MANONMANIAM SUNDARANAR UNIVERSITY - TIRUNELVELI

PG **PROGRAMMES**

OPEN AND DISTANCE LEARNING(ODL) PROGRAMMES

(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)

M.Sc. Physics

Semester	Course	Title of the Course	Course Code	Course Type
I	Core I	Mathematical Physics	SPHM11	Theory
	Core II	Classical Mechanics and Relativity	SPHM12	Theory
	Core III	Linear and Digital ICs and Applications	SPHM13	Theory
	Elective - I	Practical – I	SPHP11	Practical
	Elective - II	Energy Physics	SPHE11	Theory

MATHEMATICAL PHYSICS

UNITS	Course Details
UNIT I: **LINEAR VECTORSPACE**	Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure – linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions–Direct sum and invariant subspace–orthogonal transformations and rotation
UNITII: **COMPLEX ANALYSIS, PROBABILITY& STATISTICS**	Review of Complex Numbers -de Moivre'sTheorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion-Zeros and poles – Residue theorem. Probability – Introduction – Addition rule of probability – Multiplicationlawofprobability–Problems–Introductiontostatistics–Mean, median, mode and standard deviations.
UNIT III: **MATRICES**	TypesofMatricesandtheirproperties,RankofaMatrix-Conjugateofamatrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices - Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem –Diagonalization

UNIT IV: **FOURIER TRANSFORMS &LAPLACE TRANSFORMS**	Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string. Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions -Application - Laplace equation: Potential problem in a semi - infinite strip

UNIT V: **DIFFERENTIAL EQUATIONS**	Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function -Rodrigueformula –Orthogonalityproperties -Dirac delta function-OnedimensionalGreen'sfunctionandReciprocitytheorem-Sturm-Liouville'stypeequationinonedimension&theirGreen'sfunction.
UNIT VI: PROFESSIONAL COMPONENTS	ExpertLectures,OnlineSeminars-WebinarsonIndustrialInteractions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. George Arfkenand Hans JWeber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press. 2. P.K. Chattopadhyay,2013,*MathematicalPhysics*(2nd edition),New Age, New Delhi 3. AWJoshi,2017,MatricesandTensorsinPhysics,4thEdition (Paperback), New Age International Pvt. Ltd., India 4. B. D. Gupta, 2009, *Mathematical Physics* (4th edition), Vikas Publishing House, New Delhi. 5. H.K.DassandDr.RamaVerma,2014,MathematicalPhysics, Seventh Revised Edition,S. Chand & Company Pvt. Ltd., New Delhi.

CLASSICALMECHANICSAND RELATIVITY

UNITS	Course Details
UNIT I: PRINCIPLESOF CLASSICAL MECHANICS	Mechanics of a single particle – conservation laws for a particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates–configuration space–transformation equations – principle of virtual work.

UNIT II: LAGRANGIAN FORMULATION	D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii)Atwood's machine – Lagrange's equations in presence of non- conservative forces–Lagrangian for acharged particle movinginan Electro magnetic field.
UNIT III: HAMILTONIAN FORMULATION	Phase space – generalized momentum and cyclic coordinates – Hamiltonian function and conservation of energy – Hamilton's canonical equations of motion – applications: (i) one dimensional simple harmoni coscillator (ii) motion of particle inacentral force field.
UNIT IV: SMALL OSCILLATIONS	Stable and unstable equilibrium –Formulation of the problem: Lagrange's equations of motion for small oscillations – Properties of T, Vandw–Normal co-ordinates and normal frequencies of vibration– Free vibration so falinear triatomic molecule.
UNIT V: RELATIVITY	Inertial and non-inertial frames – Lorentz transformation equations – lengthcontractionandtimedilation–relativisticadditionofvelocities – Einstein'smass-energyrelation–Minkowski'sspace–fourvectors – position, velocity, momentum, acceleration and force in four vector notation and their transformations.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. H.Goldstein,*Classical Mechanics*, 3rdEdition,PearsonEdu. 2002. 2. J.C.Upadhyaya, *Classical Mechanics*, Himalaya Publshing Co. New Delhi. 3. S.L.Gupta,V.Kumar,H.V.Sharma,ClassicalMechanics,PrakatiPrakashan, Meerut. 4. R. Resnick, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi, 1968. 5. N.C.RanaandP.S.Joag,ClassicalMechanics-TataMcGraw Hill, 2001

LINEAR AND DIGITALICs AND APPLICATIONS

UNITS	Course Details
UNITI: INTEGRATED CIRCUITSAND OPERATIONAL AMPLIFIER	Introduction, Classification of IC's, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit diagram, Op-Amp. Characteristics, DC and AC performance Characteristics.

UNITII: APPLICATIONS OF OP-AMP	LINEARAPPLICATIONSOFOP-AMP:Solutionto simultaneous equationsanddifferentialequations,Instrumentationamplifiers,VtoIand Ito Vconverters. NON-LINEARAPPLICATIONSOFOP-AMP: Sample and Holdcircuit, Log and Antilog amplifier,multiplier and divider, Comparators,Schmitttrigger, Multivibrators,Triangular and Square waveform generators.
UNITIII: ACTIVEFILTERS& TIMERAND PHASE LOCKED LOOPS	ACTIVEFILTERS:Introduction,Butterworthfilters–1storder,2ndorder Low and high pass filters, band pass, band reject and all pass filters. TIMERANDPHASELOCKEDLOOPS:Introductionto IC 555timer, descriptionoffunctionaldiagram,monostableandastableoperationsand applications,Schmitttrigger,PLL-introduction,basicprinciple,phase detector/comparator,voltagecontrolledoscillator(IC566),lowpassfilter, monolithicPLLandapplicationsofPLL
UNITIV: VOLTAGE REGULATOR& DtoAAND Ato D CONVERTERS	VOLTAGEREGULATOR:Introduction,SeriesOp-Ampregulator,IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. D to AANDA to DCONVERTERS:Introduction,basic DAC techniques-Weighte dresistor DAC,R-2Rladder DAC,invertedR-2RDAC,AtoD converters-parallelcomparatortypeADC,countertypeADC,successive approximationADCand dualslopeADC, DACandADC Specifications.
UNITV: CMOSLOGIC, COMBINATIONAL CIRCUITS USING TTL 74XXICs & SEQUENTIAL CIRCUITS USING TTL 74XXICs	CMOSLOGIC:CMOSlogiclevels,MOStransistors,BasicCMOS Inverter,NAND and NOR gates,CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USINGTTL74XXICs:Studyoflogic gatesusing74XXICs,Four-bitparalleladder(IC7483),Comparator(IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segmentdecoder(IC7447),Encoder(IC74147),Multiplexer(IC74151), Demultiplexer(IC74154). SEQUENTIALCIRCUITSUSINGTTL74XXICs:FlipFlops(IC7474, IC7473),ShiftRegisters,Universal Shift Register(IC74194),4-bit Asynchronousbinary counter(IC7493).
UNITVI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement,Social Accountability and Patriotism

TEXT BOOKS	1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd., NewDelhi,India. 2. RamakantA.Gayakwad,(2012),OP-AMPandLinearIntegrated Circuits, 4th edition, Prentice Hall / Pearson Education, NewDelhi. 3. B.L.TherajaandA.K.Theraja,2004,ATextbookofElectrical technology, S. Chand & Co. 4. V.K.MehtaandRohitMehta,2008,PrinciplesofElectronics,S. Chand & Co, 12th Edition. 5. V.Vijayendran,2008,IntroductiontoIntegratedelectronics(Digital &Analog),S.ViswanathanPrinters&PublishersPrivateLtd, Reprint.V.

PRACTICAL I

(Choose any SIX experiments from PartA and SIX from Part B)

PART A

1. DeterminationofYoung'smodulusandPoisson'sratiobyHyperbolicfringes-Cornu's Method
2. B-Hloop using Anchor ring.
3. Determination of Thickness of the enamel coating onawire by diffraction
4. Measurement of Band gapenergy- Thermistor
5. Determination of Planck Constant– LED Method
6. Determination of Compressibility of aliquid using Ultrasonics
7. DeterminationofWavelength,Separationofwavelengths-MichelsonInterferometer
8. Measurement of Conductivity-Four probe method.
9. Arcspectrum–Iron.
10. Measurement of wavelength of Diode Laser/ He –NeLaserusingDiffraction grating.
11. Determination of Diffraction pattern of light with circularaperture using Diode/He-Ne laser.
12. Measurement of Susceptibility of liquid-Quincke's method
13. UV-Visiblespectroscopy–VerificationofBeer-Lambert'slawandidentificationofwavelength maxima – Extinction coefficient
14. Anderson'sbridge–L_1,L_2,L_s,L_p

PARTB

1. Construction of relaxation oscillator using UJT
2. FETCS amplifier- Frequency response,input impedance,output impedance
3. Study of important electrical characteristics ofIC741.
4. V-ICharacteristics of different colours of LED.
5. Study ofattenuationcharacteristics ofWien'sbridgenetwork and design of Wien'sbridge oscillator using Op-Amp.
6. Studyof attenuation characteristics ofPhase shift network and design of Phaseshift oscillator using Op-Amp.

7. ConstructionofSchmidttriggercircuitusingIC741foragivenhysteresis-applicationas squarer. 8. Construction of square waveTriangular wave generatorusingIC741 9. Construction of pulse generator using the IC741–applicationasfrequencydivider 10. ConstructionofOp-Amp-4-bitDigitaltoAnalogconverter(BinaryWeightedandR/2R ladder type) 11. Study of Binary to Gray and Gray to Binary code conversion. 12. Study of R-S, clocked R-S and D-Flip flop using NAND gates 13. Study of J-K, Dand Tflip flops usingIC7476/7473 14. Arithmeti coperations using IC 7483-4-bit binary addition and subtraction.	
TEXT BOOKS	1. Practical Physics,Gupta and Kumar,Pragati Prakasan. 2. Kit Developed for doing experiments in Physics-Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences. 3. Electronic Laboratory Primer a design approach, S. Poornachandra, B.Sasikala,Wheeler Publishing,NewDelhi. 4. Electronic lab manual Vol I, K ANavas, Rajath Publishing. Electronic lab manual VolII, KANavas, PHIeastern Economy Edition

ENERGY PHYSICS

UNITS	Course Details
UNIT I: INTRODUCTION TOENERGY SOURCES	Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution.
UNIT II: ENERGYFROM THE OCEANS	Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.
UNIT III: WINDENERGY SOURCES	Basic principles of wind energy conversion–power in the wind–forces in the Blades–Wind energy conversion–Advantages and disadvantages of Wind energy conversion systems(WECS)-Energy storage–Applications of wind energy.
UNIT IV: ENERGYFROM BIOMASS	Biomass conversion Technologies– wet and dry process– Photosynthesis - Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas-biogas from wastefuel–properties of biogas-utilizationof biogas.
UNITV: SOLARENERGY SOURCES	Solar radiation and it smeasurements–solar cells:Solar cells for direct Conversion of solar energy to electric powers–solar cell parameter–solar cellelectrical characteristics–Efficiency–solarwater Heater –solar distillation–solar cooking–solar greenhouse–Solar pondandits applications.
UNITVI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. G.D.Rai, 1996, Non–conventionsourcesof, 4thedition, Khanna publishers, New Delhi. 2. S.Raoand Dr. ParuLekar,Energytechnology. 3. M.P.Agarwal,Solar Energy,S.Chandand Co.,NewDelhi(1983). 4. Solarenergy,principlesofthermalcollectionandstoragebyS.P.Sukhatme, 2nd edition, TataMcGraw-Hill Publishing Co. Lt., New Delhi (1997). 5. EnergyTechnologybyS.RaoandDr.Parulekar.