offerroic materials.

Unit II

Polymers &Composites

Polymers: Classificationofpolymers,polymermolecules,chemistryofpolymermolecules,molecular weight, molecular structure of polymers, thermoplastic and thermosetting polymers,polymercrystallanity,mechanicalbehaviorofpolymers-stressstrainbehavior,viscoelasticdeformation,strengtheningofpolymers,crystallization,meltingandglasstransitionphenomenoninpolymers, polymerization, manufacturing of polymers, applications of polymers.

Composites :

Basic Concepts, Definition of Composite materials, reinforcements, Classification of composites-Particlereinforced,Fiberreinforced andstructuralcomposites,Particlereinforcedcomposites-large particle composites, dispersion strengthened composites, Carbon-CarbonComposites,Hybrid Composites, Applications ofcomposites.

UnitIII

Ceramics & Glasses

Ceramics:Introductiontoceramics,classificationofceramics,Ceramicstructures-oxidestructures, silicate structures, Ceramic Phase diagrams- examples of two oxide systems, Differentkindsof Ceramics-glassceramics,refractories,Propertiesof Ceramics-Stress-Strainbehavior, applicationsofceramics

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

BooksRecommended:

1. SolidState Physics–A.J.Dekker,Macmillan IndiaLtd., 2003.
2. IntroductiontoFerrioc Materials–V.K.Wadhawan,
3. MaterialsScienceandEngineeringanIntroduction-W.D.CallisterJr,JohnWileyandsons.
4. IntroductiontoCeramics--W.D.Kingery,H.K.BowenandD.R.Uhlmann,JohnWileyandSons.
5. Luminescentmaterials–G.BlasseandC.Grabmaier,Springer-Verlog,1994.

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M.Sc. (Physics) - IV Semester Syllabus
(For the batch admitted from 2023-2024 onwards)

Elective Paper-III

Course Code	Course Title	L	T	P	C
P-403T/EI	**INTRUMENTATION FOR MEASUREMENT AND DATA TRANSMISSION**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the classification of transducers.
COB2	Study the displacement, strain and pressure measurement.
COB3	Understand temperature sensors.
COB4	Understand concept of flow measurement.
COB5	Understand the methods of data transmission.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the functionality of various transducers.
COC2	Compare the various temperature measuring devices.
COC3	Evaluate the ultrasonic flow meter.
COC4	Explain interfacing transducers to electronic controland measuring systems
COC5	Appreciate the multiplexing in telemetering system.

Unit I

Transducers: Classification of transducers–Active and Passive transducers-Electricaltransducers- 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–Straingauge circuits - Full bridge.

Pressure Measurement: Bourdon Tube- Bellows - Potentiometer device- Strain gauge transducer –LVDT type transducer.

Unit II

Temperature Measurement: Classification of temperature measuring devices-Resistance type temperature sensors (platinum resistance thermometer, thermistors) –Resistance thermometer circuits- Thermocouples-Temperature Control-Liquid level control.

Flow Measurement: Classification of flow meters–Head type flow meters-–Ultrasonic flow meter- DC and AC Servomotors-Stepper motor.

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Unit III

Data Transmission and Telemetry:

Analog and Digital Data Acquisition Systems: Interfacing transducers to electronic controland measuring systems – IEEE 488 Bus.

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–Multiplexing in telemetering system.

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.

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(For the batch admitted from 2023-2024 onwards)

Elective Paper –III

Course Code	Course Title	L	T	P	C
P-403T/NS	**NANO COMPOSITES**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	Understand the concept of nuclear forces.
COB2	Study the nuclear models and its magnetic moments.
COB3	Understand nuclear decay and nuclear detection.
COB4	Understand concept of interaction of charged particles with matter.
COB5	Understand applications of nuclear physics.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the functionality of various transducers.
COC2	Compare the various temperature measuring devices.
COC3	Evaluate the ultrasonic flow meter.
COC4	Explain interfacing transducers to electronic controland measuring systems
COC5	Appreciate the multiplexing in telemetering system.

Unit-I: Introduction: Nanocomposites, nanofillers, classification of nanofillers, carbon and non-carbon based nanofillers-synthesis and properties of fillers, Nano composites containing functionalized nanoparticles : organic and polymer materials for light –emitting diodes,

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,photo-oxidation of light emitting polymers, nanoparticles approaches to enhance the lifetime of emitting polymers. (15)

Unit-II: Synthesis of Nanocomposites: 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, wear resisting polymer nanocomposites: preparation and properties, surface treatment, composites manufacturing, wear performance and mechanism. (15)

Unit-III: Mechanical Properties of Nanocomposites : 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.(15)

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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Elective Paper– III

Course Code	Course Title	L	T	P	C
P-403T/EC	**MOBILE CELLULAR COMMUNICATIONS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing andlocalization.
COC5	Appreciate the digital video broadcasting.

Unit I

Cellular Concepts: Mobile communications-evolution, Standards, Speech Coder. Fundamental Radio Propagation and System concepts, Antenna Gain, Propagation characteristics, model for multipath-faded radio signals.
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 and synchronization. Concept of Diversity Branch and Signal Paths, Combining and Switching Methods, Carrier-to- Noise and Carrier- to- Interference Ratio, Performance Improvements.

Unit II

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, Inhibit 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 III

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 -- KamiloFeher
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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Elective Paper – III

Course Code	Course Title	L	T	P	C
P-403T/BP	**CELL AND MEMBRANE BIOPHYSICS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing andlocalization.
COC5	Appreciate the digital video broadcasting.

Unit I : Cellular Oscillations and Physics of charged membrane

Cellular Oscillations: Cell, structure of 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.
Charged Cell Membrane: Excitable tissues - nerve and muscle cells, action potential, Membrane models, membrane channels, membrane capacitance, relation among capacitance, resistance and diffusion between two conductors. Fick’s first law and 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 II: Biological cell Dielectrophoresis and Magnetophoresis
Dielectrophoresis Behaviour of charged and neutral matter in (a) uniform and (b) non-uniform electric fields.Types of polarization.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 and calculation of excess permittivity of lone cells.
Magnetophoresis : Introduction to Magnetophoresis. Behaviour of charge and neutral matter in magnetic field.Theory and experimental technique of magnetophoresis.Biological applications of magnetophoresis.

Unit III: Physics of natural flying machine

Flight surface (wing); Flight muscles; Sensory organs; Laminar and Turbulant flow, equation of continuity, bernoulli's equation, reynold's number. Basics/Fundamentals of aerodynamics.Wind tunnel–types. 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. Components of power, 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.
5. Bio Aerodynamics of avian flight – N.Chari.
6. Fundamentals of Aerodynamics – John D. Anderson, Jr.

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P403T/CMP

Elective Paper - III

Course Code	Course Title	L	T	P	C
P-403T/CMP	**TRANSPORT PHENOMENA IN SOLIDS**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understand the concept of mobile communication.
COB2	To describe the spread spectrum systems.
COB3	To examine medium access control.
COB4	To describe diversity branch and signal paths.
COB5	To understand the use of satellites in mobile communications.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the fundamental radio propagation and system concepts.
COC2	Compare the various medium accessing methods.
COC3	Evaluate the transmission characteristics of GSM.
COC4	Differentiate GEO, LEO, MEO, routing andlocalization.
COC5	Appreciate the digital video broadcasting.

UNIT-I

Diffusion in solids- Ficks first law and second law, Diffusion coefficient through plane surface, cylinder and sphere, Application based on second law of diffusion.
Diffusion in a simple cubic structure, Diffusion under external field, Nernst-Einstein relation, Kirkendall shift.
Ionic conductivity, Ionic conductivity of alkali halides and effect of divalent impurities on ionic conductivity.
Thermodynamics of Specific Heats: The Specific heat of a linear crystal, Debye theory applied to a linear crystal and three dimensional crystal.
Temperature dependence of the amplitude of vibrations solids: The Lindemann Law of Melting.
Thermoelectric effects, Thermopower, Seebeck effect, Peltier effect, The Wiedemann-Franz law.

UNIT-II

Electron Transport Phenomenon: Motion of electrons in bands and the effective mass tensor (semi-classical treatment), Currents in bands and holes.
Hopping conduction, Electrical conductivity of metals- Polorons- small poloron band conduction; large poloron band conduction; small poloron hopping conduction;
Mott transitions; Ionic Conductivity; Superionic Conductivity- structure, defects and conductivity.The electrical conductivity at low temperatures, Matheissen's rule.

UNIT-III

Electronic structure of 1D systems: 1D sub-bands, Van Hove singularities; 1D metals- Coulomb interactions and lattice couplings.

Electrical transport in 1D: Conductance quantization and the Landau formula, two barriers in series resonant tunnelling. Incoherent addition and Ohm's law, Coherence-Localization.

Electronic structure of 0D systems (Quantum dots): Quantized energy levels, Semiconductor and metallic dots, Optical spectra, discrete charge states and charging energy. Electrical transport in 0D- Coulomb blockade phenomenon.

Magnetoresistance and the Hall effect. Magnetoresistance in two band model.

Recommended books

1. Principles of Theory Solids : Ziman
2. Solid State Physics : Singhal
3. Solid State Physics : H.C. Gupta
4. Elementary Solid State Physics : M.Ali Omar
5. Solid State Physics : M.A. Waheb
6. Solid State Physics : Kachchava,
7. Principles of the Solid State Physics : H.V. Keer
8. Introduction to Solid State Physics (7th edition): C Kittel
9. Solid State Physics : W. Ashcroft and N. David Mermin
10. Solid State Physics :A.K. Saxena

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Elective Paper- III

Course Code	Course Title	L	T	P	C
P-403T/OE	**FIBER OPTIC TECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives: This course enables the students:

COB1	To understand the light propagation through an optical waveguide .
COB2	To describe the formation of modes in planar and cylindrical waveguides.
COB3	To examine the transmission characteristics of optical fibers.
COB4	To describe different nonlinear effects in optical fibers.
COB5	To identify the applications of optical fiber.

Course Outcomes: After the completion of this course the student will be able to:

COC1	Explain the propagation of light through an optical waveguide.
COC2	Compare the formation of modes in planar and cylindrical waveguides.
COC3	Evaluate the transmission characteristics of optical fibers.
COC4	Differentiate nonlinear effects in optical fibers.
COC5	Appreciate the applications of optical fiber.

Unit I: Optical fiber Guide: Ray theory transmission: total internal reflection, numerical aperture, planar wave guides, guided and radiation modes, TE and TM modes in a symmetric step-index planar wave guide, Nonplanar waveguides, types of fibers – multimode and single mode; step and graded index, skew rays, modes in optical fibers, modal analysis for a step-index and parabolic index fibers, cut-off wavelength.

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

Nonlinear effects of optical fibers: Nonlinear refraction, group velocity dispersion, cross phase modulation, self-phase modulation, Four wave mixing, stimulated Raman scattering, stimulated Brillouin scattering, fiber solitons.

Unit III: Optical Fiber communication Systems: Elements of fiber optic system, analog and digital signals, analog systems – signal-to-noise ratio, digital systems - power budgeting, bit error ratio, optical transmitter circuit - source limitations, drive circuits for LED and LASER; optical receiver circuit.

Multiplexing systems: Optical time division multiplexing, wavelength division multiplexing.

Optical Networks: Network topologies, local area networks – SONET/SDH, FDDI, WDM light wave networks – single-hop and multi-hop operations, ultrahigh capacity networks.

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 - GovindP.Agarwal, Academic Press, 3rd edition.
4. Introduction to Fiber Optics - A.Ghatak and K.Thyagarajan, Cambridge University Press
5. Fiber Optic Communications - Joseph C. Palais, Pearson, 5th Edition.
6. WDM optical Networks - C. Siva Ram Murthy and Mohan Guruswamy, Prentice Hall, 2002.

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P 401T/AE

Core Paper - I

DIGITAL SYSTEM DESIGN USING VHDL

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

Behavioral Modeling **:** Entity declaration, Architecture body, Process statement, Variableassignment statement, Signal assignment statement , Wait statement, If statement, Case statement, Loop statement, Exit statement, Next statement, Assertion statement, Report statement.

*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 andexamples, Resolving signal values.Generics**,**Configuration specification, Configuration declaration, Default rules, Conversionfunctions, Direct instantiation, Incremental binding.

Unit -II: *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, Typeconversions, Guarded signals, Attributes, Aggregate targets, more details on ports.

Unit-III :*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, Differentstyles 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 SudhalarYalamanchili., Pearson Education Asia 2001..
4. Fundamentals of Digital Logic with VHDL Design-ByStephen Brown &ZvonkoVranesic., THM 2002.
5. Digital Systems Design usingVHDL by Charles H.RothJr.PWS Pub., 1998.
6. VHDL –Analysis & Modeling of Digital Systems-By ZainalabedinNavabi., 2nd Ed., MH., 1998.

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P 402T/AE

Core Paper - II

FEEDBACK 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 .

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.

Unit – II:

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. **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 – III : 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 403T/AE

Elective Paper – III
Guided and Unguided media communication

Unit I

Optical Fiber communication:

Electromagnetic Mode Theory for Optical Propagation- Electromagnetic Waves, Modes in a planar wave guide, Phase and Group velocity, Phase shift with total internal reflection and Evanescent fields. Cylindrical optical Fiber-Modes, Mode coupling, Step index fiber, Graded index fiber and WKB method.

Transmission characteristics - Attenuation, absorption, intrinsic and extrinsic absorption.intra-modal and inter-modal dispersion.

Unit II

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 III

Cellular Mobile communication:

A basic cellular system, Performance criteria, Operation of cellular systems, Hexagonal shaped cells, Planning a cellular system, Elements of cellular system design, Frequency reuse, Co-channel interference reduction factor, Hand-off mechanism, Cell splitting,
Concept of Spread Spectrum, Frequency-Hopping Spread Spectrum,Direct Sequence Spread Spectrum,Code Division Multiple Access.

Analog And Digital Cellular Systems: Definitions of terms and functions, Introduction to digital technology, ARQ techniques, Digital speech, Digital mobile telephony, Multiple access schemes, Global system for mobile (GSM).

TEXT BOOKS :

1. Optical fiber communication- John M. Senior.
2. Optical fiber communication—G Keiser
3. Semiconductor Opto electronics—Pallab Bhattacharya.
4. Microwave Devices and circuits - By S.Y.Liao
5. Fundamentals of Microwave Engineering - R.E.Collin -McGraw-Hill International
6. Mobile Cellular Telecommunications by William C. Y. Lee. [McGRAW HILL].

REFERENCE BOOKS :

1. Optical communication system—J.Gower
2. Fundamentals of fiber optical communication and sensor system—Bishnu P Pal.
3. Integrated optics –Theory and technology—R.Ghunspurger.

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