SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY,JALGAON

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS

FOR

M.Sc. Part II

PHYSICS

(With effect from July - 2018)

M.Sc. Physics Programme

Objectives of the programme

The objectives of this programme are to develop:

1. The students through high quality of education/study which enables them to succeed in career in which an understanding ofphysics is relevant.
2. The ability to think logically, to analyze problems and phenomena and to devise explanations or solutions.
3. An appreciation of the role of mathematical modeling of physical phenomena to produce predictions which can betested against experimental observations.
4. An awareness of the importance of accurate experimentation in the understanding of natural phenomena.
5. The practical and technical skills required for physics experimentation.
6. An awareness of the value and the power of computer based techniques for experimentation, analysis and presentation and afamiliarity in their exploitation.
7. An ability to communicate the concepts and discoveries of physics both orally and in writing.
8. An ability to organize time and meet deadlines.
9. An additional skills resulting from the experience of more extensive project work.
10. An ability to integrate 'Information Communication Technology' with basic concepts of physics to promoterelevant education and training.
11. The qualities of adoptability, innovation and dynamism.

Important Instructions:

1. B. Sc. (Physics) students are eligible to offer this program.
2. Two written tests, one oral test and one seminar (per semester) should be conducted for each course in addition to regularteaching schedule.
3. Faculty members are advised to use 'compact disks' and computers as teaching aids so as to ingrain the basic ideas ofPhysics.
4. Students are advised to borrow scientific information (published worldwide) from scientific websites on Internet.
5. A well-equipped computer laboratory with at least 5 computers and 5 Microprocessor kits is necessary to conduct relatedexperiments.
6. Student should start the Project work soon after the commencement of third semester. Literature survey, Definitionof the problem, Pre-oral before finalization of the topic, Preliminary experimental work, Oral to assign the internalmarks etc should be covered in the third semester.
7. Student should carry out the experimental work, keep record of the observations and results and should draw the conclusionsof the project. Systematic project report should be prepared. Teacher should arrange oral examination to assign internal marks.

M.Sc.II.(Physics)Structure

The revised syllabus for M. Sc. (II) Physics prepared by different committees wasdiscussedand finalized in the workshop for M. Sc. (II) Syllabi revision on 16th July 2018.The titles of the papers for M. Sc. (II) Physics are as given below:

SEM III	PHY 301	Atomic and MolecularPhysics
	PHY 302	Any**ONE**ofthefollowing
	PHY 302 (A)	Materials Synthesis Methods
	PHY 302 (B)	Microprocessor and itsApplications
	PHY 302 (C)	Communication Electronics
	PHY 303	Any**ONE**ofthefollowing
	PHY 303 (A)	SystematicMaterials Analysis
	PHY 303 (B)	Computational Methodsand Programming Using 'C' Language
	PHY 303 (C)	Acoustics and Entertainment Physics
	PHY 304	SpecialLaboratoryI
	PHY 305	Project Work-I(LiteratureSurvey, Definition of Problem, Experimental work, Oraletc.)
SEM IV	PHY 401	NuclearPhysics
	PHY 402	Any**ONE**ofthefollowing
	PHY 402 (A)	Nanomaterials: Synthesis, Properties and Applications
	PHY 402 (B)	LASERand it's Applications
	PHY 402 (C)	Astrophysics
	PHY 403	Any**ONE**ofthefollowing
	PHY 403 (A)	RenewableEnergySources
	PHY 403 (B)	Microwave:TheoryandApplications
	PHY 403 (C)	Environmental Physics
	PHY 404	SpecialLaboratoryII
	PHY 405	Project Work-II(Characterization, Analysis ofResult, Conclusions, Project Report, Oral etc.)

M.Sc. Physics Programme:

Number of teaching days /year	180
Number of teaching days /term	90
Number of contact hours for theory course or practical course/ week	04
Number of teaching hours for theory course /term	52
Number of contact hours /term for test, seminars and tutorials	08
Total number of contact hours / term for course	**52+08 = 60**

PHY-301: Atomic and Molecular Physics

1. Atomic Spectra

Vector atom models for two, three and more valence electrons, complex spectra: Displacement law, alternation law of multiplicities, Breits scheme for derivation of spectral terms (LS and JJ coupling), Lande interval rule , inverted terms , Hund's rule, Zeeman effect and magnetic quantum numbers in complex spectra , magnetic energy and lande g factor, Paschen Back effect in complex spectra , Stark effect of hydrogen in weak and strong field.
Hyperfine structure: Introduction, origin of hyperfine structure, hyperfine structure of two or more valence electrons, Zeeman Effect in hyperfine structure, Back Goudsmit effect in hyperfine structure. **(H-14 M-17)**

2. Rotational Spectra

Classification of molecular spectra (pure rotational spectra, Rotation-vibration spectra, visible and UV spectra),Types of molecules: Diatomic linear symmetric top, asymmetric top and spherical top molecules, Introduction to rotational spectra, relative intensities of spectral lines, rotational spectra of rigid and non-rigid molecules through microwave spectroscopy, Determination of moment of inertia and bond length from rotational spectra. **(H-10 M-12)**

3. Vibrational spectra

Anharmonic oscillator, deduction of molecular properties from vibrational spectra of diatomic molecules. **(H-4 M-5)**

4. Rotation- vibrational spectra

Coupling of rotation and vibration, rotation-vibration spectra, selection rules and transitions for the vibrating rotator, intensities in rotation and irrotional spectra, parallel and perpendicular bands of linear molecules, isotope effect in vibrational rotational spectra.
(H-5 M-6)

5. Electronic spectra of Diatomic molecules

Electronic energy curves, potential energy curves, stable and unstable molecular states, vibrational structure of electronic spectra, general formula, graphical representation, rotational structure of electronic spectra, P,Q,R branches of band, Band head formation, shading of bands: fortrat diagram, intensities in electronic – vibrationalbands structure, Frank Condon principle. **(H-7 M-17)**

6. RAMAN spectra

Raman effect, quantum theory, Molecular polarisability, Pure rotational Raman spectra of diatomic molecules, vibration rotation Raman spectrum of diatomic molecule, intensity alternations in raman spectra of diatomic molecules, applications of IR & Raman spectroscopy in the structure determination of simple molecules, polarization of Raman lines.
(H-7M-7)

7. NMR spectroscopy

Resonance Technique: NMR – nuclear spin magnetic moment, interaction of nuclear magnet with external field. Quantum description of N.M.R. NMR spectrometer, Chemical shift, spin – spin interaction , Application of NMR spectroscopy.**(H-5 M-6)**
(Total H-52 M-60)

Reference books:

1. Molecular Spectra & Molecular Structure: G. Herzberg, Vol. 1 & 2 **(Von no strand Co. Inc 1965)**
2. Fundamentals of Molecular Spectroscopy: C.B. Banwell.
3. Atomic and Molecular Spectra: Rajkumar
4. Fundamental of molecular spectroscopy: Raymond Chang, McGraw Hill-Kogakusha Ltd, London 1971.
5. Introduction to IR & Raman spectroscopy: **Calthup, Daiy& Wimberley, Academic press1964.**

6. Spectroscopy Vol I & II: Edited by B.P. Stranghan& S. Walker.
7. Spectroscopy and Molecular Structure: C. W. King Holt Reinhardt & Winston Inc. 1964.
8. Atomic Spectra – H. E. White
9. Physical Methods in Inorganic Chemistry – Drago
10. Physical Chemistry – Puri, Sharma, Patharia.

PHY-302(A): Materials Synthesis Methods

1. Nucleation and Growth of Thin Films:
Condensation,Langmuir-Frankel theory of condensation.Theoriesof nucleation: Capillarity model,Atomistic model, Various stages of growth.**(H-4 M-5)**
2. Thin Films Deposition Techniques: Thermal evaporation, sputtering, chemical vapour deposition, chemical bath deposition, chemical spray method.
Thermal evaporation: General considerations, evaporation methods: Resistance heating,Flash evaporation,R.F.heating, Electron beam (e-beam) heating,MolecularBeam Epitaxy(MBE). **(H-6 M-7)**
Sputtering: Cathodic sputtering- Sputtering process, glow discharge sputtering pressure, Depositdistribution,current andvoltage dependence, cathode, contamination problem, Deposition control, Sputtering variants, Low pressuresputtering:Magnetic field, Assisted(triode)sputtering, R.F.sputtering, Ion-beam sputtering.Reactivesputtering.**(H-5 M-7)**
Chemical vapour deposition Techniques : Principle, chemical reactions used. Pyrolysis (Thermaldecomposition), Hydrogen reduction,Halidedisproportionation,Transfer reactions, polymerization.**(H-4 M-5)**
Chemical Bath Deposition Technique:
Electodelessdeposition: Mechanisms of chemical bathdeposition. Introduction, Nuclean, Adhesion and film growth processes in Ion-by-Ion mechanism, Hydroxidecluster mechanism, complex decomposition mechanism. **(H-4 M-5)**
Chemical Spray Method: Nucleation and growth process in film deposition, General idea of air pressure spray pyrolysis, Ultrasonic spray pyrolysis toprepare nanostructured films.
(H-4 M-5)
Thickness measurements: Optical interference technique, Multiple beam interferometry, Quartz crystal microbalance, Stylus (Talyestep) method.**(H-4 M-5)**
3.Thick film deposition technique: Fundamental aspect of the process, Design aids, Screens,Substratematerials, Screen printing, Firing process, Components and network: Passive components, activecomponents, Assembly, packaging and testing: solderingmethods for componentattachment, wire bonding,packaging, testing. **(H-7 M-7)**
4. Single crystals:
Importance of growing single crystals and their uses, Thermodynamic principles andcrystal growth equilibrium. Theory of crystal growth, Nucleation, Growth of single crystalby water solution method, growth by Gel method, growth by Flux method, Hydrothermalgrowth.
(H-9 M-9)
5. Electrical Properties:
Electrical conductivity of bulk, thin and thick films, two probe, Van-der Pauw and Four probe methods, Hallmeasurements, TEP measurements. **(H-5 M-5)**
(Total H-52 M-60)
Reference books:
1. Thin Film Phenomenan, K.L.Chopra, McGraw Hill,1969.
2. Hand book of Thin Film Technology L.I.Maissel&R.Glang, McGraw Hill,1970.
3. Thin Film Processes: J.L.Vossen and W.Kern, Academic Press,1978
4.Thin Film Fundamentals, A.Goswami, New Age International Publishers.
5. Chemical Solution Deposition of Semiconductors Films : Gary Hodes- Weizmann Institute of Science, Rehorot, Iszael.New York-Basar.
6. The materials science of Thin Films: M.Ohring Academic Press,1992.
7. Active and Passive Thin Film Devices: T.J.Coutts, Acadmeic Press 1978.
8. An Introduction to Physics and Technology of Thin Films : A Wegendristel and Y.Wang, World Scientific 1994.
9. Handbook of Sensor and Actuators- Thick Film Sensors- Edited by M.Prudenziati, Elsevier (1994), Vol. I, Series editor S. Middelhoek

PHY-302(B): Microprocessor and its Applications

1. The 8086 Microprocessor:

Register organization of 8086, 8086 Architecture, Pin configuration, Physical Memory organization, General bus operation, I/O address capability, Special purpose activities, minimum and maximum mode of 8086 systems with timings **(H-15 M-20)**

2. Instruction set of 8086 and programming:

Addressing modes of 8086, Instruction set of 8086, Assembler directives and operators. Simple programs like addition of two numbers, BCD addition, find the largest number, addition of two 3 x 3 matrices, move the string of data, find the number of positive numbers and negative numbers from, a given series of signed numbers etc. **(H-17 M-20)**

3. Special Architectural features:

Stack structure of 8086, Interrupts and interrupt service routine, Interrupt programming, Macros. (Programming is not expected)

(H-6 M-10)

4. Programmable Peripheral Devices and their Interfacing:

i] Programmable peripheral interface 8255.
ii] Programmable Communication interface 8251USART.
iii] Programmable DMA interface 8257.
iv] Programmable interrupt Controller 8259. **(H-10 M-5)**

5. 32 bit Processor:

Features of 80386, 80486, 80586 (Pentium), MMX (Multimedia Extension) **(H-4 M-5)**

(TotalH-52 M-60)

Reference Books:

1. Advance Microprocessor and Peripherals: A.K.Ray, K.M.Bhurchandi., Tata McGraw Hill, New Delhi.

2. Microprocessor and Interfacing: DauglasV.Hall, McGraw Hill International Edition.

3. Architecture, Programming and Design: Yu Cheng Liu,G.A.Gibson, 2nd Edition. PHI Publications.

PHY-302(C):Communication Electronics

Unit - I Electronic Communication

Importance of Communication, Introduction to Elements of communication systems and types of electronics communication (Simplex, Duplex, Analog, Digital, Base band and modulated signals) [kennedy]. **(H-2 M- 4)**

Unit II Modulation Systems

Amplitude Modulation:- (Spectrum of an Amplitude Modulated signal,. Low level AM Modulator), Single Sideband (SSB) Modulation, Generation of SSB signal (Filter Method), Vestigial-Sideband (VSB) Modulation, Demodulation of AM Waves (Square-law Detectors, Linear Diode Detector)

Frequency and Phase Modulation:- FM generation (Parameter Variation method), Frequency multiplication, FM Demodulation (Slope Detector)

Pulse Modulation, Pulse Code Modulation (PCM), Pulse Amplitude Modulation (PAM), Time-Division Multiplexing (TDM), Pulse Time Modulation (PTM) [Roddy&Coolen].

(H-11 M-13)

Unit III Radiation & Propagation of Waves

Electromagnetic Radiation (Fundamentals of electromagnetic waves & effect of environment), Propagation of waves (Ground or surface waves, sky wave propagation- The ionosphere, space waves, Tropospheric scattering propagation, Extraterrestrial communications) [Kennedy].**(H-7 M-8)**

Unit IV: Antennas

Antenna parameters- power gain, isotropic radiator, radiation resistance, directivity, directional gain, radiation parameter, polarization, effective apparatus, effective length, front to back ratio. Types of antenna- Half wave dipole (without mathematical derivation), Yagi& dish antenna. [Roddy&Coolen]**(H-7M-8)**

Unit V: Television Fundamental

Introduction to TV, TV systems & standards, Black & White transmission & reception, Color transmission & reception. [Kennedy] **(H-6 M-6)**

Unit VI: Radar and Satellite Systems

Fundamentals of RADAR system: Block Diagram, Frequencies and Powers used in RADAR, RADAR performance Factors, Effects of Noise, Basic Pulse RADAR systems (Block Diagram and Description), Antenna and Scanning, Moving target Indication(Doppler Effect), Other RADAR systems (RADAR Beacons, Phased RADAR), RADAR applications. [Kennedy];

Orbital Satellites, Geostationary Satellites, Look Angles (angle of elevation, Azimuth angle), Satellite system Link Model (UP Link Model, Transponder, Down-Link Model) [Roddy]

(**H-9 M-10)**

Unit VII: An overview of Telecommunication

History of Telecommunication, Telecommunication network, Internet, classification of data network, by spatial distance (WAN, MAN, LAN), by Cellular concept, Mobile Telephone communication [A. A.Gokhale] **(H-4 M-6)**

Unit VIII : Introduction To Fiber Optic Technology

Introduction, Principle of light transmission in a fiber, losses in fiber, dispersion, light sources for fiber optics, photo detector, fiber optic communication system.[Roddy&Coolen, J Senior]

(H-6 M-6)

(Total H-52 M-60)

Reference Books:

1. Electronic communication System- Kennedy & Davis (Tata Mc-Graw Hill) 4th ed.
2. Electronic communication- Roddy&Coolen. (PHI) 3rd ed.
3. Satellite Communication- Dennis Roddy, (Mc-Graw Hill), 3rd ed.

4. Fiber Optic Communication- John Senior, (Prentice Hall International), 2nd ed.
5. Antenna & Wave Propagation- K. D. Prasad, (SatyaPrakashan New Delhi)
6. Introduction to Telecommunication-Anu A Gokhale, (Cengage Learning) 2nd ed.
7. Electronic communication-Sanjeev Gupta (Khanna Publication, New Delhi).
8. Electronic communication: Fundamentals Through Advances-WameTomdsi (Prentice Hall Publications)

PHY-303(A): Systematic MaterialsAnalysis

1. Characterization Techniques:
Importance of materials characterization,Classification ofcharacterizationtechniques,Destructiveandnon-destructive techniques,Electromagneticspectrum, Propertiesof electromagnetic radiation. **(H-6 M-6)**

2.InfraredSpectroscopy:
RangeofIRabsorption,RequirementsforinfraredradiationAbsorption,TheoryofIRabsorption Spectroscopy,Linearmolecules,Spherical top molecules, Symmetric topmolecules,Asymmetric molecules, Spectrophotometers, Application ofIR Spectroscopy,Limitation ofIR Spectroscopy. **(H-7 M-10)**

3.UltraViolet&VisibleSpectroscopy:
Regions of UV-Visible radiation, Colourandlightabsorption,Thechromophoreconcept,Theoryofelectronicspectroscopy– orbitalinvolvedin electronictransitions,Lawsoflightabsorption-Beer'sandLambert's laws,Instrumentation. U.V. spectrometer, Sampleand referencecells, Applications ofUV visiblespectroscopy.**(H-10M-12)**

4.X-RayDiffraction:
Crystallinestate,X-raydiffractionprocesses,Preliminarydiscussionofpowderandsinglecrystalpatternandtheirinformationcontent,Structure determination, Particle size determination,Crystallographybydiffractionofradiationotherthan X-ray, Applications ofX-raydiffraction measurements. **(H-10M-10)**

5.ElectronMicroscopy:
Demeritsofopticalmicroscopeatnanolevel,Needof ElectronMicroscopy, Whyelectrons?ElectronSpecimeninteraction(Emissionofsecondaryelectrons,backscatteredelectrons,characteristicsx-rays, transmitted electrons), Specimeninteractionvolume,resolution,Scanningelectronmicroscope(SEM)Schematicdiagram ,Short details of each component, Field Emission Gun, Field Emission Electron Scanning electron microscope(FESEM),PrinciplesofImageFormation, EnergyDispersiveAnalysisofX-rays(EDAX), Transmissionelectronmicroscope(TEM),MeritsofTEMoverSEM/FESEM. (**H-14M-16)**

6. Scanning Tunneling Microscopy:
An Introduction to Quantum Mechanical Tunneling,Basic Principlesof STM,TwoModesof Scanning,Interpreting STMImages, Applications ofSTM.**(H-5 M-6)**

(Total H-52 M-60)

ReferenceBooks:

1. ElementsofX-raydiffraction,B.D.Cullity,Addision-WeselyPublishingCo., USA.
2. SEM microcharacterizationof semiconductors, D.B.Holt, and D.C.Joy, AcademicPress, New Delhi.
3. FundamentalsofMolecularSpectroscopy,C.N.Banwell,TataMcGraw-HillPubl.Delhi.
4. InstrumentalmethodsofAnalysis(SeventhEdition)H.H.Willard,L.L.Merritt,JohnA Dean,F.A.settleCBS Publishers and Distributors, New Delhi-110002.
5. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay and A.N. Banerjee, PHI Pvt. Ltd., New Delhi- 110001.

5. Characterization ofMaterials, Volume1, &2, Elton N. Kaufman, Wiley-Interscience
6. HandbookofMicroscopyforNanotechnology,NanYao,AhongLinWang,Kluwer AcademicPublishers

PHY-303(B): ComputationalMethods and Programmingusing‘C’ Language

1.‘C’Language:

a) Review ofClanguageforpreparing and running‘C’programs. **(H-5 M-6)**

b) **Pointers:**Theconceptsofpointers,Theaddressoperator,pointerarithmetic,pointers as function parameters, pointers and arrays, Dynamicstorage allocation. **(H-4 M-4)**

c) **StructuresandUnions:** Declarationandperiodoperator,structure initialization, structureandarrays, structureandfunctions,structureand pointers,structurewithin structure, Unions, Rules to useunions. **(H-4 M-4)**

d) **File handling:**Openingandclosing adatafile,creating adatafile,processing adata file. **(H-3 M-4)**

2.Numericalmethods:

Inthefollowing topicsonnumericalmethods,studentsareexpectedtowriteprograms using’C’language aswellasperformnumericalcalculationsusingelectroniccalculatorsandmathematical tables.

a) **Iterativemethodstoobtainrootsofequations:**Themethodofsuccessivebisection,falsepositi on method,Newton-Raphsonmethod.Derivationofformulaandadvantagesaswellaslimitationsofthese methodsovereachother.**(H-8M-9)**

b) **Interpolation:** Definition ofInterpolation and extrapolation, finite differences, Interpolation with equallyspacedandunevenlyspacedpoints. Lagrangesinterpolation,curvefitting,polynomialleast squaresandcubicspline fitting. **(H-8M-9)**

c) **NumericalIntegration:**DerivationandapplicationofTrapezoidal,Simpson1/3andSimpson’s3/8th rule. **(H-7M-9)**

d) **Solutionofsimultaneouslinearequations:**Gausseliminationmethod,pivotalcondensati on,GaussSeidalmethod.**(H-7M-9)**

e) **Solutionoffirstorderdifferentialequation:**Eulersmethod,Runge-Kuttamethods.

(H-4 M-6)

(Total H-52 M-60)

ReferenceBooks:

1. The ‘C’ProgrammingLanguage:KernighanB.W.&RitchieD.M.(PrenticeHallIndiaPvt.Ltd.)
2. Letus ‘C’:YashwantKanetkar(BPBPublications)
3. Schaum’soutlineoftheoryandproblemsofprogrammingwith‘C’:GottfriedB.S.(TataMcGra wHill PublishingCo. Ltd.
4. Programmingin ANSIC(IIndEdition)-E.Balagurusamy(TataMcGrawHillPublishingCo.Ltd.)
5. TheClanguageTrainerwithCgraphicsandC^{++} -J.Jayasri(NewAgeInternationalPvt. Ltd.New Delhi.)
6. Thespirtof‘C’–MullishCooper(JaicoPublishingCo.NewDelhi)
7. Programmingin ANSIC–Ramkumar(TataMcGrawHill)
8. IntroductorymethodsofNumericalAnalysis-S.S.Sastry.
9. NumericalAnalysis–GoelandMittal(PragatiPrakashan,Merrut).
10. Numerical methodsfor engineers with programmingand software applications-StevenC. Chapra, RaymondP.Canale.(McGrawHill)
11. NumericalMethodsproblemsand solutions– M.K.Jain,S.R.K.Iyengar,R.K.Jain(WileyEasternLtd)

12.Numerical methodsforMathematics,ScienceandEngineering-JohnMathews(PrenticeHallIndiaPvtLtd)
13.NumericalReceipsinC-WillamPress&Teukolsky(CambridgeUniversityPress)
14. ComputerOriented Numerical Methods – V. Rajaraman(PrenticeHallIndiaPvtLtd)

PHY-303(C): Acoustics and Entertainment Physics

1. **Basic Principles:** Sound wave propagation ,Plane and Spherical wave**s,** Plane wave equation(without derivation) ,Acoustic Intensity, Energy density, Acoustic impedance**,** Decibel Scales : Intensity level, Sound Pressure level, Sound power level, Loudness level, Equivalent continuous sound level, Laeqt, Perceived noise level LEPN, Noise pollution level, LNP. Human Speech and hearing mechanism, Threshold of audibility and feeling, Analogy among Electrical, Mechanical and Acoustical systems. **(H-8M-10)**
2. **Architectural Acoustics:** Reverberation time, Decay of sound in a live room, Sabine Equation, Decay of sound in a dead room, Eyring's Journals, Optimum reverberation time, Coefficient of absorption and its measurement. Methods of measurement of reverberation time, Synthetic reverberation, Acoustical evaluation of Theatre/ auditoria /studios, Requirements for good acoustics ofTheatre/Studios/auditoria. Soundreinforcement systems for auditoria. Amplifier power requirements,Audio delayers.**(H-10M-14)**
3. **Loudspeakers:**Direct radiator dynamic loudspeakers, Horn loudspeakers, Directional characteristics,Equivalent circuits, Efficiency of loudspeakers, Special Purpose loudspeakers,Loudspeaker systems, woofer, midrange/squankes, tweeter, Crossover, networks,Loudspeaker Cabinets.**(H-6M-7)**
4. **Microphones:**Carbon, Condenser, Moving coil dynamic and ribbon microphones, Microphonesensitivity, directional characteristics and applications, Calibration of microphones.**(H-6 M-6)**
5. **Sound Recording and Reproducing systems:** Basic requirements of a system for good quality recording and reproduction, Hi-Fi system, volume compressors. Viviters and expanders, Graphic equalizers. Monophonic and stereophonic sound reproducing systems. Magnetic tape sound recording and reproducing systems, Basic principles Analogue recording, Digital Audio tape, recording (DAT), Noise reduction in sound reproducing system-(I) Dolby A. B. System, Basic principles of compact Disc (CD), audio systems. **(H-10M-12)**
6. **Musical Acoustics:** Characteristics of musical notes: Vibratio, tremolo, portamento, waveforms of typical musical tones, Basic principles of musical instruments, Electronic musical instruments, Computer music, MIDI and applications. **(H-6M-5)**
7. **Ultrasonic and underwater acoustics:**Ultrasonic transducers-Principles and applications, Under water acoustics-Principles andapplications of underwater transducers, underwater communication, SONAR.**(H-6M-6)**

(Total H-52 M-60)

Reference Books:

1. Fundamentals of acoustics (2nd Ed.)-Kinsler and Frey.
2. Acoustics-W.W.Sets (Schwm series)
3. Music Physics and Engineering-HIF Olson
4. Acoustics Measurement-L.L.Bernek
5. Basic Acoustics-D.E.Hall
6. Technical Aspects of sound-(Vol. I) Richardson
7. Noise reduction-L.L.Bernk.
8. Audio Cyclopedia-H.Tremanic
9. Hand book of sound Engineers (New Audio cyclopedia)-G.M.Balloh(Ed.)
10. Acoustic techniques for the Home and Studio-F Alton Everest.
11. Design for good acoustics and noise control-J.E.Moore.

PHY-304 Special Laboratory II

Perform at least TENexperiments from the following:

1. To measure the thermoelectric power of semiconductor.
2. Study of Haynes-Schokley experiment for determination of mobility and diffusion constant.
3. Measurement of thickness of thin film by Tolansky method.
4. Study of electron spin resonance spectrum for given sample and determination of Lande 'g 'factor.
5. To record and analyze the spectral response of a given photo conducting sample.
6. Determination of resonance frequency of piezoelectric element.
7. Study of hysteresis of hard and soft ferrites.
8. Skin depth of electromagnetic radiation in Al.
9. Determination of Fermi energy in Cu..
10. Coherence & width of spectral lines using Michelson interferometer.
11. The Franck-Hertz experiment.
12. Absorption Spectrum Of Iodine Vapour.
13. Charge on an electron using spectrometer.

Material Synthesis

1. Deposition of metallic thin films by vacuum evaporation method and measurement of resistance/resistivity/ conductivity and TCR at different temperatures by the two probe/four probe method.
2. Deposition of thin films by spray pyrolysis method and thickness measurement by gravimetricmethod.
3. Measurement of reflectivity and transferability of thin films by using He-Ne laser.
4. Determination of refractive index of a transparent film by Abe's method.
5. Study of vacuum system to measure speed of rotary pump.
6. Pattern generation by Photolithography.
7. Electrical conductivity measurements in thick films.
8. Synthesis of CdS thin film by chemical bath deposition (CBD) method.
9. Stress measurement of transparent conducting oxides (Newton's ring method)
10. Determination of band gap energy of a given sample using absorption/transmission spectra.

Material Science:

1. Study of phase transformation in a ferroelectric crystal.
2. Study of creep behaviour of Sn-Pb alloy.
3. Thermoluminescence of alkali halides.
4. Determination of diffusion coefficient of cobalt atoms in Gel medium.
5. Determination of crystal structure of given material by X-ray diffract meter.
6. Determination of grain size of a given sample by Scherer method.
7. Determination of direct and indirect band gap of a given materials by UV-visible spectroscopy.
8. Determination of inter atomic bond length in a diatomic molecule by studying rotational vibrational IR spectra.
9. Study of Beer Lamberts Law in absorption spectroscopy using IR spectroscopy.

10. Synthesis of conducting oxide films by pyrolysis method.

Communication Electronics:

1. Pulse amplitude modulation.
2. Pulse position modulation.
3. Pulse width modulation.
4. Study of delta modulation.
5. Characteristics of antenna.
6. Study of amplitude modulator and demodulator.
7. Study of frequency modulator.
8. Study of FSK modulator and demodulator.
9. Study of Digital multiplexer.

Microprocessors:

1. Square, Triangular and Ramp wave generator using microprocessor.
2. Interfacing an eight bit ADC with microprocessor.
3. Write a program for four digit hexadecimal counters. The counter should stop and resume countingby pressing a key.
4. Temperature measurement using ADC.
5. Read data through thumb wheel switches and display it on monitor and 7-segment display.
6. Write a program to control relay switches with a delay of 1 second.
7. Average the given set of data and display the result in decimal form.
8. Stepper motor speed control using microprocessor.
9. Read string through keyboard which is terminated by any specified character and reverse the string.
10. Read two digit hexadecimal number through key board and convert it into bingary form.
11. Interrupt driven clock.(Ref. Ramesh S.Gaonkar Page No.376)

Computational Methods & 'C' Language programming

1. Draw a flowchart and write a program to find the root of the equation f(x)=0 byBisection method.
2. Draw a flowchart and write a program to find the root of the equation f(x)=0 byNewton Raphson method.
3. Draw a flowchart and write a program to find the root of the equation f(x)=0 byFalse position method.
4. Draw a flowchart and write a program to integrate the given function usingTrapezoidal rule.
5. Draw a flowchart and write a program to integrate the given function usingSimpson's 1/3 rule.
6. Draw a flowchart and write a program to integrate the given function usingSimpson's 3/8 rule.
7. Draw a flowchart and write a program for fitting of a polynomial of degree n usingLagrange's Interpolation formula.
8. Draw a flowchart and write a program to solve given set of simultaneous equationsusing Gauss Elimination method.
9. Draw a flowchart and write a program to solve given set of simultaneous equationsusing Gauss Seidal method.

10. Draw a flowchart and write a program to solve given differential equation usingEuler's simple method.
11. Draw a flowchart and write a program to solve given differential equation usingRunge-kutta method.
12. Draw a flowchart and write a program for finding the inverse of a givenmatrix./transpose of a matrix.
13. Implement strlen ( ), Stract ( ), Strcpy ( ), Strcmp ( ) using pointers.
14. Write a menu driven program to create, list, modify and calculate the student recorddetails. Assume the file structure: Register No., Subject 1 mark, Subject 2 mark and Subject 3 mark

Biomedical Instrumentation

1. ECG preamplifier- instrumentation amplifiers design & testing.
2. Active filters for bio-signals-design & testing.
3. Wave shaping circuits for cardiac pacemaker
4. Acoustic impedance measurement
5. Recording of action potentials with extra cellular electrodes.
6. ECG signal recording with surface electrodes.
7. Blood pressure measurement with transducer/pressure differentiation circuits.

PHY-305: M. Sc. Project – I

Activities:

1. To display the list of 'project titles' on notice board.
2. To organize a meeting of project supervisors' and students for discussion about projects.
3. To finalize the project titles so as to match student's particular interest.
4. Survey of the Literature.
5. To set the experiment/to start Preliminary Experimental work.
6. Internal examination.

The guide should regularly monitor the progress of the project work.

ASSESSMENT OF PROJECT TERM WORK (FIRST TERM):

Student should submit a Progress Report on the work done by him/her during the First Phase of the project including following points;

1. Project Selection,
2. Literature Search Strategy,
3. Literature Review,
4. Project Planning.

The student will have to give a seminar on the above topics.

PHY- 401: NUCLEAR PHYSICS

Chapter I: General Properties of Nuclei

Constituents of nucleus and their properties; packing fraction; mass defects; binding energy; average binding energy and its variation with mass number; concept of parity; magnetic dipole moment; electric quadrupole moment; problems.**(H-05 M-06)**

Chapter II: Nuclear Model

Types of nuclear models (list only); Liquid drop model: assumptions, semiempirical mass formula, achievements, failure and limitations of liquid drop model; Shell model, basic assumptions, nuclear magic numbers, experimental evidences of nuclear magic number and its significance, achievements and limitations of shell model; rules for angular momenta and parity of nuclear ground state; prediction of angular momenta and parity of nuclear ground state; nuclear energy level and their applications; problems.**(H-07 M-08)**

Chapter III: Nucleon – Nucleon Interaction

The deuteron problem; radius of deuteron; magnetic dipole moment and electric quadrupole moment of deuteron; Nature of interactions: electromagnetic, weak interactions and hadronic interactions; nucleon - nucleon scattering; scattering cross section; Low-energy neutron-proton scattering and proton-proton scattering, High energy neutron-proton and proton-proton scattering.**(H-08 M-08)**

Chapter IV: Interaction of charged particle and EM radiations with matter

Energy loss of charged particles (Bohr formula); stopping power; range and straggling; cerencov radiation; gamma (γ) ray interaction through matter; law of absorption of γ – rays; linear and mass absorption coefficient; the photoelectric process; Compton effect; pair production and annihilation of electron – positron pair; Dirac's theory of pair production; problems.**(H-14 M-18)**

Chapter V: Particle accelerators and Radiation Detectors

Classification of accelerators;Van-de-Graft generator; linear accelerator; synchrocyclotron; pelletron; microtron; types of detectors;scintillation detector and photomultiplier tube (PMT); semiconductor detector; bubble chamber; cloud chamber; spark chamber. **(H-10 M-12)**

Chapter VI: Elementary Particle Physics

Introduction; classification of elementary particles; particle interactions; elementary particle and their intrinsic quantum numbers (charge, Lepton number, Baryon number, iso-spin, strangeness etc.); conservation laws; Invariance under charge; Electrons and Positrons, Protons and antiprotons, Neutrons and antineutrons, Neutrinos and antineutrinos; Quark: assumption and properties; Quark model; colour of a Quark and its importance.**(H-08 M-08)**

(TotalH-52M-60)

Reference Books:

1. Concepts of Nuclear Physics: B.L.Choen, Tata McGraw Hill
2. Subatomic Physics: Franenfelder and Hanley, Prentice Hall
3. Nuclei and Particles : E. Segre.
4. Atomic Nucleus : R. C. Evans
5. Basic Nuclear Physics: B.N. Shrivastava
6. Introduction to Nuclear Physics: David Halliday.
7. Introduction to Nuclear Physics : Herald Enge. 30
8. Nuclear Physics: Irving Kaplan
9. Elements of Nuclear Physics: M.L.Pandya and Yadav
10. An Introduction to Nuclear Physics :Bhide& Joshi
11. Nuclear Physics: D.C.Tayal.
12. Radiation Detectors By Ramamurthy and Kapoor.
13. Introduction to Nuclear Physics By S. B. Patel.
14. Radiation Detection Techniques By Price.
15. Introduction to Nuclear Techniques By Knoll.

PHY- 402 (A): Nanomaterials: Synthesis, Properties and Applications

1. **Introduction:**

   Defination of nano, Nanomaterials-Defination and Necessity, Properties of Nanoscales, Comparison of Nanomaterial with bulk material, What is nanotechnology? What should we expect fromit?

   Introduction to low dimensional structures: Quantum wells, Quantum wires and Quantum dots, Nanoclusters and Nanocrystals. Quantum mechanics for low dimensional structures: Electron confinements, Schrodinger equation for particle in one dimensional box, Density of states, Density of states for a zero dimensional quantum dots, Density of states for 1-D Quantum wire, Density of states for two dimensional thin films, Density of states for a particle in threedimensionalbox.**(H-10M-16)**

2. **Techniques for synthesis ofNanomaterials:**

   I. Physical methods: High energy ball milling, Physical vapour deposition: Resistive heating, LASER ablation, sputterdeposition.

   II Chemical methods: Colloid, Synthesis of colloids, Growth of nanoparticles, synthesis of metal nanopaticles by colloidal route, synthesis of semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Sol-gel method, Synthesis of metal oxides by sol-geltechnique.

   III Biological,methods: Introduction, Synthesis of nanopaticles using Microorganisms, Synthesis using plant extracts, Use of proteins and Templets likeDNA.

   IV Hybrid techniques: Chemical vapour deposition, Ultrasonic atomization, Electrochemical.

   V Nanolithography: Lithography using photons, using particle beams, Scanning probe lithography.**(H-20M-24)**

3. **Synthesis of some specialnanomaterials:**

   Synthesis of magnetic nanoparticles, Magnetic properties-Super paramagnetic materials, processes for their biocompatibility, applications of magnetic nanoparticles.

   Carbon nanotubes: Synthesis of SWNT and MWNT, Applications of SWNT and MWNT photons. **(H-6M-10)**

4. **Nanophotonics:**

   Foundation for nanophotonics, Synthesis of metal chalcogenides (S, Se and Te) nanocomposites, photoconducting and photoluminescence properties of metal chalcogenides, photoconductivityofnanorods.**(H-6M-10)**

5. **Characterization ofNanomaterials:**

   X-ray diffraction- structural studies, Interpretation of broadening of peaks,

   Electron microscopy (FESEM/TEM)- Microstructural properties (Tophographical and morphological studies)

   Scanning Tunneling Microscopy- Determination of surface structures

   UV-VIS- optical properties related to Quantum confinement, Electrical and thermal transport properties, Plasmon resonance peaks and blue shiftatnanoscale.

   (H-10 M-16)

(TotalH-52M-60)

Reference Books:

1. Nanotechnology: Michel Kohler, WolfgangFritzsche.
2. Nanomaterials: Synthesis, Properties and Applications: A.S. Edelstein and R.C.

Cammarata, Institute of Physics Publishing Bristol andPhiladelphia.
3. Nanoparticles:BuildingblocksforNanotechnology,VincentRotello-Springer.
4. Introduction to Nanotechnology: Charles P. Poole Jr., Frank J.Owens
5. Nanoparticles Edited by GunterSchmid.
6. Nanoscale Science and Technology : Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, John Wiley & SonsLtd.
7. Nanoparticles & Nanostructured films: Preparation, Characterization & Applications: Wiley-VCH
8. Nanomaterials:AnIntroductiontoSynthesis,PropertiesandApplications:DieterVollath
9. NanostructuredMaterialsandNanotechnology:HariSinghNalwa,AcademicPress
10. Nanophotonics:ParasNPrasad,WileyInterscienceJohnWilley&Sons, IncPublication
11. Handbook of Microscopy for Nanotechnology: Nan Yao, Zhong Lin Wang Kluwer AcademicPublishers.
12. Nanotechnology:PrinciplesandPractice,S.K.Kulkarni,CapitalPublishingCompany.

PHY-402(B): LASER and its Applications

1. Basics of Lasers:

Introduction, Brief history of LASER, Interaction of radiation with matter, Einstein's prediction about emission, Absorption, Spontaneous and Stimulated emission, Einstein's coefficients and relations between them, Condition for light amplification, Population inversion, Pumping and pumping methods, Active medium, Pumping schemes. **(H-8 M-8)**

2. Principles of Lasers:

Introduction, Optical resonator, Basic components of laser, Principle of laser action, Difficulties in laser process and their removal, Threshold condition for laser oscillation, resonance frequencies, Laser operating frequencies, Cavity configurations, Modes; Longitudinal and Transverse modes, Single mode operation. **(H-8 M-10)**

3. Laser Rate equations:

Two level system. Three and four level system, Rate equations for three and four level system, Threshold pumping power, Relative merits and de-merits of three and four level systems. **(H-6 M-8)**

4. Laser Systems and Types:

Classification of Lasers: CW and Pulsed lasers, Detail discussion about constructional features, energy level diagrams, Laser action and working, characteristics etc of the following laser systems:

I). Solid State Lasers: The Ruby Laser, Nd-YAG Laser, Nd-Glass Laser etc.

II). Dye (Liquid) Lasers,

III). Gas Lasers:

- Atomic Gas Lasers: He-Ne Laser.
- Ion Gas Lasers: Argon ion and Krypton ion lasers, He-Cd metal vapour laser
- Molecular gas Lasers: CO_2 Lasers, Eximer laser, N_2 laser etc.

IV). Semiconductor lasers,

V). Chemical Lasers: HF laser. CO2 mixture lasers. **(H-14 M-18)**

5. Laser beam characteristics:

Directionality, Intensity, Coherence, Monochromaticity, Polarization, Speckles', Measurements of Laser power, energy-wavelength, frequency, line width. etc. **(H-6M-6)**

6. Applications of Lasers:

Applications of lasers in Material Processing and Mechanical industries, Medicine and Surgery, Defense and Military applications, Laser Range finders. Optical communication, Holography, Electronic industries.Laser Spectroscopy. **(H-10, M-10)**

(TotalH-52M-60)

Reference Books:

1. Lasers – A.G.Sigman- Oxford University Press 1986.
2. Principles of Lasers- O.Suelto-Plenum, 1982.
3. An introduction to lasers and their applications. – D.C.O.Shea, W. Russell and W.T.Rhodes, Addison –WelslayPub.Co. (1977)
4. Laser Systems and Applications- SatyaPrakash , PragatiPrkashan, IInd Ed, (2012)
5. An introduction to Lasers - Theory and Applications- M. N. Avadhanulu, S. Chand & C0. (2008)
6. Principles of laser and their Applications – by Callen, O'shea, Rhodes.
7. Lasers and non linear Optics – B.B.Laud (2nd edition).

PHY-402(C): Astrophysics

1.AstronomicalInstruments:
Opticaltelescopes-refractingandreflecting-
(Newtonian&Cassegrain).Radiotelescopes.Hubble'sspacetelescope,spectroscopes, photometry, spectro-photometry, Detectors &imageprocessing. **(H-8 M-8)**

2. Messagefromstarlight:
Electomagneticspectrum,Radiationfromheatedobject,Dopplareffect,Stellarspectra,determination of abundanceof elements from stellarspectra. **(H-6 M-8)**

3.TheHertzsprung- Russeldiagram:
Brightnessandluminosity,populationofstars,H-Rdiagram,variableandbinarystars.
(H-4 M-6)

4. StellarEvolution:
NuclearFusion,Fusionreactionsinstarsformationof Helium,CarbonOxygenandotherreactions,Equationofstateforstellarinterior,Mechanicalandthermalequilibriuminstars stellarevolution,whitedwarfsredgiants,pulsars,neutronstars,blackholes. **(H-10M-12)**

5. Galaxies:
Typesofgalaxies,evolutionofgalaxies,radiogalaxies,seyfertgalaxies,quasars,milky way galaxy. **(H-8M-8)**

6. General theory ofrelativity:
Spacetime&gravitation,vectors&tensors-contravariant&covariantvectors,symmetricand antisymmetrictensors, contraction, space time curvature, Geodesics, Principle of equivalence.
(H-9 M-10)

7. Cosmology:
Bigbangtheory,steadystateuniverse,oscillatinguniverse,Hubble'slaw,experimental evidencesforbigbang, open and closeuniverses. **(H-7 M-8)**
(TotalH-52M-60)

ReferenceBooks:

1. Astronomy-Fundamentals andFrontiers-Robert Jastowand Malcolm H. Thompson(Pub. JohnWiley&Sons)
2. AnIntroduction to Astrophysics-BaidyanathBasu(Pub. PrenticeHallIndia Pvt.Ltd.)
3. Introduction to Cosmology– J. V. Naralikar (Pub: CambridgeUniversityPress)
4. AnIntroduction to thestudyofstellarstructure-S. Chandarashekhar(Pub:Dover)
5. Measureoftheuniverse-T.D. North (Pub.Oxford UniversityPress).

PHY-403(A):RenewableEnergySources

1.SolarEnergy:
SolarEnergyconversionsystemsandtheirapplications,Fundamentalsofphotovoltaic energyconversion,Principlesofphotovoltaiccell,Materialsandfabricationtechnologies of P.Vcell, P.V. systems:configuration,outputpowerandconversionefficiency,Basic P.Vsystemforpowergeneration,ApplicationsandlimitationsofP.Vsystems.**(H-9 M-10)**

2.BiomassEnergyConversionTechnologies:
Originof biomass,Biomass energy resources, Biomass energy conversion processes,generation of gaseous fuels from biomass, digesters and their designs, Energy from
Cereals,grains, sugar, fruits, starch etc. **(H-8 M-10)**

3. WindEnergy:
Introductiontowindenergy,Nature&Originofwinds,Powerinawindstream,principles andbasiccomponentsofwindmill,Efficiencyofwindturbine,horizontal andverticalaxis windmills,performanceofwindmills,meritsandlimitationsofwindenergy conversions.
(H-9 M-10)

4. Ocean Energy:
Oceanasthepotentialenergyresource:variousoceanenergyconversiontechnologies, IntroductiontoOTEC,PrincipleofOTEC,Open cycle OTEC system, closed cycle OTEC system, Oceanwaves,energy andpowerfromocean waves,originoftidalenergy,Tidalenergy conversion. **(H-7 M-8)**

5.GeothermalEnergy: Geothermalenergy asarenewablesourceofenergy,Typesof geothermalresources,Origin ofgeothermalresources,Hydrogeothermal, Geopressuregeothermaland
Petrogeothermalresources,Basicsofgeothermalelectricpowerplant.
(H-6 M-7)

6. Emerging trends inRenewableEnergy sources:
FuelCells: Principleandoperationoffuelcell,classificationandtypesoffuelcells, Phosphoric acidfuelcell(PAFC),Alkaline fuelcell(AFC),Moltencarbonate fuelcell (MCFC), Solidoxide fuelcell(SOFC),Fuelsforfuelcells, Performancecharacteristicsof fuel cells.
HydrogenEnergy: Hydrogenascleansource of energy,sources Production,storage,Use ofhydrogen asfuel, conversion to energy,Applications. **(H-13 M-15)**

(Total H-52 M-60)

ReferenceBooks:

1. Energy TechnologyNon-Conventional, Renewable and Conventional, S.Rao, Dr.B.B.Parulekar, KhannaPublications, 3rd Ed, 2005
2. Non-Conventional EnergySources, G. D. Rai, KhannaPublications, 2000
3. SolarEnergyUtilisation, G.D.Rai, KhannaPublishers (1996)
4. Non-Conventional EnergyResources, KhanB.H., TataMcGraw Hill. 2006
5. SolarEnergyConversion, S. P. Sukhatne(2nd editions)
6. SolarCells M.A.Green
7. Hydrogen asan EnergycarrierTechnologies systems Economy-Winter&Nitch.
8. SolarEnergyConversion– A. E. Dixnon&J. D.Leslie.
9. Biomass Energy– S.H.Pawar,L.J.Bhosale, A.B.Sabale, S.K.Goel.
10. RenewableEnergySourcesandConversionTechnology,Bansal,N.K.,M.KM. Meliss(1990)TataMcGraw Hill.
11. Non Conventional and Renewableenergy sources, S.S. Thipse, Narosa Publishing Housevt.Ltd.

PHY-403(B): Microwaves: Theory and Applications

1. Transmission Lines:

Introduction to microwaves, applications of microwaves, Skin effect, Transmission line theory, Transmission lineequations and their solutions, Open and terminated transmission lines, Line impedances,Line admittance, reflection coefficient, transmission coefficient, standing wave ratio,Impedance matching, Smith chart, Single stub matching and double stub matching.**(H-6 M-8)**

2. Waveguides:

Rectangular and Circular waveguides, Solution of wave equation in rectangular coordinates,TE and TM modes in rectangular waveguide, Power transmission in rectangular waveguides, Power lossesand excitation modes in rectangular waveguides. **(H-6 M-8)**

3. Waveguide components:

Attenuators, filters, junctions, rectangular cavity resonator, circular cavity resonator, E-plane(series tee), H-plane (shunt tee), magic tee (Hybrid tee), directional couplers, hybridrings (Rat-Race), waveguide corners, bends, loads, Microwave circular isolators. **(H-7 M-8)**

4. Microwave Generators:

Microwave generation problems and principles, Tubes: Two cavity klystron and Reflex-klystron. Two cavity Klystronoperation as amplifiers and oscillators, velocity modulation, bunching process, output power and beam loadingefficiency of klystron.

Reflex Klystron: Velocity modulation, power output efficiency, electronic admittance.

Magnetron, Traveling wave tube amplifier: construction and operation.

Microwave transistors: Principle of operation, microwave characteristics- cutoff frequency,current gain, power gain.

Varactordiode: Principle of operation, use of varactor diode for frequency multiplication.

Microwave Tunnel diode: Principle of operation, Gunn diode, PIN diode:Principle of operation, microwave characteristics. **(H-10 M-10)**

5. Microwave Antennas:

Transmitting and receiving antenna: Horn antenna, Microwave dish antenna, antenna gain, resistance and band width, Beam width and polarization, Introduction to Microstrip antenna. **(H-6 M-6)**

6. Measurements:

Smith chart: Derivation, use of chart for solving various problems in wave guide/ transmission lines,Microwave measurements: Measurement of impedance, power, frequency, attenuation, SWR, dielectricconstant, quality factor. **(H-7 M-8)**

7. Applications:

Radar: Block diagram and working of pulsed Radar system.

Satellite: Active, passive, design requirements, payload, launching sequence.

Microwave link,Microwave Remote Sensing

Microwave ovens: Design requirements, sizes available, and application areas,

Applications of microwaves in the medical field**.(H-10 M-12)**

(TotalH-52M-60)

Reference Books:

1. Microwave Devices and Circuits - Samuel Y. Liao,Prentice-Hall, New Delhi, 2006
2. Microwave Engineering – Annapurna das & S.K. Das, Tata McGraw Hill, 2009
3. Foundation of microwave engineering – Colin R.E. McGraw Hill 1969.
4. Introduction to microwaves – Atwater, McGraw Hill 1962-63.
5. Introduction to microwave – Wheeler, McGraw Hill 1962-63.

6. Microwave semiconductor devices and their circuit application.- Watson , McGrawHill 1962-63.
7. Microwave circuits and elements – M.L.Sisodia
8. Microwave circuits & passive Devices–M. L. Sisodia, G.S. Raghuvanshi, WileyEastern Ltd, 1987

PHY-403(C): Environmental Physics

1. Introduction:

Meaning of Environment, Environmental science an overview, definition, concept & scope, types of environmental approaches, Nomenclature, environmental segments, Natural cycles (hydrologic, oxygen, nitrogen cycle). **(H-7 M-8)**

2. Atmosphere:

Composition of atmosphere, Major regions of atmosphere, evolution of atmosphere, earth's radiation balance, Particles in the atmosphere, chemical & photochemical reactions in the atmosphere. **(H-8 M-8)**

3. Environmental Resources:

Forest-Utilization, degradation & conservation, water-water cycle, degradation & conservation, Soil-utilization degradation & conservation. **(H-7 M-8)**

4. Pollution & environmental problems:

Meaning of pollution, sources, causes elementary fluid dynamics, factors governing air, water and noise pollution Green house effect/Global warming ozone hole. El Nino phenomenon. Acid Rain.**(H-6 M-8)**

5. Water Pollution:

Aquatic environment, water pollutant, Sources of contamination of water pollution, waste water treatment, water quality parameters & standards, sampling, preservation, monitoring techniques pH dissolved oxygen, chemical oxygen demand, total oxygen demand, analysis of water quality parameter. **(H-9 M-10)**

6. Air Pollution:

Air pollutant, air quality standard, sampling, monitoring, sampling, analysis technique, Gaseous and particulate matter. **(H-7 M-8)**

7. Global & Regional Climate:

Elements of weather and climate, stability and vertical and horizontal motion of air and water, viscous force, inertia force, Reynolds number, energy balance, pressure gradient force, global climate model and climate of India. **(H-8 M-10)**

(TotalH-52M-60)

Reference Books:

1. Environmental Chemistry: A.K.De
2. Environmental Chemistry: O.D.Tyagi, M. Mehra (Anmol Publications)
3. Physics of atmosphere: J.T.Hougtion (Cambridge Uni.Press:1977)
4. Renewable Energy Sources: Elbs.1988.J.T.Widell &J.Weir.
5. Water Pollution (problems and Prospects): V.K.Prabhakar(Anmol Publications).
6. The Physics of Mansoons: R. N. Keshavmurthy& M. Shankar Rao Allied Publishers,1992.
7. Solar Energy: S.P.Sukhatme.
8. Solid State Energy Conversion: S.H.Pawar, V.H.Shinde.
9. Environmental Physics:EgbertBoekar and Rienk Van Groundelle(John Willey)
10. An Introduction to Solar Energy for Scientists and Engineers: Sol-Wieder John Wiley,1982.
11. Numerical Weather Prediction: G.J.Haltiner and R.T.Williams John Wiley,1980.

PHY-404 Special Laboratory II

Perform at least<u>TEN</u>experiments from the following.

1. To find water of crystallization in Copper sulphate by TGA.
2. Differential thermal analysis [DTA] of $CuSO_4$,$5H_2O$.
3. Schottky barrier determination for various semiconductors.
4. To analyse the Raman Spectrum of a sample.
5. To determine Young's modulus of a metallic rod by Searle's optical interference method (Newton's Rings).
6. To analyse the photoluminescence spectrum of a given sample.
7. Determination of Curie temperature of a given sample.
8. Determination of calorific value of wood/cow dung.
9. Determination of wind power.
10. Wind data analysis of a given site.
11. Study of power vs. load characteristics of solar P.V. systems and study of series and parallel combination of solar P.V. panels.
12. Study of Optical Properties of Selective Coatings.
13. Hyperfine structure of spectral lines using FP etalon/L.G. plate.
14. To study the Quantum defects of S and P states of Na atom using constant deviation spectrometer.
15. Study of dielectric behavior of $BaTiO_3$ sample.

Nanomaterials

1. Synthesis ofmetal nanoparticles.
2. Synthesis ofporous silicon.
3. Absorption bymetal nanoparticles.
4. X-rayDiffraction ofnanoparticles.
5. Photoluminescenceofnanoparticles.
6. Synthesis ofsemiconductornanoparticles bychemical method.
7. Optical absorption ofnanoparticles (observation ofBlueshift with sizeof particles).
8. Photoluminescenceofnanoparticles (Luminecencedecaytime).
9. X-raydiffraction studies ofnanoparticles (effect oftemperature).
10. Densityofstates calculation ofsmall clusters (experiments on computer).

LASERS:

1. To verify Heisenberg uncertainty principle using He-Ne laser source.
2. Study of Faraday's effect using Laser source.
3. Diameter of a given wire by diffraction.
4. Determination of bandwidth of a given optical fiber.
5. Measurement of reflectivity and transferability of thin film by using He-Ne laser.
6. Verification of Brewster's law of polarization using He-Ne laser.
7. Study of magneto-optic rotation and magneto-optic modulation.
8. To determine the wavelength of a LASER source using an engraved scale as a reflecting diffraction grating.

Astrophysics

1. Toestimatethetemperatureofanartificialstarbyphotometry.
2. Tostudycharacteristicsofa CCDcamera.
3. Tostudythe solarlimbdarkeningeffect
4. Topolarassignanastronomicaltelescope.
5. Toestimatetherelativemagnitudesofagroupofstarsbya CCDcamera.

Microwaves

1. Studyofpassivecomponents
2. Studyofvariousloads
3. TostudycharacteristicscurveofKlystron.
4. Determinationofconstantsoftransmissionline,striplines.
5. Studyofcavityresonator.
6. Studyofringresonatorandrejectionfilter.
7. Todesign,fabricateandtestastriplineresonator.
8. Tofinddielectricconstantof givenliquidusingmicrowavebench.
9. MeasurementofQualityfactorQ ofamicrowaveresonator.

PHY-405: M. Sc. Project - II

Activities:

1. To complete the experimental work.
2. To carryout the measurements.
3. To characterize the samples.
4. To obtain the results.
5. To draw the conclusions.
6. To write the project report.
7. To appear for Internal examination
8. To appear for External examination

Project Report:

1. Students have to write a 'project report'.
2. A report should be a concise account of project work containing full descriptions of the aims, methodand outcomes.
3. Length of report should not normally exceed 40 pages.

Assessment Criteria of the project:

The following criteria are to be used in assessing the project work:

(i)The conduct of project work:

The following questions are considered in assessing how well students have carried out the projectwork.

1. How difficult was the project?
2. How well did the student understand the scientific principles behind the project?
3. How well did the student plan the project work?
4. How much effort was put into the project?
5. Was an interium report presented on time?
6. Was the student's project logbooks adequate?
7. How much initiative and/or originality did the student contribute to the project.
8. How well did the student cope with problems that arose during the course of project?
9. Did a project reach a stage of completion where meaningful results were obtained and definite conclusionscould be drawn?

(ii) The Project Report:

1. How well did the report set out the background?
2. How well did the report describe the underlying them?
3. Was the report a reasonable length?
4. How well was the report structured?
5. How understandable was the written content?
6. How well did the report describe the execution of the project?
7. Did the report have an adequate summary or conclusions?

(iii) Oral Examination:

1. Did the student adequately describe what he/she had done in their project?
2. Did the student have a clear interpretation of his/her results?
3. What was the clarity and overall standard of the presentation?
4. How well was the talk/presentation structured?
5. Did the student cover all the relevant material in a reasonable time?

CAREER OPPORTUNITIES FOR M.Sc. PHYSICS STUDENTS

M.Sc Physics students can find jobs in public and private sectors. There are many opportunities available for M. Sc Physics students in technical as well as scientific fields. They can work as Scientist, Assistant Scientist, Quality Control Manager, Laboratory Technician, School Science Technician or Research Analyst in any government or private organization. Besides these, they can also go for teaching in government or private institutions.

Private Sector:

There are many opportunities available in IT field for M. Sc Physics graduates. Many IT companies such as Infosys, Wipro and TCS are recruiting M. Sc. Physics graduates for software jobs. They can also get jobs in Energy Plants. Another jobs available for these graduates is Technician in Electronic Industry. They can apply for jobs in many companies in automobile industry. Some of those companies are MarutiUdyog, TATA Motors and Tech Mahindra.

Government Sector:

There are vast opportunities available for M.Sc graduates in Government sector.They can apply for jobs in Scientific Research and Development Organizations such asThe Defence Research and Development Organisation (DRDO), CSIR, PhysicalResearch Laboratory (PRL) Ahmedabad, Saha Institute of Nuclear Physics Kolkata andNuclear Science Centre New Delhi. They can also apply for various jobs in popular government organizations such as:

- Bhabha Atomic Research Centre (BARC)
- Atomic Energy Regulatory Board (AERB)
- Oil and Natural Gas Corporation (ONGC)
- Bharat Heavy Electricals Limited (BHEL)
- National Thermal Power Corporation (NTPC)
- Indian Space Research Organization (ISRO)
- National Chemical Laboratory (NCL)
- Indian Institute of Tropical Meteorology (IITM)

They can also apply for the various competitive exams conducted by Union PublicService Commission such as IFS, IPS and IAS. Several other government examsconducted for recruiting M.Sc Physics graduates are given below:

- Tax Assistant Exam, Statistical Investigator Exam, Combined Graduate LevelExam.

After qualifying NET or SET exam they can apply for teaching jobs in governmentcolleges or schools. Another option available for M.Sc. Physics graduate is to apply forjobs in public sector banking. Several banks are conducting exam every year forrecruiting graduates to the post of Probationary Officers. They can also find many jobsin Railway sector. They should qualify the exams conducted by Railway RecruitmentBoard to get a job in Railway sector. These graduates can also apply for Combined Defence Services Exams conducted for recruiting candidates to various posts in Defence Department.

Foreign countries:

There are wide opportunities available for M. Sc. Physics graduates in foreigncountries. They can work in several health care, manufacturing and electronicscompanies in foreign countries. Students having high percentage during their postgraduation can apply for jobs in National Aeronautics and Space Administration(NASA), one of most famous space research organization in the world.

Long term Career in Research:

Those who have completed M. Sc. degree in Physics can find a long term careerin the research field. Even though they are joining the research organization asassistant/research fellow(JRF, SRF), can earn lot of experience and/or Ph.D. Degree.After these achievements, they will have chances to get promoted to higher posts.

EQUIVALENT COURSES

Old Course		New Course	
Course Number	**Title of the Course**	**Course Number**	**Title of the Course**
PHY 301	Atomic and Molecular Physics	PHY 301	Atomic and Molecular Physics
PHY 302	Any **ONE** of the following	PHY 302	Any **ONE** of the following
PHY 302(A)	Materials Synthesis Methods	PHY 302(A)	Materials Synthesis Methods
PHY 302(B)	Microprocessor and its Applications	PHY 302(B)	Microprocessor and its Applications
PHY 302(C)	Communication Electronics	PHY 302(C)	Communication Electronics
PHY 303	Any **ONE** of the following	PHY 303	Any **ONE** of the following
PHY 303(A)	Systematic Materials Analysis	PHY 303(A)	Systematic Materials Analysis
PHY 303 (B)	Computational Methods and Programming Using 'C' Language	PHY 303(B)	Computational Methods and Programming Using 'C' Language
PHY 303(C)	Acoustics and Entertainment Electronics	PHY 303(C)	Acoustics and Entertainment Electronics
PHY 304	Special Laboratory I	PHY 304	Special Laboratory I
PHY 305	Project Work- I (Literature Survey, Definition of Problem, Experimentalwork, Oral etc.)	PHY 305	Project Work- I (Literature Survey, Definition of Problem, Experimentalwork, Oral etc.)
PHY 401	Nuclear Physics	PHY 401	Nuclear Physics
PHY 402	Any **ONE** of the following	PHY 402	Any **ONE** of the following
PHY 402(A)	Nanomaterials: Synthesis, Propertiesand Applications	PHY 402(A)	Nanomaterials: Synthesis, Propertiesand Applications
PHY 402 (B)	LASER and it's Applications	PHY 402 (B)	LASER and it's Applications
PHY 402 (C)	Astrophysics	PHY 402 (C)	Astrophysics
PHY 403	Any **ONE** of the following	PHY 403	Any **ONE** of the following
PHY 403 (A)	Renewable Energy Sources	PHY 403 (A)	Renewable Energy Sources
PHY 403 (B)	Microwave: Theory and Applications	PHY 403 (B)	Microwave: Theory and Applications
PHY 403 (C)	Environmental Physics	PHY 403 (C)	Environmental Physics
PHY 404	Special Laboratory II	PHY 404	Special Laboratory II
PHY 405	Project Work- II (Characterization, Analysis of Result, Conclusions, Project Report, Oral etc.)	PHY 405	Project Work- II (Characterization, Analysis of Result, Conclusions, Project Report, Oral etc.)