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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 1PGP4**
(2008 on)

COURSE TITLE : Advanced Electronics **QN.NO : 1608**
TIME : 3 Hours **MAX.MARKS :75**

Unit – I (Combinational Logic)
Introduction – Minterms _ Truth Tables and Maps – solving digital problems using maps – SOP and POS reduction – Hybrid functions – Incompletely specified functions – Multiple output minimization .

Unit – II (Sequential Circuits)
Introduction – Flip-flops – Ripple counters – Type T design – Type D design – Type JK design – asynchronous sequential circuits (No multiple inputs)- Types of Registers – Serial in–serial out – serial in–parallel out – parallel in-parallel out – parallel in-serial out registers.

Unit – III (Arithmetic-Logic unit)
Binary Half adder and Full adder –Parallel Binary Adder – positive and negative numbers – addition in 1's complement and 2's complement system – Addition and subtraction in a parallel arithmetic element – Binary multiplication and division – Logical operations.

Unit – IV (A/D and D/A conversions)
D/A and A/D conversion – variable resister network – binary ladder – D/A converter D/A accuracy and resolution – A/D converter simultaneous conversion – counter method – continuous A/D conversion – Successive approximation converter.

Unit – V (Microprocessors)
Microprocess Architecture – Instruction set of 8085 – Examples of assembly language programs – addition of two 8-bit numbers sum 8-bit –
8-bit subtraction – addition of two 8-bit numbers sum 16-bit – find the largest number in a data array – find the smallest number in a data array.

Text Books :

Unit 1	Digital Electronics – An introduction to Theory and Practice 2nd Edn. William H. Gothman.	(6.1- 6.9)
Unit 2	Digital Electronics – an introduction to Theory and Practice William H. Gothman.	(Sections 7.1 – 7.7)
	Digital Principles and applications 4th Edn Malvino and Leach	(Sections 10.1 – 10.5)
Unit 3	Digital computer fundamentals 6th Edn. Thomas C. Bartee	(Sections 5.3-5.9, 5.16, 5.18, 5.19)
Unit 4	Digital Principles and applications 4th Edn Malvino and Leach	(Sections 13.1 – 13.8)
Unit 5	Fundamentals of Microprocessor and Microcomputers. B. Ram – 4th Ed. 1993 – Dhanpat Rai - 3.1, 4.1-4.6, 6.3-6.5, 6.21,6.24	

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PROGRAMME : M.Sc., Physics **COURSE CODE : 2PGP2 (2008 on)**

COURSE TITLE : ELECTROMAGNETIC THEORY **QN.NO : 1612**

TIME : 3 Hours **MAX.MARKS :75**

I. Divergence and curl of electric fields:

Field lines and Gauss law –The divergence of **E** – Applications of Gauss law - The curl of **E. Electric potential:** Introduction to potential – Comments on potential – Poisson's equations and Laplace equations – The potential of a localized charge distribution – Electrostatic boundary conditions. **Laplace equations:** Laplace equations in 1, 2 and 3 dimensions – Boundary conditions and uniqueness theorem – Conductors and the second uniqueness theorem. **Multipole expansion:** Approximate potentials at large distances – The monopole and dipole terms – Origin of coordinates in multipole expansions – The electric field of a dipole. **Polarization:** Dielectrics – Induced dipoles – Alignment of polar molecules – Polarization. **Field of a polarized object:** Bound charges - Physical interpretation of Bound charge – The field inside the dielectric. The electric displacement: Gauss law in the presence of dielectrics – Comparison of **E** and **D**. **Linear dielectrics:** Susceptibility – Permittivity – Dielectric constant – Special problems involving linear dielectrics – Forces on dielectrics – Polarizability and susceptibility.

II. The divergence and curl of B:

Straight line currents – The divergence and curl of **B** – Applications of Ampere's law – Comparison of magneto statics and electrostatics – Magnetic vector potential – Magnetostatic boundary conditions – Multipole expansion of two vector potentials – The auxiliary magnetic field **H** – Ampere's law in magnetized materials – Comparison between **B** and **H** – Faraday's law – Electromagnetic induction – Inductance – Energy in magnetic fields.

III. Maxwell's equations:

Maxwell's equations and magnetic charge - Maxwell's equations inside matter – Boundary conditions. **Potential formulations of electrodynamics:** Scalar and vector potentials - - Gauge transformations – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form. Energy and momentum in electrodynamics: Newton's third law in electrodynamics – Poynting's theorem.

IV. Electromagnetic waves:

The wave equation in one-dimension – Sinusoidal waves – Polarization – Boundary conditions. **Electromagnetic waves in non-conducting media:** Monochromatic plane waves in vacuum – Energy and momentum of EM waves – Propagation through linear media – Reflection and transmission at (1)normal incidence and (2) oblique incidence. **Electromagnetic waves in conductors:** The modified wave equation – Monochromatic plane waves in conducting media

V. Electromagnetic radiation:

Dipole radiation – Retarded potentials – Electric dipole radiation – Magnetic dipole radiation – Radiation from arbitrary distribution of currents and charges. Radiation from a point charge: Lienard-Wiechert potentials – The fields of a point charge in motion – Power radiated by a point charge – Magnetism as a relativistic phenomenon – The transformation of fields

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Text Book:

1. Introduction to electrodynamics – David J. Griffiths II edn. P.H. of India (1997).
Chs.2.2, 2.3.3, 2.3.4, 3.1, 3.4, 4.1 to 4.3, 4.4.1, 4.4.2, 4.4.4, 4.4.5, 5.3, 5.4, 6.3, 7.2 to 7.4, 7.5.1, 7.5.2, 8.1 to 8.3, 9.1, 9.2.1, 10.3.1.

Reference:

Electromagnetic waves – Lorrain and Corson – CBS pub.- 1998 reprint

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PROGRAMME : M.Sc., Physics **COURSE CODE : 2PGP3 (2008 ON)**
COURSE TITLE : QUANTUM MECHANICS-I **QN.NO : 1614**
TIME : 3 Hours **MAX.MARKS :75**

I. The Schroedinger wave equation:

Need for wave equation – The one dimensional wave equation – Extension to three dimension – Interpretation of the wave function – Statistical interpretation – Normalization of the wave function – Probability – Current density – Expectation values – Ehrenfest theorem.

Eigen energy function: Separation of wave equation – Significance of separation constant E – Boundary conditions at large distances – Continuity conditions – One dimensional square well potential – Perfectly rigid walls – Finite potential step – Energy level parity.

II. Eigen function and Eigen values:

Postulates – Dynamical variables as operators – Expansion in Eigen function – Ortho normality of energy Eigen functions – Reality of energy eigen values - Probability function and expectation value – Momentum Eigen functions – Box normalization – Dirac normalization Schwartz inequality – Minimal uncertainty product – Form of the minimum wave packet – Schroedinger equation in momentum representation.

Unit III : Discrete Eigenvalues : Bound States

Discrete Eigen values: One dimensional and three dimensional linear harmonic oscillator – Energy levels – Degeneracy – Zero-point energy – Rigid rotor – Eigen values and and Eigen functions – Spherically symmetric potential – Spherical harmonics – Solutions for l=0 and arbitrary l values - Interior and exterior solutions - Schroedinger equation for the hydrogen atom – Solution for s-state only and the ground state wave function.

IV. Matrix formulation and quantum mechanics:

Hilbert space – Dirac bra-ket notation – Projection operator – Equation of motion in Schroedinger and Heisenberg pictures – Evaluation of commutator brakets - Velocity of a particle in an EM field – Virial theorem – Matrix theory of harmonic oscillator.

V. Angular momentum:

Commutation relations – Eigen values of J+ and J- - Addition angular moments – CG coefficients – Construction of resultant wave function (j1=1/2 and j2=1/2 only) – Angular momentum matrices – Spin – Angular momentum and Pauli's spin matrices.

Text Books :

Quantum mechanics – Schiff. IIIrd Edn.
Unit I : Chapters 6-9
Unit II : Chapters 10-12
Unit III : Chapters 13-16
Unit IV : Chapters 23-25
Unit V : Chapters 27, 28

Reference :

Quantum Mechanics - Merzbacher – 3rd Edition – John Wiley
Quantum Mechanics – Mathews & Venkatesan – TMH – 1976

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PROGRAMME : M.Sc., Physics **COURSE CODE : 3PGP1**
(2008 on)

COURSE TITLE : SOLID STATE PHYSICS – I **QN.NO : 1622**

TIME : 3 Hours **MAX.MARKS :75**

Unit I: Crystal lattice

Primitive cell-Unit cell-Crystallographic systems-Bravais lattices-Directions, planes Miller indices-Simple crystal structures, NaCl, hcp, CsCl, Diamond, ZnS-Lattice vacancies and interstitial atoms (Schottky and Frenkel defects)-Edge dislocation and screw dislocation-Buerger's vector.

Unit II: Diffraction and bonding

Bragg law- Photographic techniques -Laue, Powder, Oscillation methods-Reciprocal lattice vectors- Diffraction condition-Brillouin zones, SC, BCC, FCC- Atomic form factor-Structure factor - Ionic bonding, Madelung constant, Calculation of M. constant, lattice energy- Covalent crystals -Metal crystals-Hydrogen bonded crystals

Unit III: Lattice vibrations

Dispersion relation- Monatomic lattice- Diatomic lattice- Phonon momentum- Heat capacity- Einstein model- Debye model

Unit IV: Optical processes

Frenkel exciton - Mott exciton - Exciton condensation into electron hole drops (EHD)-Raman effect in crystals

Unit V: Superconductivity

Meissner effect- Thermal properties-Energy gap-Type I and II superconductors London equations-Thermodynamics of superconductivity -DC and AC Josephson tunneling

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Text Books

1. Solid State Physics, C. Kittel, Vth Edition, 1976, 9th Reprint 1989, Wiley Eastern Ltd.
   Unit I : Pages 21-27
   Unit II : pp 39-44, 47-63, 86-97
   Unit III : pp 107-116
   Unit IV : pp 332-337, 340-347
   Unit V : pp 390-394

2. Solid State Physics, S. O. Pillai, 6th Edition, New Age International P Ltd., 2005
   Unit I : Pages 90-92, 101-117, 125-133
   Unit III : pp 334-352
   Unit V : pp 366-379, 382, 383, 390-394

P.T.O.

Reference books

1. Fundamentals of Solid State Physics – B.S. Saxena, R.C. Gupta, P.N. Saxena - Pragati Prakashan – 2008
2. Elements of Solid State Physics - J.P. Srivastava - Prentice-Hall of India Pvt Ltd - 2006
3. Solid State Physics – N.W. Ashcroft, N. D. Mermin – Pub.- Holt, Rinehart and Winston, 1976

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PROGRAMME : M.Sc., Physics **COURSE CODE : 3PGP2**
(2008 on)

COURSE TITLE : QUANTUM MECHANICS – II **QN.NO : 1624**
TIME : 3 Hours **MAX.MARKS :75**

I. Approximation methods for stationary problems:
Stationary perturbation theory – Non degenerate case – I order perturbation – 2nd order perturbation – Perturbation of an oscillator – Degenerate case – Removal of degeneracy in I order and II order – I order stark effect in Hydrogen – Perturbed energy levels- Occurrence of permanent electric-dipole moment.

II. Born Approximation:
Collision in 3 dimensions – Scattering cross section - Relation between angles in the Lab. and CM systems. Relation between cross section - Asymptotic behavior – Normalization – The Born approximation – Perturbation approximation – Green's function – Green's function for a free particle – Scattering by a square well potential – Validity of Born approximation – Scattering by a screened Coulomb potential.

III. Variation method and Approximation methods for time dependent Problems:
Expectation value of the energy – Application to excited states – Ground state of Helium - Time dependent perturbation theory – Expansion in un perturbed Eigen functions – Physical interpretation – Transition probability – Scattering cross section – Harmonic perturbation Adiabatic and sudden approximations.

IV. Identical particles and spin:
Identical particles – Physical meaning of identity – Symmetric and asymmetric wave functions – Construction from un symmetrized functions – Distinguishability of identical particles – The exclusion principle – Correction with statistical mechanics – Spin-angular momentum – Correction between spin and statistics – Spin matrices and Eigen functions. Semi classical treatment of radiation – absorption and induced emission – Transition probability – Interpretation in terms of absorption and emission – Electric dipole transition – Forbidden transitions – Spontaneous emission – Classical radiation field – Asymptotic form – Dipole radiation – Conversion from classical to QM – Planck distribution formula.

V. Relativistic wave equations:
Schroedinger relativistic wave equation – Electromagnetic potential – Separation of the equation – Energy levels in a Coulomb field – Dirac's relativistic equation – Free particle equation – Matrices for α and β - Free particle solution – Charge and current density – Electromagnetic potentials – Spin-angular momentum – Spin-orbit energy – Negative energy states.

Text Book:
1. Quantum mechanics – L.Schiff – Mc Graw Hill International Edn. Ch.7, Sec.18,25,26,27,29,31,32,33,35,36,42,43,44.

Books for Reference :

1. Mathews, Venkatesan – Quantum Mechanics – TMH – 1976.
2. Gupta, Kumar Sharma – Quantum Mechanics – 2007 reprint.

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PROGRAMME : M.Sc., Physics **COURSE CODE : 3PGP3**
(2008 on)

COURSE TITLE : MOLECULAR SPECTROSCOPY **QN.NO : 1629**
TIME : 3 Hours **MAX.MARKS :75**

Unit I Microwave Spectroscopy
The rotation of molecules-rotational spectra-diatomic molecules-poly atomic molecules-techniques and instrumentation-microwave oven.

Unit II Infra-Red Spectroscopy
Vibrating diatomic molecules-diatomic vibration rotator-vibrational rotation spectrum of CO molecules- breakdown of Born-oppenheimer approximation-vibrations of poly atomic molecules-influence of rotations- IR spectrometer.

Unit III Raman Spectroscopy
Introduction-rotational and vibrational Raman spectra-structure determination from Raman and IR spectroscopy- Raman spectrometer.

Unit IV Electronic Spectroscopy
Vibrational coarse structure-Franck-Condon principle-dissociation energy and dissociation products-rotational fine structure-the Fortrat diagram-pre dissociation- techniques and instrumentation.

Unit V NMR and ESR Spectroscopy & Lasers
Magnetic properties of nuclei- resonance condition- instrumentation- additional techniques - relaxation process- Bloch equations- dipolar interaction-chemical shift- NMR imaging -ESR introduction- principle - ESR spectrometer- total Hamiltonian- hyperfine structure - Population inversion- pumping- resonators- vibrational modes- open resonator- the Q factor – losses – threshold condition- ruby LASER- He-Ne and CO_2 LASERs.

Text Books

1. Fundamentals of molecular spectroscopy by Banwell and Mc Cash, IVth Edn., TMH, New Delhi, 27th Reprint, 2007.
   Unit I: Sections: 2.1-2.4, 2.4.1,2.4.2, 2.7
   Unit II: Sections: 3.1-3.6, 3.6.1-3.6.3
   Unit III: Sections: 4.1, 4.2, 4.2.1, 4.2.2, 4.3(Excluding 4.3.3 & 4.3.5), 4.5
   Unit IV: Sections: 6.1, 6.4
2. Molecular structure and spectroscopy by G. Aruldhas, IInd Edn., PHI, New Delhi.
   Unit I: Section: 6.14
   Unit II: Section: 7.16
   Unit III: Section: 8.6
   Unit IV: Sections: 10.1-10.8, 10.19, 11.1-11.5, 11.5.1
3. LASERs and Non-linear optics by B.B. Laud, IIIrd Edn., New age international, New Delhi.
   Unit V: Sections: 6.1-6.10, 7.1, 8.1, 8.5, 8.5.1

Books for Reference

1. Optical Electronics by Ajoy Ghatak and K. Thyagarajan, Cambridge University Press (Foundation Books, New Delhi)
2. Modern Optics by A.B.Gupta.

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PROGRAMME : M.Sc., Physics **COURSE CODE : 3PGPNM**
(2008 on)

COURSE TITLE : Universe & Non Conventional Energy Sources **QN.NO : 1631**

TIME : 3 Hours **MAX.MARKS :75**

Unit I Introduction of energy sources

Energy as a measure of prosperity- world energy futures – energy sources and their availability – introduction – commercial or conventional energy sources – new energy technologies – non-conventional energy sources.

Unit II Solar thermal energy and wind energy

Solar water heating systems – solar cell principle – solar distillation – solar cooker (box type solar cooker only) - Basic principle of wind energy – types of wind mills – horizontal axis and vertical axis wind machines.

Unit III Biomass and Ocean energy

Energy from biomass- biogas generation – types of biogas plants –KVIC digester and Chinese digester – energy from tides and ocean waves.

Unit IV Universe I

Universe – solar system – measurement of distance – size of plants – surface temperature – atmosphere – space exploration and search for extraterrestrial life – Asteroids – Comets – Meteorites – Stars.

Unit V Universe II

Interpretation of Stellar spectra – radii of stars – Mass of stars – Interior of stars – Stellar evolution – galaxies and the universe – Expanding of universe – Big bang theory.

Text Books:

1. Non – conventional energy sources by G.D.Rai, 2003 Reprint
   Unit I : Chapter 1 pages 1-11, 15-30.
   Unit II : Sections: 5.2, 5.6 (page 178- 180), 5.8, 5.11 (pages 202-207), 6.2, 6.8.1 and 6.8.2
   Unit III : Sections: 7.1, 7.4 (page 327 only), 7.9 (pages 342 and 343), 9.3.1 and 9.3.2
2. Properties of Matter by Mr. Brijlal and Subramanian
   Unit IV : Chapter 9, Sections: 9.1, 9.11, 9.12, 9.16-9.18, 9.24-9.26
   Unit V : Chapter 9, Sections: 9.28, 9.29 (2), (3), 9.30-9.32, 9.35-9.37

Books for references:

1. Solar Energy Utilization, G.D. Rai, Khanna Pub., Vth Edn., 1995.
2. Solar energy, S. P. Sukhatme, TMH, IInd Edn., 1998.

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PROGRAMME : M.Sc., Physics **COURSE CODE : 4PGP1**
(2008 on)

COURSE TITLE : NUCLEAR PHYSICS **QN.NO : 1632**
TIME : 3 Hours **MAX.MARKS :75**

Unit-1 : The Q Equation:

Introduction - Types of Nuclear Reactions- The Balance of Mass and Energy in Nuclear Reaction- The Q Equation- Solution of the Q Equation- Centre of Mass Frame in Nuclear Physics. **The Nucleus -** Introduction, Rutherford scattering and Estimation of the Nuclear size- Nuclear Radius- Nuclear spin- Moments and Statistics.

Unit-2 : Radioactivity Alpha Rays:

Range of α-particles, Disintegration Energy of Spontaneous α-Decay, Barrier penetration. **Beta Rays:** Introduction - Continuous β-ray Spectrum-- Pauli's Neutrino Hypothesis- Fermi's Theory of Beta Decay- The Detection of Neutrino- Parity Non-conservation in Beta Decay- **Gamma Emission:** Introduction,- γ-ray Emission-Selection Rules, Internal Conversion, Nuclear Isomerism.

Unit-3 : The Liquid Drop Model of Nucleus

Introduction, Binding Energies of Nuclei; Weizsacker's Semi-empirical Mass Formula, Mass Parabolas: Prediction of Stability Against β-decay - Stability limits - Barrier penetration- Decay probabilities for Spontaneous Fission- Nucleon Emission.
Nuclear Energy -Introduction- Neutron Induced Fission- Asymmetrical Fission-Mass Yield- Emission of Delayed Neutrons- Energy Released in the Fission - Fission of Lighter Nuclei -Chain Reaction- Neutron Cycle in a Nuclear Reactor- Nuclear Reactors.

Unit-4: The Shell Model of Nucleus:

Introduction-The Evidence that led to the Shell Model -Main assumptions of the Single-Particle Shell Model-Spin-orbit Coupling in Nuclei - The Single Particle Shell Model-Parabolic Potential - Square well Potential- Predictions of the Shell Model.
Nuclear Force: Introduction, The Ground State of the Deuteron- Magnetic Dipole and Electric Quadrupole Moments of the Deuteron - Central and Non-Central Forces: Exchange Forces: Meson Theory of Nuclear Forces-Nucleon-Nucleon Scattering.

Unit 5: Elementary particles.

Classification of elementary particles **–** particle interaction- conservation laws- isospin-hypercharge-strangeness- Charge conjugation Time Reversal – The CPT Theorem -SU_3 symmetry-Quark theory

P.T.O.

Text Books:

1. Nuclear physics-An Introduction – S.B.Patel – New Age International (P) Limited (Reprint 2003)

2. Nuclear Physics – D.C. Tayal, "Nuclear Physics", Himalaya Publishing House, (reprint 2007)

Book (1) Unit 1 : Chapter 3 , Chapter 4.1.1 – 4.1.5
Unit 2 : Chapter 4.2.1 - 4.4.4
Unit 3 : Chapter 5 & 6
Unit 4: Chapter 7.1-7.3, 7.5 -7.8, 8.1 -8.2, 8.5 – 8.7

Book (2) Unit 5: Chapter 16.2 -16.4, 16.19, 16.20

Books for Reference :

1. Nuclear Physics – Theory and experiment – R.R. Roy and B.P. Nigam – New Age International (P) Ltd., (2001 Edi).

2. Nuclear Physics-V. Devanathan –(Narosa Publishing House, New Delhi, 2006).

3. M.L. Pandya and R.P.S. Yadav, "Elements of nuclear physics", Kedar nath Ram nath publishers, 1996.

4. Introduction to nuclear physics – Harold Enge.

5. Nuclear physics – Irving Kaplan – (Narosa Publishing House , 1987) .

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PROGRAMME : M.Sc., Physics **COURSE CODE : 4PGP2**
(2008 on)

COURSE TITLE : MICROPROCESSORS **QN.NO : 1634**

TIME : 3 Hours **MAX.MARKS :75**

I. 8086µP architecture and assembly language programs:

Introduction - Architecture – addressing modes – instruction set – 8086 assembler dependent instructions – typical 8086 assembler pseudo instructions 8086 input/output: Programmed I/O – 8089 I/O Processor.

II. 8086µP interrupts and system design:

8086 interrupts – 8086 DMA System design using 8086 : pins &signals- 8086 Basic System Concepts – Interfacing with memories – I/O Ports – 8086 based microcomputer.

III. The Intel X86 Family Architecture:

Introduction - the Register set – Data formats – Addressing modes – Instruction set & assembly directives –Interrupt- Segmentation - Paging –Real & Virtual mode execution – Protection mechanism – Task management

IV. The Pentium:

The i486 & i386 microprocessors, 80286,80186 and 80188 systems.

V. RISC Principles & i860µP :

RISC vs CISC - RISC properties - RISC evaluation – On-Chip Register File vs Cache evaluation - Introduction - i860 architecture.

Text Books :

1. Microprocessors: Theory & Applications: Intel & Motorola by M.Rafiquzzaman (Prentice –Hall of India Private Ltd.,New Delhi, revised edition ,1993) Chapter 5 for UNIT I &II.

2. Advanced Microprocessors - Daniel Tabak (Mc Graw Hill Internatl. Edn.- second edn.). Ch. 7: Unit III, Ch. 8, 9, 10: Unit IV, Ch. 6, Ch.18.1, 18.2 : Unit V

Reference :

1. N. Mathivanan – Microprocessors PC Hardware and Interfacing – PHI – 2005

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CLASS : M.Sc., Physics **SUB. CODE: 4PGP3 (2013 ON)**
TITLE : MODERN OPTICS **QN.NO: 1637**
TIME : 3Hrs **Max. Marks: 75**

Unit I Matrix Optics

Mathematical reperesentation of polarized light – Jone's vectors – mathematical representation of polarizers – Jone's matrices - Matrix method - Single lens system – principal plane transformation : general – thick lens – combination of two lens systems – general concept of image formation – examples – doublet, microscope and telescopic system

Unit II Statistical Optics

The principle of linear superposition - Partial coherence – visibility of fringes – coherence time and length – spectral resolution of a finite wave train - spatial coherence – The Van Cittert-Zernike theorem and measurement of Stellar diameters - FT spectroscopy – multiple beam interference – resolution of Fabry – Perot interferometer – multi layer films – antireflecting films – High reflectance films

Unit III Fourier Optics I

Green's theorem – integral theorem of Helmholtz and Kirchhoff – diffraction by a plane screen – Kirchhoff boundary conditions – Frensnel-Kirchoff formula – Huygen Fresnel principle – Rayleigh-Sommerfield formulation by a plane screen

Unit IV Fourier Optics II

Fresnel and Fraunhofer approximation – examples – rectangular and circular aperture – Fourier transforming and imaging properties of lenses : a thin lens as a phase transformation - Fourier transforming properties of lenses i) object placed against the lens and ii) object placed behind the lens

Holography – principles – theory – characteristics and applications

Unit V Non-linear optics

Harmonic generation – second harmonic generation – Phase matching – third harmonic generation – optical mixing –parametric generation of light - self-focusing

Text Books

Unit I:

1. Introduction to Optics, Frank L. Pedrotti S.J. and Leno S. Pedrotti, PHI, Inc.1993. SECTIONS : Chapter 14 (full)
2. Optics, Miles V.Klein and Thomas E.Furtak, John Wiley & Sons, Inc., Second Edition 1986, SECTIONS : 3.3,3.4,3.5-A3(a & b), 3.5-B (full).

Unit II:

3. Introduction to Modern Optics, G.R. Fowles, IInd Edn., Dover Publications, Inc., 1989, SECTIONS : Chapter 3: 3.1,3.4 - 3.7, 3.9, Chapter 4 (full)

Unit III :

4. Introduction to Fourier Optics, Joseph W. Goodman, McGraw Hill, IInd Edn., 1991, SECTIONS: 3.3 (full), 3.4 (full) , 3.5(full) .

Unit IV:

5. Introduction to Fourier Optics, Joseph W. Goodman, McGraw Hill, IInd Edn., 1991, SECTIONS: 4.1.2, 4.2 (only) , 4.3, 4.4.1, 4.4.2, 5.1(full), 5.2, 5.2.1, 5.2.3.
6. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrd Edn., 2011, SECTIONS: Chapter 12 (full)

Unit V:

7. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrd Edn., 2011, SECTIONS: Chapter13 (full)

Books for Reference

1. Optical Electronics, A.K. Ghatak and K.Thyagarajan, Cambridge University Press, 1991.
2. Optics, Ajoy Ghatak, IInd Edn., TMH Co.Ltd., 1997.

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PROGRAMME : M.Sc., Physics **COURSE CODE : 4PGP4**
(2008 on)

COURSE TITLE : SOLID STATE PHYSICS - II **QN.NO : 1638**
TIME : 3 Hours **MAX.MARKS :75**

Unit I: Free electron Fermi gas

Energy levels and density of orbitals in 1D-Energy levels and density of orbitals 3D-Theoretical and experimental heat capacity of electron gas-Electrical conductivity-Resistivity-Motion in magnetic fields-Hall effect-Thermal conductivity-Widemann-Franz ratio.

Unit II: Energy bands and semiconductors

Nearly free electron model-Origin of energy gap-Bloch function-Wave equation of an electron in a periodic potential, Direct and indirect band gap- Electrons vs holes- Effective mass- Effective mass in semiconductors - Intrinsic carrier concentration- Thermo electric effect in semiconductors.

Unit III: Metals and Fermi surfaces

Construction of Fermi surface-Electron orbit, hole orbit, open orbits-Pseudo potentials- Quantization of orbits in magnetic fields-De Hass van Alphen effect.

Unit IV: Magnetism

Langevin theory of diamagnetism- paramagnetism- Quantum theory of paramagnetism - Hund's rule-Weiss theory of Ferromagnetism – Temperature dependence - Curie-Weiss law-Ferromagnetic domains – Domain model.

Unit V: Dielectrics and ferroelectrics

Dielectric polarization-Macroscopic field-Local field at an atom-Depolarization field-Dielectric constant and polarizability- Polarization catastrophe - Dipole moment and polarization - Electronic, ionic and orientation polarizations – Effects of dielectrics – Insulating materials .

Text Books

1. Solid State Physics, C. Kittel, Vth Edition, 1976, 9th Reprint 1989, Wiley Eastern Ltd.
   Unit I : Pages 157-178
   Unit II : pp 186-190, 193-198, 207-211, 214-224, 228-231, 237-238
   Unit III : pp 255-260, 268-275
   Unit IV : pp 441-448, 460-471, 474-475, 487-493
   Unit V : pp 401-410, 417-418

2. Solid State Physics, S. O. Pillai, 6th Edition, New Age International P Ltd., 2005
   Unit V : pp 633-637, 681-688

Reference books

1. *Fundamentals of Solid State Physics – B.S. Saxena, R.C. Gupta, P.N. Saxena - Pragati Prakashan – 2008*
2. *Elements of Solid State Physics - J.P. Srivastava - Prentice-Hall of India Pvt Ltd - 2006*
3. *Solid State Physics – N.W. Ashcroft, N. D. Mermin – Pub.- Holt, Rinehart and Winston, 1976*

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)

RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 1PGP1 (2014 ON)**
COURSE TITLE : MATHEMATICAL PHYSICS-I **QN.NO : 3101**
TIME : 3 Hours **MAX.MARKS :75**

Unit I Vectors

Line integrals – Conservative vectors field – Surface integral – Volume integral – Stoke's theorem – Green's theorem in a plane – Gauss divergence theorem – Applications of Gauss theorem –Curvilinear coordinates – Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.

Unit II Matrices

Linear vector space – Linear dependent and independent vectors – Basics – Schmidt orthonormalization – Matrices as linear transformations – Eigen values and eigen vectors – Cayley Hamilton theorem and its applications – Diagonalisation – Similarity transformations – Special matrices – Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices – Orthogonal and unitary transformations.

Unit III Fourier transforms

Fourier transform – Infinite Fourier sine and cosine transforms – Properties of Fourier transforms – Linearity theorem – Similarity theorem – Shifting property – Modulation theorem – Convolution theorem – Parseval's Theorem – Derivative of Fourier transform – Fourier transform of a derivative.

Unit IV Special functions - I

Beta function: Symmetry property – Evaluation – Other forms – Gamma Function : Evaluation – other forms – Relation between beta and gamma functions – Miscellaneous propositions - Legendre differential equation – Generating function - Rodrigues' formula – orthogonal property – Recurrence formulae.

Unit V Special functions - II

Bessel's differential equation (No power series solution) – Recurrence formulae – Generating function – Orthonormality of Bessel functions – Hermite polynomials (no power series solution) – generating function – recurrence formulae – Rodrigue's formula – orthonormality of Hermite polynomials.

Text Books

1. Vectors analysis, M. R. Spiegel, Schaum's outline series, MHI, 1974.
   Unit I: Chapter 5, 6 and 7.
2. Engineering mathematics, M. K. Venkataraman , Vth Edn., National Pub., 1999.
   Unit II: 4.1, 4.2, 4.5, 4.7, 5.1, 5.3, 6.2, 6.3, 7.1-7.6, 7.8.
3. Mathematical Physics with Classical Mechanics, Satya Prakash, Vth Edn., Sultan Chand & Sons,2007.
   Unit III: 10.1 to 10.5
   Unit IV: 4.1 to 4.7, 4.9, 4.10, 7.11 to 7.15
   Unit V: 7.21, 7.25, 7.26, 7.29, 7.33 to 7.37

Books for Reference

1. Matrices, Schaum Series, McGraw Hill International, 1974.
2. Mathematical Physics, B.D.Gupta, IInd Edn. Vikas Pub. Ltd., 2012.

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 1PGP2**

(2014 on)

COURSE TITLE : Classical & Statistical Mechanics **QN.NO : 3103**

TIME : 3 Hours **MAX.MARKS :75**

Unit I Hamiltonian dynamics

Generalised momentum and cyclic coordinates - Hamiltonian function H and conservation of energy - Jacobi integral - Hamilton's equations - Hamilton's equations in different coordinate system (spherical and polar) - Examples in Hamiltonian dynamics (Harmonic oscillator, motion of a particle in central field, simple pendulum, compound pendulum) - Routhian function - modified Hamilton's principle - Deduction of Hamiltonian's equation from Variational principle - The principle of least action - Other forms of principle of least action.

Unit II Canonical transformations

Canonical transformations - Generating function - Condition for Canonical transformation - Poisson's brackets - Lagrange brackets - relation between Lagrange and Poisson brackets - angular momentum and Poisson brackets - invariance of Poisson bracket with respect to Canonical transformations.

Unit III Small oscillations

Stable, unstable and neutral equilibrium - one dimensional oscillator - two coupled oscillators - solution to the differential equations - normal coordinates and normal modes - general theory of small oscillations - secular equation and eigen value equation - solution of the eigen value equation - small oscillation in normal coordinates - examples of coupled oscillators - two coupled pendulum - vibrations of a linear triatomic molecule.

Unit IV Classical statistics

Phase space - volume of phase space - ensembles - microcanonical, canonical and grand canonical ensembles - microstates and macrostates - general statistical distribution law – most probable distribution - partition function and its correlation with thermodynamical quantities.

Unit V Quantum statistics

Statistical weight or a priori probability - Bose-Einstein Statistics - Fermi - Dirac Statistics - Grand canonical ensemble and quantum statistics - black body radiation - Planck's radiation law - Energy and pressure of ideal Fermi-Dirac gas - Thermodynamic functions of degenerate Fermi - Dirac gas.

Text books

1. Classical mechanics, J.C. Upadhyaya, Himalaya Publishing House (Revised edition) 2005.
   Unit I : Chapters 3.2, 3.4, 3.5, 3.6, 3.7, 3.8, 5.4, 5.5, 5.1, 5.12.
   Unit II: Chapters 6.1, 6.3, 6.5, 6.6, 7.2, 7.3, 7.4, 7.5, 7.6.
   Unit III: Chapters 9.2, 9.3, 9.4, 9.5, 9.6.
2. Statistical mechanics, S.L.Gupta & V. Kumar, Pragati Prakashan educational publishers, XXVth Edn., 2012.
   Unit IV: Chapters 1.1, 1.3, 2.1, 2.4, 2.5, 2.6, 3.0-4.
   Unit V: Chapters 5.8, 6.2, 6.3, 6.10, 6.11, 9.0, 9.1.

Books for Reference

1. Classical mechanics, Gupta, Kumar and Sharma, XXIst edition, 2003, Pragati Prakashan.
2. Classical mechanics, Herbert Goldstein, IInd Edition, New Delhi, Narosa Publishing House, 2001.
3. Statistical mechanics and properties of matter, E.S.RajaGopal, McMillan, NewDelhi, 1976.

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 1PGP3**
(2014 on)

COURSE TITLE : Communication System **QN.NO : 3105**
TIME : 3 Hours **MAX.MARKS :75**

Unit I Amplitude modulation

Introduction – AM characteristics – Demodulation – Single Side Band Modulation – Introduction - Principles – Balanced Modulation – FET balanced modulator– Double balanced ring modulator – SSB generation – Filter, phasing method – Third method – Frequency division – Multiplexing (FDM)only – Comparison of signal to noise ratio**.**

Unit II Angle Modulation

Introduction – Frequency modulation – Characteristics – Phase modulation – Equivalence between FM and PM – Angle modulation circuits – Varactor diodes – Directly modulated FM transmitters – Indirectly modulated FM transmitters – FM broadcast – Angle modulation detectors – Slope detector – Amplitude limiters – Noise in FM**.**

Unit III Pulse Modulation

Introduction – Pulse amplitude modulation (PAM) – Time division multiplexing (TDM) – Pulse with modulation - pulse code modulation (PCM) – Quantisation – Compression – PCM receiver (block diagram only) – Differential PCM – Delta Modulation – Pulse Frequency modulation (PFM) - Pulse time modulation (PTM) – PPM.

Unit IV Satellite communication

Introduction – Orbits – Station Keeping – Satellite altitude control-Transponders-multiple access method - Fibre optic communication: Introduction – propagation within a fibre – Light sources for fibre optics – Photo detectors – Fibre optic communication system-losses in fibers.

Unit V Microwave generators

Wave guide (circular)-cavity resonator- Klystron – Reflex Klystron and Magnetron – Production of microwaves only.

Text Books

1. Electronic communication, Dennis Roddy & John Coolen IVth Edn. P.H. India.
   Units I : Chapters 8.1 to 8.9, 9.1- 9.5 (p312-315),9.6,9.7
   Unit II : Chapters 10.1 to 10.5, 10.6-10.9, 10.12 (p337-p341), 10.13, 10.14 (p352-p353), 10.16, 10.17
   Unit III : 11.1 to 11.7
   Unit IV : 19.1 – 19.6,19.8,19.9,19.13,19.18, 19.9, 20.1, 20.2, 20.5, 20.6
2. Electronic communication, George Kennedy, IIIrd edition,TMH
   Unit V : Chapter 10.2, 10.4 and Chapter 11.2 to 11.4

Books for Reference

1. Communication Systems, Simon Haykin–Ist Edn.,1988, John wiley & sons.
2. Communication Systems, B.P.Lathi - Ist Edn. 1994, Wiley Eastern Ltd**.**

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 2PGP1 (2014 on)**

COURSE TITLE : MATHEMATICAL PHYSICS-II **QN.NO : 3109**

TIME : 3 Hours **MAX.MARKS :75**

Unit I Complex variables-I

Analytic function – Cauchy Reiman equations – CR in polar form – Complex line integral – Cauchy integral theorem (simple proof) – cauchy integral formula – Derivative of an analytic function (n^{th} derivative) – Expansion of an analytic function.

Unit II Complex variables-II

Singular point – Isolated singularity – Removal singularity – Cauchy-Residue theorem – Residue – Calculation of residue at simple poles and poles of higher order – Evaluation of definitive integrals – Integration around unit circle – Jordan lemma – Semicircular contours – Poles on the real axis.

Unit II I Tensors

Scalar, vector and tensors – difference between a tensor and a transformation matrix – second rank tensor – Definition – Examples – Contra variant, covariant and mixed tensors – Tensors – Tensors in EM theory – Invariance of Maxwell's equations. Dirac delta function: Definition – properties – Delta sequence - Examples – Delta calculus.

Unit IV Crystal symmetry and Abstract Group theory

Crystal symmetry operators – The crystallographic point groups – stereographic projection of simple point groups – classification of point groups according to crystal systems – Definition of groups – Group multiplication table – Multiplication tables for C_{2v}, C_{3v}, C_3, C_4, C_2 point groups – Rearrangement theorem – Cyclic groups – Subgroups – Cosets – Example groups of finite order – Conjugate elements and class structure – physical interpretation of class structure – Normal divisors and factor groups – isomorphy and homomorphy – class multiplication.

Unit V Theory of Group Representations

Definitions – reducible and irreducible representations – Lemma I, II and III with proof – Great orthogonal theorem – Character of a representation – Construction of character tables – Decomposition of regular representations.

Text Books

1. Mathematical Physics with Classical Mechanics, Satyaprakash, Sultan Chand & sons, New Delhi, V^{th} edition, 2009 – Unit I: 6.9, 6.10, 6.12, 6.14, 6.16, 6.17.
2. Mathematical Physics with Classical Mechanics, Satyaprakash, Sultan Chand & sons, New Delhi, V^{th} edition, 2009 – Unit II: 6.22, 6.23, 6.24, 6.25(a), 6.25(b), 6.25(c), 6.25(d).
3. Vector analysis and Tensor analysis – M.R. Spiegel, Schaum's outline series, MH, 1974
   Unit III – chapter 8.
4. Group theory and quantum mechanics, Michael Tinkam, 2003.
   Unit IV – Chapter 2.1-2.9, 4.1, 4.2; Unit V – Chapter 3.1-3.5.

Books for Reference

1. Matrices and tensors in Physics, A.W. Joshi, New Age International, 1975
2. Chemical applications of group theory, F Albert Cotton, Wiley Eastern Ltd., 1971
3. Computer Oriented Numerical Methods, V. Rajaraman, 1980, PHI

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 2PGP4**
(2014 on)

COURSE TITLE : Programming In C++ **QN.NO : 3115**
TIME : 3 Hours **MAX.MARKS :75**

Unit I C++ Basics

Identifiers and key words – String numeric and character constants – Operators – Type conversion – Declaration of variables – Types of statements – features of iostream.h - Keyboard and screen I/O – Predefined manipulators – Control statements: branching statements - loop statements.

Unit II Functions, arrays and pointers

Defining a function – 'Return' statement – Types of functions – Actual and formal arguments – Local and global variables – Default arguments – Multifunction program – Recursive function – Header files – Standard functions – Array notation, declaration and initialization – Processing with array – Arrays and functions – Multidimensional arrays – Character array – Pointer operator – Address operator – Pointer expressions – Pointer arithmetic – Pointers and functions – Pointers and arrays - Pointers and strings – Arrays of pointers – Pointers to pointers.

Unit III Structures, Classes and objects

Declaration of structure – Initialization – Functions and structures – Arrays of structures- Arrays within a structure – Nested structure – Pointers and structures – Declaration of class – Member functions – Object of a class – Accessing a member of a class - Array of class objects – Pointers and classes – Nested class – Copy constructors – Default constructors – Destructors – Static data member – Static member functions – Friend functions – ' this' pointer.

Unit IV Inheritance and overloading

Single inheritance – Direct and indirect base classes – Public, private and protected inheritance – Array of class objects and single inheritance – Multiple inheritance – Container classes – Member access control – Summary Inheritance Access Specifier – Function overloading with various data types and arguments – Scoping rules and special features of function overloading – Overloading assignment, arithmetic, comparison and Unary operators.

Unit V Polymorphism and data file operations

Polymorphism – Early binding - Polymorphism with pointers – Virtual functions – Late binding – Pure virtual functions – Abstract base classes – Constructors and destructors under inheritance – Virtual destructors and base classes – Opening and closing of files – Stream state member functions – Reading / Writing a character from a file.

Text Books

1. Programming with C++, D. Ravichandran, Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 2002.

Books for Reference

1. Object oriented programming with C++, E.Balagurusamy, Tata McGraw Hill Pub. Co. Ltd., 2008.
2. Let us C++, Yashwant P.Kanetkar, BPB Publications, New Delhi, 2010.

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 21P1PMC1**

COURSE TITLE : Mathematical Physics – I **QN.NO : 12601**

TIME : 3 Hours **MAX.MARKS :75**

Course Objectives:

- To highlight the relationship of mathematical tools to understanding the dynamics of the physical world we live in.
- To impart knowledge on mathematical tools and techniques that could model real life physical systems.
- To demonstrate the use of vectors, matrices, transforms and specials functions spanning areas like Electromagnetic theory, Quantum Mechanical systems, communication electronics and optics.

Course Content:

Unit	Description	Hours	K-level	CLO
I	**Vectors :** Line integrals – Conservative vectors field – Surface integral – Volume integral – Stoke's theorem – Green's theorem in a plane – Gauss divergence theorem – Applications of Gauss theorem – Curvilinear coordinates – Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.	15	Up to K3	1
II	**Matrices :** Linear vector space – Linear dependent and independent vectors – Basics – Schmidt orthonormalization – Matrices as linear transformations – Eigen values and eigen vectors – Cayley Hamilton theorem and its applications – Diagonalisation – Similarity transformations – Special matrices – Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices – Orthogonal and unitary transformations.	15	Up to K3	2
III	**Fourier Transforms:** Fourier transform – Infinite Fourier sine and cosine transforms – Properties of Fourier transforms – Linearity theorem – Similarity theorem – Shifting property – Modulation theorem – Convolution theorem – Parseval's Theorem – Derivative of Fourier transform – Fourier transform of a derivative.	15	Up to K4	3
IV	**Special functions - I :** Beta function: Symmetry property – Evaluation – Other forms – Gamma Function : Evaluation – other forms – Relation between beta and gamma functions – Miscellaneous propositions - Legendre differential equation – Generating function - Physical basis in Electrostatics - Linear electric multipoles - Rodrigues' formula – orthogonal property – Recurrence formulae - gravitational potential due to spheroidicity of earth.	15	Up toK4	4
V	**Special Functions - II :** Bessel's differential equation (No power series solution) – Recurrence formulae – Generating function – Orthonormality of Bessel functions – Application of Bessel's function to Fraunhoffer diffraction using circular aperture - Hermite polynomials (no power series solution) – generating function – recurrence formulae – Rodrigue's formula – orthonormality of Hermite polynomials.	15	Up toK3	5

Books for study:

1. Vectors analysis, M. R. Spiegel, Schaum's outline series, MHI, 1974.
   Unit I: Chapter 5, 6 and 7.
2. Engineering mathematics, M. K. Venkataraman , VthEdn., National Pub., 1999.
   Unit II: 4.1, 4.2, 4.5, 4.7, 5.1, 5.3, 6.2, 6.3, 7.1-7.6, 7.8.
3. Mathematical Physics with Classical Mechanics, Satya Prakash, VthEdn., Sultan Chand & Sons,2007.
   Unit III: 10.1 to 10.5
   Unit IV: 4.1 to 4.7, 4.9, 4.10, 7.11 to 7.15
   Unit V: 7.21, 7.25, 7.26, 7.29, 7.33 to 7.37
4. Mathematical Methods for Physicists, Arfken& Weber, VI Edition, Elsevier, 2011
   Unit IV : 12.1 (Pages 744 to 748), Example 7.3.1 (Page 758)

Unit V : Example 11.1.1 (Page 680)

Books for References:

1. Mathematical methods in Physical Sciences, Mary L Boas, Wiley Eastern, III Edition, 2006
2. Mathematical methods for Physicists and Engineers, Riley, Hobson and Bence, Cambridge University Press, III Edition, 2018.

Web Resources:

1. https://oer.uoch.edu.pk/home/watch_lecture/1373/70674
2.https://math.libretexts.org/Bookshelves/Differential_Equations/Book%3A_Partial_Differential_Equations_(Walet)/10%3A_Bessel_Functions_and_Two-Dimensional_Problems
3. https://www.physics.uoguelph.ca/chapter-3-legendre-polynomials
4. https://online.stat.psu.edu/stat505/lesson/4/4.5

Pedagogy :

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Plan:

Unit	Topics	Hrs	Mode
Unit I	Line integrals – Conservative vectors field - Surface integral – Volume integral	**3**	Chalk and talk, Presentation, Quiz and assignment
	Stoke's theorem	**3**	
	Green's theorem in a plane	**3**	
	Gauss divergence theorem – Applications of Gauss theorem	**3**	
	Curvilinear coordinates – Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.	**3**	
Unit II	Linear vector space – Linear dependent and independent vectors – Basics – Schmidt orthonormalization	**3**	Chalk and talk, Quiz and assignment
	Matrices as linear transformations – Eigen values and eigen vectors	**3**	
	Cayley Hamilton theorem and its applications – Diagonalisation – Similarity transformations	**3**	
	Special matrices – Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices	**3**	
	Orthogonal and unitary transformations	**3**	
Unit III	Fourier transform – Infinite Fourier sine and cosine transforms	**3**	Chalk and talk, Quiz, assignment and seminar
	Linearity theorem – Similarity theorem – Shifting property – Modulation theorem – Convolution theorem – Parseval's Theorem	**5**	
	Derivative of Fourier transform	**4**	
	Fourier transform of a derivative	**3**	
Unit IV	Beta function: Symmetry property – Evaluation – Other forms	**3**	Chalk and talk, quiz, Seminar
	Gamma Function : Evaluation – other forms - Relation between beta and gamma functions – Miscellaneous propositions	**3**	
	Legendre differential equation	**3**	
	Generating function - Physical basis in Electrostatics - Linear electric multipoles	**1**	
	Rodrigues' formula	**1**	
	orthogonal property - gravitational potential due to spheroidicity of earth	**2**	
	Recurrence formulae	**2**	
Unit V	Bessel's differential equation (No power series solution) – Recurrence formulae	**3**	Chalk and talk, Quiz, Presentation, Seminar
	Generating function	**2**	
	Orthonormality of Bessel functions – Application of Bessel's function to Fraunhoffer diffraction using circular aperture	**3**	
	Hermite polynomials (no power series solution) – generating function – recurrence formulae – Rodrigue's formula – orthonormality of Hermite polynomials	**7**	

Course learning Outcomes:

On the successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Apply the concept of vector calculus to solve the real world problem in Physics.	Up to K3
CLO–2	Solve Eigen value problems and appreciate its application to the field of Quantum Mechanics.	Up to K3
CLO–3	Analyse diffraction data and power spectrum of electronics circuits using Fourier transforms.	Up to K4
CLO–4	Analyse physical problems like electric monopoles, dipoles and analyzing the gravitational potential of the earth due to its spheroidicity by modeling the systems using Legendre Polynomials. Also solve Eulerian integrals as beta and gamma functions.	Up to K4
CLO–5	Apply Bessel's functions to Fraunhofer diffraction through a circular aperture. Also study the properties of Hermite polynomials.	Up to K3

Mapping of CLOs with PSOs :

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3		2	1
CLO2	3	3		2	1
CLO3	3	3		2	1
CLO4	3	3		2	1
CLO5	3	3		2	1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K3	2	K1& K1	1	K1	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2 (K1&K1)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	**16**	13.33
K2	2	4	10	10	**26**	21.67
K3	4	2	10	20	**36**	30.00
K4	2	-	20	20	**42**	35.00
Total Marks	10	10	50	50	**120**	100.00

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 21P1PMC2**

COURSE TITLE : Classical Mechanics **QN.NO : 12602**

TIME : 3 Hours **MAX.MARKS :75**

Objectives:

- To enhance the knowledge of mechanics of particles
- To solve the equation of motion using Lagrangian, Hamilton and Hamilton – Jacobi equations.
- To study the kinematics of the rigid body through Euler equation.
- To acquire knowledge in equations of motion for systems with small oscillations.

Unit	Description	Hours	K-level	CLO
I	**Lagrangian Formulation:** Generalized coordinates – Principle of virtual work – D'Alembert's Principle – Lagrange's equation of motion from D'Alembert's Principle – Procedure for formation of Lagrange's equation – Lagrange's equation in presence of non conservative forces – Generalized potential – Lagrangian for a charged particle moving in a Electromagnetic field.	15	Up to K2	1
II	**Hamilton's Equations :** Generalized momentum and Cyclic coordinates – Hamiltonian function – Hamilton's canonical equations – Hamilton's equation in different coordinate systems (Cartesian, polar and cylindrical) – Examples – Harmonic Oscillator – Charged Particle moving in an electromagnetic field – Modified Hamilton's Principle – Hamilton's equations from Variational principle – Variation – Principle of Least action – other forms of least action.	15	Up to K3	2
III	**Canonical Transformation :** Canonical transformations – Legendre transformation – Generating functions – Condition for canonical transformations – Examples – Bilinear Invariant Condition – Poisson brackets and its properties – Lagrange bracket – Relation between Poisson and Lagrange Brackets – Angular momentum and Poisson Brackets – Invariance of Poisson brackets under canonical Transformations.	15	Up to K3	3
IV	**Hamilton – Jacobi theory & Small oscillations :** Hamilton – Jacobi equation – Solution of Harmonic oscillator problem by Hamilton – Jacobi method – Hamilton's characteristic function – Kepler's problem by Hamilton – Jacobi Method – Action and angle variables – Small Oscillations – General theory – Eigen value equation – Two coupled pendulum – Vibrations of linear tri atomic molecule.	15	Up to K4	4
V	**Kinematics of Rigid body & Central force problem:** Generalized coordinates of a rigid body – Euler angle – infinitesimal rotations – Angular momentum and inertia tensor – Euler's equations of motion for a rigid body derived from Lagrange's method –Torque free motion of a rigid body – Reduction of the two - body central force to the equivalent one body problem – Equation of motion under central force and first integrals – Differential equation for an orbit – Inverse square law– Kepler's laws of planetary motion and their deduction – Virial theorem – Scattering in a central force field.	15	Up to K4	5

Book for study:

1. J.C. Upadhyaya, 2018, Classical Mechanics, Published by Himalaya Publishing House Pvt. Ltd.
   Unit 1: 2.4 – 2.10.
   Unit II: 3.2, 3.4, 3.5, 3.6, 3.7.1, 3.7.3, 5.4, 5.5, 5.10, 5.11, 5.12

Unit III: 6.1, 6.2, 6.3, 6.5, 6.6, 7.2 – 7.7.
Unit IV: 8.2 – 8.6, 9.4 – 9.6.
Unit V: 10.1, 10.3, 10.4, 10.6, 10.11.2, 10.12.1, 4.1, 4.3 – 4.6,4.9,4.10.

Books for reference:

1. Classical Mechanics – H. Goldstein, C. Poole and J. Safko,Pearson Education Asia, New Delhi, Third Edition, 2002.
2. Classical Mechanics – G. Aruldhas, PHI Learning Private Limited, New Delhi, 2015.
3. Classical Mechanics – S. L. Gutpa, V. Kumar and H.V. Sharma, Pragati Prakashan, Meerut, 2016.
4. Classical Mechanics of Particles and Rigid Bodies – K.C. Gupta, New Age International Publishers,New Delhi, Third edition,2018.

Web Resources:

1. https://worldscientific.com/doi/10.1142/9789814551496_0031
2. https://nptel.ac.in/courses/115/105/115105098/
3. https://www.iiserpune.ac.in/~santh/course/phy311 – cm/phy311 – cm.html
4. https://galileoandeinstein.phys.virginia.edu/7010/CM_10_Canonical_Transformations.html
5. http://www.scholarpedia.org/article/Hamilton – Jacobi_equation
6. https://rotations.berkeley.edu/kinematics – of – rigid – bodies/

Rationale for Nature of the course

In this course, Classical Mechanics which is the study of macroscopic mechanical systems is considered from different perspectives of Lagrangian and Hamiltonian methods. Practical applications of these general principles towards simple problems of oscillatory systems, rigid bodies would enhance comprehension of the principles of Classical Mechanics and develop the skills necessary to analyze the behavior of the mechanical systems based on variety of mathematical methods of Classical Mechanics.

P.T.O.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Lagrangian and Hamiltonian equations of motion derived for different systems develops the application of mathematical and simulation skills to understand various practical applications involving macroscopic and microscopic objects in motion.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcome	Knowledge level
CLO 1	Infer basic concepts of mechanics to describe the Lagrangian equations of motion to simple systems.	Up to K2
CLO 2	Develop Hamilton's equation of motion to real life applications.	Up to K3
CLO 3	Apply generating functions and Poisson brackets to solve problems in Canonical transformations	Up to K3
CLO 4	Analyse and evaluate equations of motion for coupled systems having small oscillations.	Up to K4
CLO 5	Formulate equations of motion for rigid bodies using Euler's equations.	Up to K4

Mapping with CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5
CLO–1	3	2	1	2	2
CLO–2	3	2	1	2	2
CLO–3	3	2	1	2	2
CLO–4	3	2	1	2	2
CLO–5	3	2	1	2	2

Advance application– 3; Intermediate level–2; Basic level–1

Course plan

Unit	Topics	Hrs	Mode
I	System of particles – Degrees of freedom	2	PPT, Chalk and talk, and Group discussion
	Constraints – Types of constraints	2	
	constraints in a rigid body	2	
	Generalized coordinates	1	
	Principle of virtual work	1	
	D'Alembert's Principle –	2	
	Lagrange's equation of motion from D'Alembert's Principle	3	
	Free particle in space	1	
	Atwood's machine.	1	
II	Generalized momentum and Cyclic coordinates	1	PPT, Chalk and talk, and Group discussion
	Hamiltonian function – Hamilton's canonical equations	1	
	Hamilton's equation in different coordinate systems (Cartesian, polar and	3	
	Examples – Harmonic Oscillator, Charged Particle moving in an	2	
	Modified Hamilton's Principle	1	
	Hamilton's equations from Variational principle	2	
	Δ Variation	1	
	Principle of Least action	2	
	Other forms of least action.	2	
III	Canonical transformations	1	PPT, Chalk and talk, Quiz and Group discussion
	Legendre transformation	1	
	Generating functions	3	
	Condition for canonical transformations – Examples –	2	
	Bilinear Invariant Condition –	1	
	Poisson brackets and its properties	2	
	Lagrange bracket – Relation between Poisson and Lagrange Brackets	2	
	Angular momentum and Poisson Brackets –	1	
	Invariance of Poisson brackets under canonical Transformations.	2	
IV	Hamilton – Jacobi equation	1	PPT, Chalk and talk, Assignment
	Harmonic oscillator problem by Hamilton – Jacobi method	2	
	Hamilton's characteristic function	2	
	Kepler's problem by Hamilton – Jacobi Method – .	2	
	Action and angle variables	1	
	General theory of small oscillations	2	
	Eigen value equation –	1	
	Two coupled pendulum	2	
	Vibrations of linear tri atomic molecule.	2	
V	Generalised coordinates of a rigid body	1	PPT, Chalk and talk, Quiz and Group discussion
	Euler angle – infinitesimal rotations	1	
	Angular momentum and inertia tensor	1	
	Euler's equations of motion for a rigid body derived from Lagrange's	2	
	Torque free motion of a rigid body	1	
	Reduction of the two – body central force to the equivalent one body	1	
	Equation of motion under central force and first integrals	1	
	Differential equation for an orbit	1	
	Inverse square law	1	
	Kepler's laws of planetary motion and their deduction	2	
	Virial theorem	1	
	Scattering in a central force field.	2	

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		SectionB		Section C (Either/OR)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	**16**	13.33
K2	2	4	10	10	**26**	21.67
K3	4	2	10	20	**36**	30.00
K4	2	-	20	20	**42**	35.00
Total Marks	10	10	50	50	**120**	100.00

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)

RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 21P1PMC3**

COURSE TITLE : Advanced Electronics **QN.NO : 12603**

TIME : 3 Hours **MAX.MARKS :75**

Course Objectives:

The objective of the course is

- To impart depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, Memories and digital devices, converters etc., to the students.
- To introduce the basics of Minimizing Booleans functions by using K-Map and techniques of realizing corresponding Logic circuits. The theoretical knowledge gained in the class room can be experimented in the practical classes.
- To make students understand and experiment the combinational logic circuits (OP-AMP) which serve as Arithmetic circuits in analog computers.
- To make them understand the working of various Flip- Flops, Register types, Counters, ADC/DAC and their applications

Unit	Description	Hours	K-level	CLO
I	**Semiconductor Diodes** Introduction to Semiconductor- Zener diode- Gunn diode- Tunnel diode-Varactor diode-schottky diode- Characteristics and Applications. Transistor Characteristics (CE only)-Transistor biasing and stabilization- The D.C.Operating Point and Load line-Simpler way of drawing a D.C. Load line – Q-Point and Maximum undistorted output– Factors affecting stability of Q-point – Stability factor- Voltage Divider Bias – Stability of Voltage Divider Bias- Stability factor of Voltage Divider Bias- Basic Construction of UJT - UJT Operation - UJT Application-SCR-SCR Biasing- SCR Operation.	15	Up to K2	1
II	**Operational Amplifier Applications** Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier - Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder- Subtractor-Differentiator- Integrator- Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger – Triangular wave generator – Square wave generator – Active filters: Low, High and Band pass filters.	15	Up to K3	2
III	**Combinational Logic and sequential circuits** Minterms - Solving digital problems using maps – SOP & POS reduction (Up to 5-variable) – Incompletely specified functions – Flip-flops – Ripple counters- synchronous counters – Type T and JK design	15	Up to K4	3
IV	**A/D and D/A Converter** DAC- variable resistor networks - Binary Ladder network –D/A accuracy and resolution - ADC – simultaneous conversion – counter method – continuous A/D conversion - successive approximation, A/D accuracy and resolution.	15	Up to K4	4
V	**Memories, Registers** Memory – Basic terms and ideas- Memory Read and Write – ROMs, PROMs and EPROMs-7489-74S201-DRAMS-Programmable Array Logic, Programmable Logic Arrays- Shift Registers- siso-sipo-piso and pipo registers	15	Up to K2	5

Books for Study

1.Applied Electronics by R.S.Sheda

Unit – I: 13.1-13.3, 13.6-13.9, 13.11-13.12, 13.14-13.16, 15.6-15.8, 22.2-22.6, 22.17-22.19-17.20,17.23-17.25,

2. Electronics (Classical and Modern) by Kar

Unit – II : 9.1, 9.2, 9.3, 9.4, 9.5 (Excluding 9.5.5), 9.6, 9.7(Excluding 9.7.2),9.9

3.Digital Electronics – An Introduction to Theory and Practice – William H. Gothman (2nd Edition)-PHI

Unit – III: 6.1-6.6, 6.8,7.1-7.4, 7.6

4.Digital Principles and Applications – D. P. Leach, A.P. Malvino, G. Saha (8th Edition) McGraw Hill

Unit-IV: 12.1.,12.2,12.4,12.5-12.8,12.10

Unit –V : 13.1,13.2,13.4,13.5,4.11,4.12,9.1-9.5

Books for References

1. Modern Digital Electronics – R.P. Jain – Tata McGraw Hill, 2007.
2. Op-Amp and linear integrated circuits - R.F. Coughlin and F.F, Driscol, Prentice Hall of India, New Delhi, 1996.
3. Op-Amps and Linear Integrated Circits -Ramakant A. Gayakwad, Pearson Education: Fourth Edition, 2015.
4. Electronic Principles- Albert Malvino, David J Bates, 7 th Edition, McGraw Hill, 2007.
5. Principles of Electronics- V.K.Mehta, 6 th Revised Edition, S.Chand and Company, 2001.
6. Electronic Devices and Circuits- David A. Bell, 4th Edition, Prentice Hall. 2007.

Web Resources

1. https://circuitglobe.com/semiconductor-diode.html
2. https://www.electronics-notes.com/articles/electronic_components/semiconductor-ic-memory/memory-types-technologies.php
3. https://dewesoft.com/daq/types-of-adc-converters

Rationale for Nature of the course

This course will enable the students to comprehend the theory, concepts, characteristics and working principles of electronic devices like Combinational Logic and sequential circuit'ssemiconductor diodes and their applications in electronic circuits.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge of various devices acquired by the students will help them to design, test, troubleshoot and repair semiconductor diodes, DAC/ADC Converter, OPAMP.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
Unit I	Introduction to Semiconductor- Zener diode- Gunn diode- Tunnel diode	3	Chalk and talk, Quiz and assignment
	Varactor diode-schottky diode –-Characteristics and Applications.	3	
	Transistor Characteristics (CE only)-Transistor biasing and stabilization-	3	
	Need for biasing-operating point	3	
	Bias stability- UJT- SCR	3	
Unit II	Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier	3	PPT, Chalk and talk, and Group discussion
	Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits	3	
	Adder- Subtractor-Differentiator- Integrator	3	
	Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger	3	
	Triangular wave generator – Square wave generator – Active filters: Low, High and Band pass filters.	3	

Unit III	Minterms - Solving digital problems using maps	**3**	PPT, Chalk and talk, Quiz and Group discussion
	SOP & POS reduction (Up to 5-variable)	**3**	
	Incompletely specified functions – Flip-flops	**3**	
	Ripple counters- synchronous counters	**3**	
	Type T and JK design	**3**	
Unit IV	DAC- variable resistor networks - Binary Ladder network	**3**	PPT, Chalk and talk, Assignment
	D/A accuracy and resolution	**3**	
	ADC – simultaneous conversion- counter method	**3**	
	Continuous a/d conversion - successive approximation,	**3**	
	A/D accuracy and resolution.	**3**	
Unit V	Memory – Basic terms and ideas	**3**	Chalk and talk, Quiz and Interaction
	Memory Read and Write – ROMs, PROMs and EPROMs-7489-74S201-DRAMS	**3**	
	Programmable Array Logic	**3**	
	Shift Registers- siso-sipo-piso and pipo registers	**3**	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Differentiate various semiconducting diodes by comparing their principles and working and itsapplications.	Up to K2
CLO–2	Apply and analyze various operating modes of Op-amp, its linear/non-linearapplications.	Up to K3
CLO–3	Realize the combinational and sequential logic circuits by using various logical blocks.	Up to K4
CLO–4	Compare and contrasts the concept ADC, DAC blocks required for data conversion.	Up to K4
CLO–5	Classify various types of memories and shift registers	Up to K2

Mapping with CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5
CLO–1	3	1	2	1	1
CLO–2	3	1	2	1	1
CLO–3	3	1		1	1
CLO–4	3	1	2	1	1
CLO–5	3	1	2	1	

Advance application– 3; Intermediate level–2; Basic level–1

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K1	1	K1	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2 (K1&K1)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented –Solving Problem
K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	**16**	13.33
K2	2	4	10	10	**26**	21.67
K3	4	2	10	20	**36**	30.00
K4	2	-	20	20	**42**	35.00
Total Marks	10	10	50	50	**120**	100.00

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 21P1PME1(A)**

COURSE TITLE : Physics of Non – Conventional Energy Resources **QN.NO : 12604**

TIME : 3 Hours **MAX.MARKS :75**

Course Objectives:

1. To develop the human resources in non conventional Energy resources is needed.
2. To create the people who will teach the science of non conventional Energy resources, this will be also helpful for the promotion of Research in this field.
3. To create several self-employment opportunities in renewable energy and energy efficiency sectors for modestly-trained and self-trained human resources exist in all geographic locations of the country.
4. It will help to develop the skills required in renewable energy and energy management fields.

Unit	Description	Hours	K-level	CLO
I	**Energy Sources:** Introduction- Energy resources and their availability- classification –conventional energy sources- non-conventional sources. Solar energy- Electricity from solar energy-world renewable energy sources - Solar radiation geometry. Theory of solar cell, solar cell material, limitations-Solar radiation at the earth's surface.	**15**	**Up to K2**	**1**
II	**Solar Thermal energy:** Solar Thermal Energy: Introduction- flat plate collectors –solar air heaters-application-advantages-solar energy storage-introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage-latent heat storage-application of solar energy-introduction-solar heating-active based heating system- Solar cooling-absorption air conditioning-LiBr-H_2O system-solar heating-passive heating system- Solar cooling-NH_3-H_2O coolers-Advantages and disadvantages of concentrating collectors over flat plate types collectors.	**15**	Up to K4	2
III	**Wind Energy:** Introduction-The power of the Wind - site selection consideration-wind energy conversion systems. Classification of WEC systems-advantages and disadvantages of WECS-Performance of wind machines-Application of wind energy.	**15**	Up to K3	3
IV	**Geothermal Energy** Introduction- Geothermal sources-hydrothermal resources-Interconnection of geothermal fossil systems-Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy-application of geothermal energy-Magneto-hydrodynamics (MHD): Principle of working of MHD system-Advantage of MHD systems-Estimates of geothermal power- advantages of geothermal field-Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displacement machines.	**15**	Up to K4	4

V	**Bio-Mass and ocean Energy** Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion (OTEC): Introdiuction-methods of Ocean thermal electricity power generation-open cycle OTEC system. Wave and Tidal Wave: Basic Principle of Tidal power-operation methods of utilization of tidal enegy-advantage and limitation of tidal power generation-utilization of biogas, OTEC Utilization, component of tidal power-Hybrid cycle, prospects of OTEC, Prospects of tidal energy.	**15**	Up to K4	5

BOOKS FOR STUDY:

1. Non-Conventional Energy Sources – G.D.Rai- Khanna publication(reprint-2018)
   Sections:
   UNIT I: Chapter-1: 1.4, 1.6, pg(30-31)
   Chapter-2:2.4
   UNIT II: Chapter-3:3.3,(B) pg(63-67)
   Chapter-4:4.1,4.2pg(97-100)
   Chapter-5:5.1,5.2,5.3pg(120-122),5.4(126-128)
   UNIT III: Chapter-6:6.2,6.2.2,6.4,6.5,6.6,6.7
   UNIT IV: Chapter-8:8.1,8.4,8.5,8.5.1,8.10,pg(354-356),8.11,8.11.3,8.12,8.13
   Chapter-12:12.1,12.2.12.5
   UNIT V: Chapter-7:7.2
   Chapter-9:9.2,9.2.1,9.3.1,9.3.2,9.3.4,9.3.9

BOOKS FOR REFERENCE:

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications, 2006.
2. Energy Resources: Conventional & Non-Conventional -M.V.R. KoteswaraRao, BSP Publications, 2006.
3. Non-conventional Energy Resources -D.S. Chauhan, New Age International.
4. Renewal Energy Technologies: A Practical Guide for Beginners, C.S. Solanki-PHI Learning.

Web Resources:

1. https://www.pveducation.org/pvcdrom/properties-of-sunlight/solar-radiation-at-the-earths-surface.
2. https://hal-mines-paristech.archives-ouvertes.fr/hal-01676634/document.
3. https://public.wmo.int/en/sun%E2%80%99s-impact-earth.
4. https://alteredenergy.com/types-of-concentrated-solar-collectors-and-their-advantages-disadvantages/.
5. https://askinglot.com/which-is-a-disadvantage-of-concentrating-solar-thermal-systems.
6. https://www.sciencedirect.com/topics/engineering/geothermal-power-plant.
7. https://www.osti.gov/servlets/purl/6125875.
8. https://www.najah.edu/media/cms_page_media/759/Wind_Energy.pdf.
9. https://www.e-education.psu.edu/eme807/node/713.
10. https://www.researchgate.net/publication/339985429_Prospects_of_ocean-based_renewable_energy_for_West_Africa's_sustainable_energy_future.
11. https://en.wikipedia.org/wiki/Ocean_thermal_energy_conversion.

Rationale for Nature of the course

This course is mainly occupational skill and essential for many work in the renewable energy are delivered.

Activities having direct bearing on skill development/ Employability / Entrepreneurship

The activity is mainly efficient knowledge to work and go in to the further learning of energy resources.

Pedagogy: Chalk and talk, materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Energy resources and their availability	**3**	PPT, Chalk and talk, Quiz and assignment
	Non-conventional sources. Solar energy	**3**	
	Electricity from solar energy-world renewable energy sources	**3**	
	Classification –conventional energy sources- non-conventional sources.	**4**	
	Solar radiation geometry, solar cell material.	**2**	
Unit II	Solar Thermal Energy: Introduction- flat plate collectors	**3**	Chalk and talk, Quiz and assignment
	solar air heaters-application-advantages- solar energy storage	**3**	
	Introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage	**3**	
	latent heat storage-application of solar energy-introduction-solar heating	**2**	
	Active based heating system- Solar cooling-absorption air conditioning-LiBr-H_2O system.	**4**	
Unit III	Introduction, The power of the Wind energy	**4**	Chalk and talk, Quiz, assignment and seminar
	wind energy conversion systems	**2**	
	Classification of WEC systems-advantages and disadvantages of WECS.	**4**	
	Performance of wind machines**,** Application of wind energy.	**3**	
	Wind energy, site selection consideration	**2**	
Unit IV	Geothermal Energy, Introduction, Geothermal sources	**3**	Chalk and talk, quiz, Group discussion
	hydrothermal resources-Interconnection of geothermal fossil systems	**2**	
	Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy	**4**	
	hydrodynamics (MHD): Principle of working of MHD system-Advantage of MHD systems	**2**	
	Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displaement machines	**4**	
Unit V	Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion	**4**	PPT, Chalk and talk, Quiz and Interaction
	(OTEC): Introdiuction-methods of Ocean thermal electricity power generation	**2**	
	open cycle OTEC system. Wave and Tidal Wave	**3**	
	Basic Principle of Tidal power-operation methods of utilization of tidal enegy-advantage and limitation of tidal power generation.	**4**	
	utilization of biogas,OTEC Utilization, component of tidal power.	**2**	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Discuss about the energy system an resources available in the world	Up to K2
CLO 2	Categorize the thermal storage collection and its application	Up to K4
CLO 3	Apply the real life application and study its uniqueness of wind energy	Up to K3
CLO 4	classify sustainable geothermal application	Up to K4
CLO 5	Compare the design and working principle of the wind ,wave and ocean energies	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	2	2	2
CLO2	3		2	3	2
CLO3	3	2	2	3	
CLO4	3		2	2	2
CLO5	3	2	2	3	2

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	**CLOs**	**K- Level**	**Section A**		**Section B**		**Section C (Either/or Choice)**	**Section D (Open Choice)**
			MCQs		**Short Answers**			
			No. of Questions	**K- Level**	**No. of Questions**	**K-Level**		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K4	2	K2 & K3	1	K3	2 (K4&K4)	1 (K3)
3	CLO 3	Up to K3	2	K3 & K4	1	K1	2 (K2&K2)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (No Choice)**	**Section C (Either/or)**	**Section D (Open Choice)**	**Total Marks**	**% of Marks without choice**
K1	2	4	10	-	**16**	13.33
K2	2	4	10	10	**26**	21.67
K3	4	2	10	20	**36**	30.00
K4	2	-	20	20	**42**	35.00
Total Marks	10	10	50	50	**120**	100.00

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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Physics **COURSE CODE : 21P1PME1 (B)**

COURSE TITLE : Medical Physics **QN.NO : 12605**

TIME : 3 Hours **MAX.MARKS :75**

***Course Objectives*:**

1. To understand the general concepts in radiation and its interaction and dose measurement.
2. To apply the physics concepts in clinical trials.
3. To educate scientifically the principles of radiation and its effect in the medical field.
4. To emphasize the significance of various medical techniques and therapy.

Unit	Description	Hours	K-level	CLO
I	Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities-units and relationship between DQ- linear energy transfer- tissue weighting factor-charged particle equilibrium-biological effects of radiation.	15	Up to K2	**1**
II	Interaction of gamma rays and X-rays with matter: Introduction-types of interaction with matter – over all interaction of photons with matter.	15	Up to K3	**2**
III	Treatment planning in radiation therapy: photon beam treatment planning-electron beam treatment planning.	15	Up to K3	**3**
IV	Image-Guided radiation therapy: Introduction – Rationale of IGRT- current available IG techniques – traditional IGRT technologies –real time tracking systems – image registration and correction strategies – image guided Adaptive treatment (IG-ART) - management of respiratory motion.	15	Up to K3	**4**
V	Magnetic Resonance Imaging (MRI): MRI – contrasts in MRI – Physiological and functional MRI – MRI safety – future MRI applications. CT and MRI Radiotherapy: CT based treatment simulation and planning – MRI in Radiotherapy.	15	Up to K4	**5**

BOOKS FOR STUDY:

1. Introduction to Medical Physics – Muhammad Maqbool – Springer International Publishing (2017).

BOOKS FOR REFERENCE:

1. Attix FH (1986) An introduction to radiological physics and radiation dosimetry,Wiley. Bortfeld T, Biirkelbach J, Boesecke R, SchlegelW(1990a) Methods of image reconstruction from projections applied to conformation radiotherapy. Phys Med Biol35(10):1423–1434.
2. Adler JR Jr et al (1997) The Cyberknife: a frameless robotic system for radio Surgery StereotactFunct Neurosurg69:124–128.
3. Antonuk LEet al (1996) Megavoltage imaging with a large-area,flat-panel,amorphous silicon imager. Int J Radiat Oncol Biol Phys36:661–672.
4. Baltzer PA, Dietzel M, Kaiser WA (2012) MR-spectroscopy at 1.5 tesla and 3 tesla. Asystematic review and meta-analysis. Eur J Radiol 81(Suppl 1):S6–S9
5. Hendee WR, Ritenour ER (2002) Medical imaging physics, 4th edn. Wiley-Liss. xix, NewYork.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK230653/
2. https://en.wikipedia.org/wiki/Dosimetry
3. http://www-naweb.iaea.org/nahu/DMRP/documents/Chapter2.pdf
4. https://www.britannica.com/technology/radiation-measurement/Interactions-of-gamma-rays-and-X-rays
5. http://www.sprawls.org/ppmi2/INTERACT/
6. https://www.itnonline.com/article/introduction-current-radiation-therapy-treatment-planning-systems
7. https://pubmed.ncbi.nlm.nih.gov/1908420/

8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3532745/
9. https://www.sciencedirect.com/science/article/pii/S0936655520303691
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4435985/
11. https://aapm.onlinelibrary.wiley.com/doi/pdf/10.1118/1.4894495
    https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6404845/

Rationale for Nature of the course

This course is mainly work-related skill and essential technically the principles of radiation and its achieve in the medical field.

Activities having direct bearing on skill development/Employability / Entrepreneurship

Knowledge is to extend and highlighting the practical skill of medical field.

Pedagogy: Chalk and talk , materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities	**3**	PPT, Chalk and talk, Quiz and assignment
	units and relationship between DQ	**3**	
	linear energy transfer- tissue weighting factor	**3**	
	Charged particle equilibrium-biological effects ofradiation.	**4**	
	Definitions of radiation and Quantities	**2**	
Unit II	Interaction of gamma rays and X-rays with matter	**3**	Chalk and talk, Quiz and assignment
	Introduction- types of interaction with matter	**3**	
	gamma rays and X-rays	**3**	
	Photons interaction	**2**	
	All interaction of photons with matter.	**4**	
Unit III	Treatment planning in radiation therapy	**4**	Chalk and talk, Quiz, assignment and seminar
	photon beam treatment planning	**2**	
	electron beam treatmentplanning.	**4**	
	Types of interaction with matter	**3**	
	X-rays with matter	**2**	
Unit IV	Image-Guided radiation therapy	**3**	Chalk and talk, quiz, Group discussion
	(IG-ART) - management of respiratorymotion.	**2**	
	Introduction – Rationale of IGRT- current available IG techniques	**4**	
	traditional IGRT technologies –real time tracking systems	**2**	
	image registration and correction strategies – image guided Adaptive treatment (IG-ART)	**4**	
Unit V	Introduction-Magnetic Resonance Imaging (MRI)	**4**	PPT, Chalk and talk, Quiz and Interaction
	MRI – contrasts in MRI – Physiological and functional	**2**	
	MRI – MRI safety – future MRI applications	**3**	
	MRI applications. CT and MRI Radiotherapy:	**2**	
	CT based treatment simulation and planning – MRI in Radiotherapy.	**4**	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Physics aspects of Interaction of Radiation Quantities and Units	Up to K2
CLO 2	Acquire knowledge on x –ray interaction and production.	Up to K3
CLO 3	Apply the real life application and study its radiation therapy	Up to K3
CLO 4	Discuss about the different types of particle accelerators and their medical application	Up to K3
CLO 5	Explain the different types Electromagnetic Radiation and their sources/properties	Up to K4

Mapping of CLOs with PSOs#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3		2	1	3
CLO2	3			1	2
CLO3	3		2	1	2
CLO4	3	2		1	2
CLO5	3	1	2	1	3

Advance application –3, Intermediate level –2, Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2(K2&K2)	1 (K3)
3	CLO 3	Up to K3	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K3	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	**16**	13.33
K2	2	4	10	10	**26**	21.67
K3	4	2	10	20	**36**	30.00
K4	2	-	20	20	**42**	35.00
Total Marks	10	10	50	50	**120**	100.00

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)

RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : NME - Physics **COURSE CODE : 21P1PNM1**

COURSE TITLE : Astrobiology **QN.NO : 12608**

TIME : 3 Hours **MAX.MARKS :75**

Course Objectives :

- To introduce the students to the interdisciplinary field of Astrobiology.
- To make the students appreciate the scope of astrobiology in light of our understanding of life, as we know it in the present form and the on the basis of discovery of exoplanets in the habitable zone.
- To appreciate the origin of life and environment of our earth and extrapolate the findings to our solar system.

Course Content :

Unit	Description	Hours	K-level	CLO
I	**Astronomy and Astrobiology :** Introduction - Life from the perspective of physics - the bare necessities of life - Basic astronomy - Formation of stars and galaxies - nucleosynthesis - HR diagram - spectral classification of stars - theory of formation of planets - the age of earth and moon.	7	Up to K2	1
II	**Origin of life and environment** : The early earth - origin of life - signs of earliest life - role of atmosphere - the great oxidation event - advent of animal life - snowball earth - occurrence of advanced life	8	Up to K2	2
III	**Life in the solar system :** Habitable bodies in the solar system - Sunlight's effect on habitability of inner planets - Life on venus - early atmosphere and climate on mars - Interest on europa and titan	6	Up to K2	3
IV	**Life outside solar system :** Hunt for exoplanets (astrometry, stellar doppler shift, transit telemetry, gravitational microlensing) - the habitable zone - biosignatures	5	Up to K2	4
V	**Extraterrestial Intellligence :** Drake's equation - SETI - Fermi's paradox - Rare earth hypothesis	4	Up to K2	5

Books for study :

1. Astrobiology : A Very short introduction, David C. Catling, Oxford University Press, 2013.

Unit I : Chapter 1 : Pages 1-2, 6-12; Chapter 2 : 14-27
Unit II : Chapter 3 : Pages 28 - 37, 39-43; Chapter 4 : 44-59
Unit III : Chapter 6 : Pages 82-88, 94-96, 100-106
Unit IV ; Chapter 7 : Pages 110 - 119
Unit V : Chapter 7 : 120-124, Chapter 8 : 125-127

Web Resources:

1. https://www.terc.edu/terc_products/astrobiology-an-integrated-science-approach/
2. https://guides.lib.uw.edu/c.php?g=341353&p=2303542
3. http://astrobiology.com/

Pedagogy :

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Plan :

Unit	Topics	Hrs	Mode
I	Introduction - Life from the perspective of physics - the bare necessities of life	2	Chalk and talk, Presentation, Quiz and assignment
	Basic astronomy - Formation of stars and galaxies - nucleosynthesis - HR diagram - spectral classification of stars -	3	
	theory of formation of planets - the age of earth and moon.	2	
II	The early earth	2	Chalk and talk, Quiz and assignment
	origin of life - signs of earliest life	3	
	role of atmosphere - the great oxidation event -	3	

	advent of animal life - snowball earth - occurrence of advanced life		
III	Habitable bodies in the solar system - Sunlight's effect on habitability of inner planets	**2**	Chalk and talk, Quiz, assignment and seminar
	Life on venus - early atmosphere and climate on mars -	**2**	
	Interest on europa and titan	**2**	
IV	Hunt for exoplanets	**3**	Chalk and talk, quiz, Seminar
	the habitable zone - biosignatures	**2**	
V	Extraterrestial Intelligence	**3**	Chalk and talk, Quiz, Presentation,
	Rare earth hypothesis	**1**	

Course learning Outcomes:

On the successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Understand the origin of universe and its evolution	Up to K2
CLO–2	Explain the early universe and appreciate the factors that led to the occurrence of advanced life on earth.	Up to K2
CLO–3	Comprehend the idea of habitability and identify objects in the solar system that can / could have harboured life.	Up to K2
CLO–4	Understand the techniques used to detect exoplanets and look for biosignatures.	Up to K2
CLO–5	Understand Drake's equation and its implication to extra terrestrial intelligent life forms.	Up to K2

Mapping of CLOs with PSOs :

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3				1
CLO2	3				1
CLO3	3				1
CLO4	3				1
CLO5	3				1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	**10**	**35**	**50**	**130**	**100.00**	**100**

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

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