MAHATMA GANDHI UNIVERSITY

Anneparthy, Post.: Yellareddy Gudem, Dist. : Nalgonda - 508254

Board of Studies in Physics (PG) meeting was held on 30.09.2023 at 3.00pm in the Department of Physics, Osmania University, Hyderabad.

Members present:

1. Prof.D.Karuna Sagar	Osmania University	Chairman
2. Prof.M.Srinivas	Osmania University	Member
3. Prof.M.Prasad	Osmania University	Member
4. Prof.J.Laxman Naik	Osmania University	Member
5. Dr.Md.Shareefuddin	Osmania University	Member
6. Dr.N.V.Prasad	Osmania University	Member
7. Dr.N.Bikshamaiah	Mahatma Gandhi university	Coordinator

Resolutions:

1. The paper titles and corresponding syllabus of M.Sc Physics for I to IV Semesters has been approved.

Sr. Prof.D.Karuna Sagar

Prof.M.Srinivas

Prof.M.Prasad

Prof.J.Laxman Naik

Dr.Md.Shareefuddin

Dr.N.V.Prasad

DEPARTMENT OF PHYSICS
MAHATMA GANDHI UNIVERSITY-NALGONDA

M.Sc. (Physics) Course under CBCS
(W.e.f 2023-2024 for the batch admitted in I year from the academic year 2023 – 2024 onwards)
Scheme of Instructions and Examinations

SEMESTER – I

S.No.	Subject Code	Paper No.	Subject	Instructions. Hrs/Week	Credits	Duration Of exam. (hours)	Max. Marks
THEORY							
1	PHY 101 T	I	Mathematical Physics and Numerical Methods	4	4	3	40+60*
2	PHY 102 T	II	Classical Mechanics	4	4	3	40+60*
3	PHY103 T	III	Quantum Mechanics- I	4	4	3	40+60*
4	PHY 104 T	IV	Electronic Devices & Circuits	4	4	3	40+60*
PRACTICALS							
5	PHY 105 P	V	Optics Lab	6	3	2.5	30+45
6	PHY 106 P	VI	Heat & acoustics Lab	6	3	2.5	30+45
			Total:		22		550

PHY- Physics, T- Theory, P- Practical

* Internal + External.

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SEMESTER – II

S.No.	Subject Code	Paper No.	Subject	Instructions. Hrs/Week	Credits	Duration Of exam. (hours)	Max. Marks
THEORY							
1	PHY 201 T	I	Quantum Mechanics – II	4	4	3	40+60*
2	PHY 202 T	II	Statistical Mechanics	4	4	3	40+60*
3	PHY203 T	III	Electromagnetic Theory	4	4	3	40+60*
4	PHY 204 T	IV	Digital Electronics and Microprocessors	4	4	3	40+60*
PRACTICALS							
5	PHY 205 P	V	Computer Programming Lab	6	3	2.5	30+45
6	PHY 206 P	VI	Electronics Lab	6	3	2.5	30+45
7	ADD ON	VII		2	2	2	
			Total:		24		600

PHY- Physics, T- Theory, P- Practical

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SEMESTER – III

S.No	Sub. Code	Subject	Instruction Hrs/Week	Credits	Duration of Exam (Hours)	Max. Marks
		THEORY				
1	PHY 301T	Nuclear Physics	4	4	3	40+60**
2	PHY 302T	Solid State Physics	4	4	3	40+60**
		Special paper–I				
3	PHY EC303T/A	Microwave Devises & Antenna Systems	3	3	3	30+45**
	PHY EC303T/B	R.F devices & Antenna Systems				
	PHY NEC 303T/A	Photovoltaics	3	3	3	30+45**
	PHY NEC 303T/B	Renewable Energy Sources				
		Special paper–II				
4	PHY EC304T/A	Analog Digital Transmission Techniques & Information Theory	3	3	3	30+45**
	PHY EC304T/B	Digital Signal Processing				
	PHY NCE 304T/A	Hydrogen Energy	3	3	3	30+45**
	PHY NCE 304T/B	Bio mass Energy				
		PRACTICALS				
5	PHY 305 P	Modern Physics Lab – I (Common to all)	6	3	2.5	30+45
6	PHY EC 306 P	Electronics Communication Lab – I	6	3	2.5	30+45
	PHY NCE 306 P	Non-Conventional Energy Physics Lab-I				
7	ID 307 T	Inter disciplinary Paper(students opt a paper offered by other Department)	2	2	2	
		Total		22		550

PHY– PHYSICS, T–Theory P– Practical
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SEMESTER – IV

S.No	Sub. Code	Subject	Instruction Hrs/Week	Credits	Duration of Exam (Hours)	Max. Marks
		THEORY				
1	PHY 401T	Modern Optics & Spectroscopy	4	4	3	40+60**
2	PHY 402T	Physics of Phonons & Nanomaterials	4	4	3	40+60**
		Special paper–I				
3	PHY EC 403T/A	Optical Fiber Communication	3	3	3	30+45**
	PHY EC 403T/B	Opto -Electronics and Optical Communication				
	PHY NEC 403T/A	Solar Thermal Energy	3	3	3	30+45**
	PHY NEC 403T/B	Fuel Energy Application				
		Special paper–II				
4	PHY EC 404T/A	Satellite & Mobile Communication	3	3	3	30+45**
	PHY EC 404T/B	Intelligent Network For Wireless communication				
	PHY NEC 404T/A	Energy Conversion Systems	3	3	3	30+45**
	PHY NEC 404T/B	Renewable Energy Technologies				
		PRACTICALS				
5	PHY 405 P	Modern Physics Lab - II (Common to all)	6	3	2.5	30+45
6	PHY 406 P/EC	Electronics Communication Lab - II	6	3	2.5	30+45
	PHY 406 P/NCE	Non-Conventional Energy Physics Lab-II				
7	PHY 407/PW	Project Work		4		100
		Total		24		600

PHY - PHYSICS ; T - Theory P - Practical.
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PHY-101 T

Paper - I
MATHEMATICAL PHYSICS & NUMERICAL METHODS

Unit I (13 Hrs)

Legendre's Differential Equation: The Power series Solution –Legendre Functions of the first and second kind –Generating Function- Rodrigues Formula –Orthogonal Properties – Recurrence Relations. Beta and Gamma function –Properties –Relations between them.

Bessel's Differential Equation: Power series Solution –Bessel Functions of First and Second kind-Generating Function –Orthogonal Properties –Recurrence Relations.

Hermite Differential Equation: Power series Solution –Hermite polynomials - Generating Function-orthogonality –Recurrence relations -Rodrigues formula

UNIT – II: (13 Hrs)

Fourier Transform : Infinite Fourier Sine and Cosine transforms –Properties of Fourier transforms-Derivative of Fourier transform –Fourier transform of a derivative-Fourier Sine and Cosine transform of derivatives-Finite Fourier transforms –Applications ofFourier Transforms.

Laplace Transform: Properties of Laplace transforms –Derivative of Laplace transform– Laplace transform of a derivative –Laplace transform of periodic functions- Inverse Laplace transform and its properties –Inverse Laplace theorem –Convolution theorem- Evaluation of inverse Laplace Transforms by Convolution theorem.

UNIT III :(13Hrs)

Solution of Algebraic Equations: Back substitution Gauss Elimination method, Gauss- Jordan Elimination method, Pivoting, Jacobi methods & Gauss-Seidel iterative methods Comparison of direct and iterative methods.

Root-finding Methods: Bisection method, successive bisection method, method of false position, Newton-Raphson method, Secant method, method of Successive approximations.

UNIT IV: (13 Hrs)

Interpolation and differential equations: Lagrange's Newton interpolation method, least square line fitting. Numerical differentiation, Numerical Integration (Gaussian Quadrature method, Newton-cotes Integration formula, Trapezoidal rule and Simpson's rules.

Numerical methods for ordinary differential equations: Euler's method &Runge-Kutta method (second & fourth order)

Reference Books:

1. Applied Mathematics for Engineers and Physicists –Lious A Pipes and Lawrance R.Rarvill.
2. Mathematical Physics – AK Ghatak, IC Goyal and SL Chua-Macmillan India Ltd.
3. Mathematical Physics – Satya Prakash
4. Sastry: Introductory Methods of Numerical Analysis.
5. An Introduction to Numerical Analysis by Kendall E. Atkinson.
6. Numerical Methods – E.Balaguruswamy, Tata McGraw – Hill publishing CompanyLimited.
7. Numerical Methods for Scientific and Engineering Computations – M.R.Jain, S.R.KIyengar and R.K. Jain – PHI Publisher.

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PHY-102 T

Paper - II
CLASSICAL MECHANICS

UNIT – I: Newtonian formalism (13 Hrs)

Inertial frames and Galilean transforms-Non-inertial frames-pseudo forces, rotational frames, rotational transforms and conservation theorems. Description of rotations in terms of Euler angles-Euler's equations of motion for a rigid body. Minkowski space, space-time diagrams, world point and world line-relativistic motion and Lorentz transforms as rotations in four-space, four velocity, energy-momentum vectors with few examples.

UNIT – II: Lagrangian formalism (13 Hrs)

Constraints, generalized coordinate. Principle of virtual work and D'Alembert's principle Lagrange's equations from D'Alembert's principle- Applications of Lagrange's equations (plane and spherical pendulums, L-C circuit), velocity dependent potential-Lagrangian for a charged particle in electromagnetic field, Euler's equations from Lagrange equations,Hamilton's principle- Lagrange equation's from Hamilton's principle.

UNIT – III: Hamiltonian formalism (13 Hrs)

Principle of Least Action and Hamilton's equations – Applications of Hamilton's equations (Motion of a particle in a central force field, projectile motion of a body). Cyclic coordinates and conservation theories, Canonical coordinates and canonical transforms, Conditions for a transformation to be canonical, generating functions, Lagrange and Poisson brackets. Hamilton equations in Poisson bracket from, Hamilton-Jacobi theory.

UNIT – IV: Mechanics of continuous systems (13 Hrs)

Analysis of the free vibrations of a linear triatomic molecule, Eigen value equation- Principal axis transformation-Frequencies and normal coordinates Lagrangian formulation for continuous systems, Hamiltonian formulation.

Reference Books:

1. Classical Mechanics : By Goldstein, Poole &Safko (Pearson 2002)
2. Classical Mechanics :By JC Upadhyaya (Himalaya Publishing House)
3. Introduction to Classical Mechanics : Takwale&Puranik (TMH)
4. Classical Mechanics :Rana&Joag (TMH)
5. Classical Mechanics of Particles and Rigid Bodies :Kiran C Gupta. (New Age
6. International Publishers)
7. Lagrangian and Hamiltonian Mechanics: Calkin (Allied Publishers 2000)
8. Lagrangian Dynamics : Dave Wells (schaum series)

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PHY-103 T

Paper - III
QUANTUM MECHANICS - I

UNIT –I Basics of Quantum Mechanics (13 Hrs)

Linear Vector space, Dirac's Ket and Bra notation. Eigen value equation, Eigenkets and Eigenvalues – Degenerate and non-degenerate states - completeness relation, Wave functions in position and momentum space. Normalization and Orthogonality of wave functions, change of basis. Observables -Operators, Hermitian operators and their properties-Commuting and non-commuting operators, Physical significance. Matrix representations of vectors and operators –Observable and expectation value of an observable - Parity operator, Projection operator and significance. Basic commutation relations. Uncertainty principle between any two non-commuting Operators.

UNIT –II Exactly Solvable problems (13 Hrs)

The Schrodinger, Heisenberg picture and interaction pictures. Linear harmonic oscillator-Solution to Schrodinger equation, Eigen values and Eigen functions, properties of stationary states. Linear harmonic oscillator- Solution by operator's method. Raising and Lowering operators, the number operator. Hydrogen atom, solution of the radial part of the Schrodinger equations.

UNIT –III Symmetries in Quantum Mechanics (13 Hrs)

Space and time displacements –unitary operators of space and time displacements and equations of motion. Generators of infinitesimal rotations. Space inversion and unitary inversion operator - intrinsic parity. Time reversal operator –anti-linear operator- time reversal operator for spin zero and non- zero spin particles.

UNIT –IV Angular Momentum (13 Hrs)

Orbital Angular Momentum, Commutation Relations involving : L^2,L_x, L_y, L_z –Eigen values and Eigen functions of L^2 –Generalized angular momentum, J – commutation relations between J^2 and components of J. J_+ and J_- - Eigen values of J^2 and J_z. Matrix representation for J^2 and J_z. Spin angular momentum-Pauli spin matrices and their properties. Addition of angular momenta - Clebsch-Gordon coefficients- Recursion relations-C-G coefficients for $J_1 = ½$, $J_2 = ½$, and $J_1 = ½$, $J_2 = 1$, as examples.

Reference Books:

1. Quantum Mechanics by LI Schiff
2. A Text book Quantum Mechanics : PM Mathews and K Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Lokanathan (Macmillian)
4. Quantum Mechanics by E Merzbacher (John Wiley)
5. Quantum Mechanics by Aruldhas (New Age International
6. Modern Quantum Mechanics by Sakurai (Addison Wesley)

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PHY-104 T

Paper - IV
ELECTRONIC DEVICES & CIRCUITS

Unit I (13 hrs)

Special purpose electronic devices: Zener diode, Tunnel diode, Varactor diode, Transistor – operating modes, transistor biasing configurations transistor as a switch, Field – Effect Transistor (FET), MOSFET and their parameters, SCR – Construction, Characteristics and controlled power rectification Uni Junction Transistor (UJT) construction, characteristics andas a relaxation oscillator.

Unit II (13 hrs)

Power supply: Transistor regulated power supply, switch mode power supply, IC voltage regulator – LM78XX, LM79XX, and LM317 series.

Amplifiers: RC Coupled CE amplifier – Frequency response, Emitter follower – frequency response, impedance measurements, Feedback topologies classifications, positive and negative feedback techniques, Advantages of negative feedback.

Oscillators: Barkhausen Criterion, Phase shift Oscillator, Wein Bridge Oscillator, Hartley and Colpitts Oscillators, Crystal Oscillator.

Unit III (13 hrs)

Operational Amplifiers: Characteristics, Open and closed loops configurations, Inverting andNon – inverting amplifiers – Voltage follower, Addition, subtraction, Differentiator, integrator, Analog computation – Solution to second order D.E. Logarithmic and Anti-log amplifiers. Waveform generators: Sine wave, square wave, and saw tooth voltage generators.

Unit IV (13 hrs)

Active Filters: Active Filters – First and second order low pass, high pass, band pass and band stop filters.

Timer Circuits: 555 timer – Astable, monostable, VCO, Schmitt trigger phase locked loop (PLL) (IC 565). Basic principles of frequency multiplications / division, analog phase detector.

Reference Books:

1. Electronic Devics and circuit theory – Robert L.Boylestrad & Louis Nasheisky.
2. Integrated Electronics: Millmann & Halkies (Tata Magraw Hill)
3. Microelectronics: Millmann & Grable
4. Operational amplifiers: Ramakanth A Gaykwad(printic Hall India)
5. Semiconductor by SM Sze, Wiley (1985)
6. Introdduction to semiconductor Devices by M.S Tyagi #John wiley & sons
7. Fundamentals of electronics & applications by J.D. Ryder.

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PHY-105 P

Paper – V (Practical)
OPTICS LAB

1. Fraun Hoffer Diffraction Single – Double Slit.
2. Determination of wavelength of laser light – Transmission grating.
3. Spectrophotometer - Cauchy's constants
4. Dispersive power of the prism
5. Single slit – Laser
6. Diffraction grating – determination of wavelength of Sodium ligh
7. Newton's rings Y & n of glass plate
8. Verification of law of mauls
9. Fiber optics experiments
   a) Determination of numerical aperture of a given optical fiber,
   b) Estimation of losses in the given Optical fiber (Bending, Coupling).
   c) Optical source (LED) and optical detector (photo diode) Characteristics.

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PHY-106 P

Paper – VI (Practical)
HEAT ACOUSTICS LAB

1. Specific heat of graphite
2. Ultrasonic Velocity in the given liquid (water) media.
3. Stefan's constant.
4. y and n of the material of the given spiral spring.
5. Coefficient of linear expansion of solid (Brass / Aluminum/Copper/Iron.)
6. Viscosity of a given liquid by oscillating disc.
7. Estimation of errors. (Gaussian Curve)
8. Characteristics of a given thermostat / semiconductor
9. TEP
10. Thermal Conductivity

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M.Sc. (Physics) II Semester Syllabus (w.e.f 2023-24 Admitted batch onwards)

PHY-201 T

Paper – I
QUANTUM MECHANICS - II

UNIT – I (13 Hrs) Scattering Theory:

Kinematics of Scattering Process: Asymptotic from of scattering wave function - Relation between scattering cross section and scattering amplitude - differential and total cross-section. Greens method-Scattering amplitude using Green's method. Born approximation method -validity condition- Screened coulomb potential as an example - Partial wave analysis and phase shift-Optical Theorem- Relationship between phase shift and Potential. Scattering by Hard sphere.

UNIT – II (13 Hrs) Time Independent Perturbation Theory

Approximation Methods. Non-degenerate case, First-and Second- order cases – application to an harmonic Oscillator - Degenerate case- Stark effect for H-atom for n=2 level. Variation Method - Helium atom ground state. WKB approximation method - connection formulae - application to Alpha Decay.

UNIT – III (13 Hrs) Time Dependent Perturbation Theory

Time development of state, variation of constants (coefficients), Transition probability- Selection rules for transition. Constant perturbation. Transition probability to closely spaced leaves- Fermi's golden rule. Harmonic perturbation- Transition probability rate. Interaction of an atom with electromagnetic radiation. Electric dipole approximation. The Einstein Coefficients.

UNIT – IV (13 Hrs) Relativistic Quantum Mechanics

Klein-Gordon equation. Dirac equation. Position probability density. Dirac matrices and their properties. Plane wave solutions of the Dirac equation. Energy spectrum-significance of negative energy states-spin angular momentum of the Dirac particle. Dirac particle in a magnetic field-spin magnetic moment. Dirac equation in covariant form. Gamma matrices.

Reference Books:

1. Quantum Mechanics by LI Schiff
2. A Text book Quantum Mechanics by PM Mathews and K Venkateshan (TMH)
3. Quantum Mechanics by Ghatak and Lokanathan (Macmillian)
4. Quantum Mechanics by E Merzbacher (John Wiley)
5. Quantum Mechanics by Aruldhas (New Age International
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PHY-202 T

Paper – II
STATISTICAL MECHANICS

UNIT – I: (13 Hrs)

Relation between thermodynamics and statistical mechanics- Micro states and macro states of a system – Phase space- Ensembles – Mean values and ensemble average –Density distribution in phase space-Liouville's theorem. Apriori probability postulate –Micro canonical, canonical and grand canonical ensembles –Quantization of phase space. Entropy and Probability –Equilibrium conditions: Thermal, mechanical and concentration equilibrium. Entropy of a perfect gas using micro canonical ensemble-Gibbs paradox.

UNIT – II: (13 Hrs)

Maxwell –Boltzmann statistics-Distribution law- Maxwell velocity distribution-Equipartition theorem. Canonical ensemble- Partition function-Ideal gas, Grand canonical ensemble-Partition function-Ideal gas. Quantum Statistical Mechanics-Postulates- Indistinguishability-Bose-Einstein and Fermi-Dirac statistics and distribution laws. Partition function and thermodynamic quantities-Translational, rotational and vibrational partition functions - Specific heat of diatomic molecules.

UNIT – III: (13 Hrs)

Ideal Bose-Einstein gas-Energy and pressure of the gas. Bose-Einstein condensation-Liquid Helium Two Fluid model-Phonons, super fluidity. Ideal Fermi-Dirac gas Energy and pressure of the gas –Electronic specific heat, thermionic emission, white dwarfs.

UNIT – IV: (13 Hrs)

Fluctuation-mean square deviation-Fluctuations in energy, volume and concentration Brownian motion-Classification of phase transition-Phase transitions of first and second kind: Ising model, Bragg-Williams approximation-One dimensional Ising model application to Ferro magnetic systems-Order-Disorder transition.

Reference Books:

1. Statistical Mechanics by Satya Prakash and JP Agarwal (Pragati Prakahan-2002)
2. Statistical Mechanics by Gupta and Kumar (Pragathi Prakashan -2002)
3. Statistical Mechanics by BK Agarwal and M Eisner (New Age International)
4. Statistical Mechanics by RK Srivastava and J Ashok (Prentice Hall, India)
5. Introduction to phase transitions and critical Phenomena HE Stanley (Clarendon Press, Oxford).
6. Heat and Thermodynamics by Zemanski (TMH).

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M.Sc. (Physics) II Semester Syllabus (w.e.f 2023-24 Admitted batch onwards)

PHY-203 T

Paper – III
ELECTROMAGNETIC THEORY

UNIT – I: Electro-Static Potentials and Maxwell's Field Equations (13 Hrs)

Special techniques for calculating electrostatic potential: Poisson's and Laplace's equations- solution of Laplace's equation for electrostatic potential in Cartesian, spherical and cylindrical coordinates-Multipole expansion of the energy of a system of charges in an electrostatic field-The scalar and vector magnetic potentials.

Derivation of Maxwell's equations-General wave equation-Gauge transformations-Lorentz and Coulomb gauges-Momentum, angular momentum and free energies of electromagnetic field- Poynting Theorem (work energy theorem in electrodynamics).

UNIT – II: Propagation of Plane Electromagnetic Waves (13 Hrs)

Electromagnetic (EM) waves in unbounded media-EM wave equation for a homogeneous isotropic dielectric medium-Propagation of plane EM waves in free space-Propagation of EM waves in homogeneous isotropic dielectric medium- Energy transmitted by a plane EM wave-Propagation of EM wave in conducing medium- Attenuation and Skin effect-Energy transmitted –Polarization of EM wave.

UNIT – III: Interaction of Electromagnetic Waves with Mater (13 Hrs)

Propagation of EM waves in bounded media-Boundary conditions for E,D,B and H – Reflection and Refraction of plane EM waves at plane interface between two dielectrics-Laws of reflection and refraction-Fresnel's relations- Reflection (R) and Transmission(T) coefficients -Brewster's angle- Total internal reflection-Reflection and Refraction of plane EM waves at plane interface between non-conducing and conducting medium-Metallic reflection and its applications –Dispersion in non- conductors –Normal and anomalous dispersion.

UNIT – IV: Electromagnetic Fields and Radiating Systems (13 Hrs)

Electromagnetic radiation: Inhomogeneous wave equation for potentials-Retarded potentials- Multipole expansion of EM radiation for harmonically oscillating source-Long wavelength approximation-Oscillating electric dipole radiation-Oscillating magnetic dipole radiation-Radiation from center fed linear antenna

Radiation from accelerated charges: Lenard Weichert potentials-Electromagnetic field of a charge in arbitrary motion.

Reference Books:

1. Classical Electrodynamics by SP Puri, Tata McGraw-Hill Publishing Co., Ltd (2000).
2. Introduction to Electrodynamics by DJ Griffiths, Prentice- Hall of India (1998).
3. Electricity and Magnetism by MH Nayfeh and MK Brussel, John Wiley and Sons (1985).
4. Classical Electrodynamics by JD Jackson, John Wiley and Sons (1999).
5. Foundations of Electromagnetic Theory by JR Rietz, FJ Milford and Christy, Narosa Publishing house (1986)
6. Engineering Electromagnetics by WH Hayt and JA Buck Tata Mc-Graw Hill (2001)
7. Electromagnetic waves and Radiating systems by EC Jordan and KG Balmain, PrenticHall (1968)

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PHY-204 T

Paper – IV
DIGITAL ELECTRONICS AND MICROPROCESSORS

Unit-I (13 Hrs)

Combinational Logic –Introduction to logic gates, Demerger's theorems, Boolean algebra, Boolean laws, Simplifications of Boolean expressions, Sum of Product (SOP) and Product of Sum (POS) forms, fundamental product, Min terms and Max terms. Karnaugh maps (up to 4 variables). Logic families and their performance characteristics- RTL, DTL, I^2R logic, TTL, ECL, PMOS, NMOS and CMOS logic.

Unit-II (13 Hrs)

Sequential Logic: RS, D, JK, MS-JK and T flip-flops, their operating principals and truth tables. Shift and control shift registers and their operations. Counters: BCD Asynchronous counter, modulo-N counters Synchronous and ring counters. Encoders and Decoders. Memories: RAM, ROM, PROM and EPROM

Unit-III (13 Hrs)

Data converters: Digital to Analog converters (DAC) binary weighted resister- R-2R ladder network-Accuracy and Resolution-Analog to digital converters (ADC), Dual slope integrated type, simultaneous type, successive approximation and counter type. Realization of A/D converter using D/A converter. Multiplexer and De Multiplexer.

Unit-IV (13 Hrs)

Microprocessors: Introduction to microprocessors, Organization and Architecture of Intel 8085. Signal diagram, explanation of various functional modules of 8085.Flag Register and explanation of various flags with suitable examples, Interrupts, Stack. Instruction set: Instruction formats, addressing modes, and instruction groups of 8085, Data transfer, Arithmetic, logical, branch, I/O and machine control group. Programming-Assembly Language Programs for sorting data, arranging data in Ascending or Descending, BCD addition.

Reference Books:

1. Digital Principles and Applications – A.P.Malvino and Donald P.Leach (TMH)
2. Modern Digital Electronic – R.P.Jain (TMH 3rd Edition)
3. Fundamentals of Digital circuits – A.Anand Kumar (PHI)
4. Microprocessor Architecture, Programming and applications with 8085/8086- Ramesh-S-gaonkar (Wiley Eastern Edition)
5. Microprocessor and Microcomputers – B.Ram(TMH)
6. Introduction to Microprocessor – Aditya P.Mathur (TMH)
7. Advanced Microprocessor and Peripherals –A.K.Ray and K.M. Bhurchandi.

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DEPARTMENT OF PHYSICS
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M.Sc. (Physics) II Semester Syllabus (w.e.f 2023-24 Admitted batch onwards)

PHY-205 P

Paper – V (Practical)

COMPUTER PROGRAMMING LAB

1. Evaluation of function sin x, cos x and log x etc.
2. Evaluation of determinant of a matrix and matrix multiplication.
3. Evaluation of the values of 1st order Bessel function

Solutions of Non – Linear Equations

4. Newton – Raphson method
5. Bi-Section method

Numerical Integration

6. Trapezoidal rule
7. Simpson's $1/3^{rd}$ & $3/8^{th}$ rule
8. Gaussian Quadrature

Solutions of Differential Equations

9. Euler's method
10. Runge-Kutta Method
11. Making difference Table
12. Lagrange's interpolation
13. Polynomial curve fitting method.

Solutions of system of Linear Equations

14. Gauss's elimination method
15. Gauss's seidel method.

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PHY-206 P

Paper – VI (Practical)
ELECTRONICS LAB

1. Design & study of a Regulated power supply using IC 723.
2. Frequency response of RC coupled amplifier.
3. Design of CE Transistor amplifier
4. Study of basic operational amplifier (741), Inverting and non – inverting amplifier.
5. Construction of Astable Multivibratior with IC 741 and study its response.
6. Phase Shift Oscillator (BC 107 / LM741)
7. Wein Bridge Oscillator (BC 107 / LM741)
8. Astable Multivibrator (IC 555)
9. Schmitt Trigger (IC 741)
10. Differentiator and Integrator (IC 741)
11. Construction and verification of logic gates using TTL NAND and NOR gates.
12. Study of flip Flops (R-S, J-K and MS J-K)
13. Digital – to analog converter using R-2R ladder network.
14. Study of Voltage controlled oscillator using IC – 566.
15. Experiments with microprocessor, internal 8085.

ii) To arrange N numbers in ascending order

iii) To write a program to add two 8 - bit

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PHY-301 T

Paper – I
NUCLEAR PHYSICS

Unit I: Nuclear Force and Nuclear Models

Systematics of nuclear force-strength, range, charge independence; Deuteron problem and its contribution to the definition of the Nuclear force. Exchange force theories- Majoranna, Bartlett, Heisenberg and Yukawa. The liquid drop model, the semi empirical mass formula and its applications. The Shell model, states based on square well potential and harmonic oscillator potential. Predictions-spins and parities of nuclear ground states, magnetic moments, electric quadrupole moments.

Unit II: Nuclear Decay Processes

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

Unit III: Nuclear Radiation Detection:

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

Unit IV: Nuclear Reactions & Particle Physics

Classification of nuclear reactions, Kinematics and Q-value of reactions. Basic theory of direct nuclear reactions-Born approximation, stripping and pick-up reactions, characteristics, cross-sections, examples and applications. Compound nucleus formation. Theory of Fission and fusion reactions. Nuclear structure information from nuclear reactions. Elementary Particles Classification and their Quantum Numbers (Charge, Spin, Isospinetc). Fundamental Forces, Conservation of Parity, Strangeness and Lepton and Baryon numbers, Quark model.

Reference Books:

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

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PHY-302 T

Paper – II
SOLID STATE PHYSICS

UNIT – I Crystallography and Band Theory solids: (13 Hrs)

Introduction to crystal structures, atomic packing in solids, Crystal structures of fcc, bcc, hcp. Symmetry operations, Point groups, Space groups and their notation. Types of Defects in solids - Schottky Defects - Frenkel Defects.

Classical free electron theory of metals, Failure of Free electron theory of metals, Bloch theorem, Behavior of electron in periodic potentials (Kronig- Penny model), E vs K relation, Density of states in a band, Effective mass of electron, Negative effective mass and concept of hole. Distinction between metals, Semiconductors and Insulators.

UNIT – II Semiconductor Materials: (13 Hrs)

Semiconductor Structure – Conduction in semiconductors, Band gap, Intrinsic and extrinsic semiconductors - Fermi level- Expressions for electron and hole concentrations. Hall Effect in semiconductors.

Absorption of Light (Absorption Coefficient, Absorption Depth, Generation Rate, Types of Recombination, Radiative Band – to Band Recombination, Recombination Through Defect Levels, Auger Recombination), P-N Junction Photo Diodes, LED, Solar cell, Laser diode.

Unit III Thin Films: (13 Hrs)

Advantages of Thin Films, Thin Film nucleation and growth, Thin film deposition techniques, Evaporation, sputtering, LPCVD and APCVD, plasma Enhanced, hot wire CVD, Ion assisted deposition, Thickness measurements, Electrical and Optical properties of Thin Films.

UNIT – IV Lattice Vibrations and Thermal Properties: (13 Hrs)

Elastic waves in one dimensional array of identical atoms, Vibrational modes of a diatomic linear lattice and dispersion relations, Infrared absorption in ionic crystals, Phonons and verification of dispersion relation in crystal lattices.

Lattice heat capacity- Einstein and Debye theories, Lattice thermal conductivity –Phonon mean free path, Origin of thermal expansion and Grunceisen relation.

Reference Books:

1. Solid State Physics – A.J. Deckker, Macmillian Indian Ltd, 2003.
2. Introduction to Solid State Physics – C. Kittel, Johan Wiley Sons Inc, New York
3. Solid State Physics- RL Singhal, Kedar Nath & Ramnath& Co, 2006
4. Elements of Solid State Physics – J.P. Srivastava, Prentice Hall India, 2006.
5. Elements of Solid State Physics -- Ali Omar, Pearson Education Inc, 2002.
6. Solar cells – M.A. Green (PHI)
7. Thin films by Goswami
8. Thin films by K.L.Chopra.
9. Solid State Physics – S.O.Pillai

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PHY EC303T/A **Paper – III (A)**

MICROWAVES & ANTENNASYSTEMS

(Electronic Communication Specializations)

Unit- I Introduction to Microwaves & Microwave transmission lines

Microwave characteristics-microwave bands, Transmission lines equations and solutions, Reflection coefficient and Transmission coefficient, Standing wave and Standing wave ratio, Line impedance and Admittance, Impedance matching. Microwave Coaxial Connectors.

Unit- II Microwave Waveguides

Introduction to microwave wave guides, Maxwell equations in time domain, Rectangular waveguide, solutions of wave equations in Rectangular coordinates, TE and TM Modes in rectangular waveguides, Power Transmission and Power losses in rectangular waveguide, Circular waveguides, Solutions of wave equations in cylindrical coordinates TE, TM and TEM modes in circular waveguides, Field patterns.

Unit- III Microwave Components & Sources & Antennas & Wave Propagation

Microwave Components: Microwave hybrid circuits, Scattering(S) parameters or Matrix – S Matrix formulation. Waveguide Tees – E –Plane, H – Plane and Magic Tees. Hybrid Rings. Microwave Sources: Klystron, Reentrant cavities, velocity modulation, Bunching process. Power output and Beam loading, Efficiency of Klystron. Reflex Klystron, Antenna fundamentals, Magnetic and Electric fields. Antenna operation. V.H.F Antennas: Reflector (corner) Antennas, loop antenna. Microwave Antennas: Parabolic reflector antenna, gain, beam width, feed methods, Horn antenna.

Recommended Text Books:

1. Microwave Device and Circuits – Samuel Y.Liao – PHI
2. Fundamentals of Microwave Engineering – R.E.Collin
3. Antennas – J.D Kraus
4. Principles of Electronic Communication Systems – Louis E Frenzel (3rd Ed.) TMH

Reference Books

1. Microwave Integrated Circuits – K.C.Guptha
2. Electronic Communication – Dennis Rody and John Collins
3. Electronic Communication Systems – Kennedy and Devins
4. Antenna Theory –K D Prasad.

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PHY EC303T/B **Paper – III (B)**

R.F DEVICES & ANTENNA SYSTEMS
(Electronic Communication Specializations)

UNIT-I RF-POWER AMPLIFIERS

RF Power Transistor Characteristics – Transistor Biasing – RF Semiconductor Devices – Power Amplifier Design – Matching to coaxial Feed lines – Automatic shutdown circuitry – Broad Band Transformers.

RF Front – End Design: Higher levels of Integration – Basic Receiver Architectures – ADC's Effect on Front – End Design.

UNIT-II Antenna System

Introduction Isotropic radiator and plane waves far – field Region. Antenna analysis. Antenna characteristics and parameters. Monopole and Dipole antennas, Horn Antennas, Parabolic Dish Antennas. Microstrip patch Antennas, Antenna Arrays and Phased arrays, Antenna Measurements.

UNIT-III Antenna Types

Dipoles and Monopoles, Base station Applications corner Reflector, Yagi, Log – Periodic, Arrays, Unusual Antennas, Active Antennas, Diversity Antennas.

Antenna System Requirements and Design: Define System Requirements, Design System, Select appropriate components.

Antenna System Resources : Internet Resources, Periodicals, Manufacturer's and Vendors catalogs.

Reference Books:

1) RF circuit design – Christopher Bowick with John Blyter and Cheryl Ajluni.
2) RF and M.W circuit and component design for wireless systems. Chang K, Bahi I and Nair V.
3) RF and microwave wireless systems – John wiley & Sons, INC.
4) Antenna System Guide NIJ guide 202-00

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PHY NCE 303T/A **Paper – III (A)**

PHOTOVOLTAICS

(NCEP Specializations)

UNIT–I ENERGY RESOURCES - INTERACTION OF LIGHT WITH SEMICONDUCTOR (15H)

Energy Resources -Classifications of Energy Resources; Non-Conventional Energy Resources; needs of RE source, advantages and limitations of RE source, Solar spectral distribution-Solar constant, Solar insolation, Solar intensity at earth's surface and outside earth's surface. Solar intensity measurements: Pyrometer and Pyro heliometer.

Interaction of light with semiconductor, Direct & Indirect band gap semiconductor, Recombination processes -Radioactive recombination- Recombination through traps, p-n junction potential and I-V equation; Carrier concentration profile, Diffusive flow in Quasi-neutral regions, Dark characteristics-Illumination characteristics of p-n junction .

UNIT-II SOLAR CELL PARAMETERS & DESIGN-FABRICATION OF SOLAR CELLS (15H)

Principle of photovoltaic cell; PV Cell- PV Module-PV Array; I-V equation of Solar cell, Solar cell output parameters and their equations, Efficiency losses -Short circuit current losses, Open circuit voltage losses, Fill factor losses, Effect of finite cell dimensions on Io, Effect of temperature on solar cell performance,

Purification of SiO_2 from metallurgical grade to semiconductor grade- crystal growth of solar grade Silicon; preparation of wafers from Si Crystal, Solar cell interconnection, Collection probability of generated carriers, Junction depth, Top contact design, Optical design.

UNIT- III BATTERIES AND CHARACTERISTICS (15H)

Introduction to Batteries-Basic components of a Battery-Classification of Batteries Definitions of fundamental quantities of batteries, factor affecting on battery performance, Different types of battery arrangement, electrochemical batteries, large capacity approaches, Power conditioning equipment -DC to AC Inverter, difference b/w conventional cell and fuel cell.

Batteries for PV systems: Lead acid batteries, Nickel Cadmium (Ni-Cd) Batteries, Advantages of batteries for bulk energy storage, comparison of batteries, Solar PV systems- Design of PV – powered DC fan without battery and Design of PV powered DC pump.

Reference Books:

1. Solar Cells-Operating Principles Technology and system application by Martin A. Green (PHI)
2. Energy Technology: S.Rao & B.B.Parulekar (Khanna Publications)
3. Solar Photovoltaics: Chetan Singh Solanki (PHI).
4. Non-Conventional Energy Resources:D.S. Chauhan. S.K. Srivastava (New AGE)
5. Photovoltaic systems-Analysis & Design: A.K. Mukerjee,Thakur.

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PHY NCE 303T/B **Paper – III (B)**

RENEWABLE ENERY SOURCES
(NCEP Specializations)

UNIT-I: ENERGY SCENARIO - INTRODUCTION OF ENERGY SOURCES

Indian energy scenario in various sectors; domestic, industrial, commercial, agriculture, transportation and others; Present conventional and non- conventional energy status; Potential of various renewable energy sources; Global energy status; Per capita energy consumption; Renewable and Non renewable energy sources, Principles of renewable energy; brief descriptions of renewable and non- renewable energy sources - their utilization; environmental impact of fossil fuels.

UNIT-II: SOLAR AND WIND ENERGY SOURCES

Solar Energy: Basics of solar energy; Brief History of solar energy utilization; Various approaches of utilizing solar energy; Basic parameters of the Sun; The origin of solar energy Storage and Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar heating and cooling technique and drying, photovoltaic energy conversion.

Wind Energy: Sources and potentials; horizontal and vertical axis windmills; performance characteristics; Environmental issues; Applications.

UNIT-III: OTHER RENEWABLE ENERGY SOURCES

Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Bio-Mass - Geothermal Energy: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking- Geothermal Energy resources, types of wells, methods of harnessing the energy, potential in India.

Reference Books:

1. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", TataMcGraw Hill Publishing Company Ltd., New Delhi, 2009.
2. Non-Conventional Energy - Ashok V Desai - Wiley Eastern.
3. Non-Conventional Energy Sources by G.D Rai
4. Renewable energy resources- Tiwari and Ghosal -Narosa. Tiwari G.N., "Solar Energy – Fundamentals - Design, Modelling and applications", Alpha Science Intl Ltd, 2015.

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PHY EC304T/A **Paper – IV (A)**

ANALOG & DIGITAL TRANSMISSION TECHNIQUES AND INFORMATION THEORY

(Electronic Communication Specialization)

Unit-I: Analog signal Transmission Techniques

Need for modulation, Amplitude modulation (AM), Frequency spectrum for sinusoidal AM. Power Calculation of AM, Amplitude Modulation Systems (Linear and Non-Linear)-Suppressed Carrier Systems (DSB-SC), Single-Side band Modulation Systems (SSB). Detection of AM signals. Frequency Modulation (FM), Frequency Spectrum for Sinusoidal FM, Frequency Modulation Methods. Detection of FM waves – FM Demodulation with Discriminator. Phase Modulation (PM). Digital Transmission of Analog Signals, Quantization of Signals, Pulse code Modulation (PCM), Compounding.

Unit- II: Digital Modulation Techniques & information Theory

Binary Modulation Techniques: ASK, PSK, FSK and their Generation and Detection. Differential Phase Shift Keying (DPSK) Information Theory: Discrete messages, Average information, Entropy, Information rate, Shannon's theorem, Channel Capacity, Capacity of Gaussian- channel. Band width – S/N trade off. Use of orthogonal signals to attain Shannon's limit. Efficiency of Orthogonal signal transmission.

Unit- III: Coding

Need for coding, Parity check bit coding for Error detection, coding for error detection and Correction, Block Codes, Coding and Decoding for block codes, Decoding the Received Codeword, Single Parity-Check Bit Code, Repeated Codes, Hadamard Code, Hamming Code. Algebraic Codes, Burst-error correction. Convolution coding and Decoding, Error in Convolution Codes, Automatic Repeat Request (ARQ).

Recommended Text Books:

1. Electronic Communication system – G.Kennedy
2. Principles of Communication Systems-H-Taub and D.L.Schilling (2nd Edition) TMH
3. An Introduction to Analoh and Digital Communications- Simon Haykin. 2nd Ed.Wiely
4. Wireless Digital Communication-KamiloFeher

Reference Books

1. Communication Systems Analog and Digital- R.P.Singh and S.D.Spare, TMH, 2004
2. Digital and Analog Communication Systems – K.SamShanmugam, John Wiely, 2005
3. Communication Systems – B.P.Lathi, BS Publications 2006
4. Principles of Communication Systems - H-Taub and D.L.Schilling and GoutamSahe, 3rd Ed.TMH
5. Digital Communications – john Proakis, TMH, 1983

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PHY EC304T/B **Paper – IV (B)**

DIGITAL SIGNAL PROCESSING AND DIGITAL SIGNAL PROCESSORS

(ElectronicCommunication Specialization)

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

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

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

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

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

TMS320C5X Language-Assembly language syntax-Addressing modes-Instructions-Load/Store-Addition/Subtraction-Move-Multiplication NORM-Program control-Peripheral control.

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

Recommended Text Books:

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

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PHY NCE 304T/A

Paper – IV (A)

HYDROGEN ENERGY

(NCEP Specializations)

Unit- I: Fundamentals of Hydrogen & Production of Hydrogen (15H)

Physical properties of hydrogen-State and Phase diagrams, Triple point and Toxicity. Chemical Properties, Hydrogen content, Energy content, Energy density, Flammability, Ignition Energy, Auto ignition temperature, Octane number, Burning speed, Quenching gap, Flame characteristics, Methods of production of Hydrogen - Production from fossil Sources(steam reforming, partial oxidation, auto thermal reforming), Production by Electrolysis, Alkaline electrolysis, polymer electrolyte membrane(PEM) electrolysis, photo electrolysis, Photo-biological Hydrogen Production, thermo chemical water splitting, Artificial photosynthesis, Hydrogen from Solar energy, from Biomass.

Unit- II: Hydrogen Storage and Transportation (15H)

Hydrogen storage methods, Liquid hydrogen storage, Metal hydrides, Gas on solids- adsorption (Physisorption and chemisorptions), chemical and related storage, Hydrogen storage in nanostructure carbons, Challenges of hydrogen storage.

Hydrogen transportation (road, train and pipe line), Hydrogen leakage, methods to detect the leakage, Utilization of Hydrogen gas, Hydrogen as a fuel in heat engine: stationary and powering vehicles in road transport and aviation industry.

Unit- III: Fuel Cells (15H)

Introduction, Basic Principle of fuel cells. Fuels, Oxidants and electrolyte materials for fuel cells, Classification of fuel cells, Acidic Electrolyte fuel cells, Alkaline Electrolyte fuel cells, molten carbonate fuel cells (MCFC), Solid Oxide Fuel Cells (SOFC), Methanol fuel cell, Fuel cell with permeable ion exchange membrane(PEMFC), phosphoric acid fuel cell(PAFC),Zinc-Air fuel cell(ZAFC),Regenerative fuel cell(RFC),Reversible fuel cell, internal current losses, Ohmic losses, mass transport/concentration losses. Comparison of batteries vs fuel cells. Advantages, limitations and applications of fuel cells.

Reference:

1. Non Conventional Energy Resources-S. Hasan saeed, D.K. Sharma.
2. Non Conventional Energy Resources –D.S. Chauhan, S.K.Srivastava.
3. Energy Technology- S.Rao and Dr.B.B.Parulekar .
4. Non Conventional Energy Sources- G.D .Rai
5. Vladimir Molkov, Fundamentals of Hydrogen safety engineering – I
6. Vladimir Molkov, Fundamentals of Hydrogen safety engineering – II

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PHY NCE 304T/B **Paper – IV (B)**

BIOMASS ENERGY

(NCEP Specializations)

Unit – I Biomass Fundamentals

Availability of Biomass, Materials for Biogas, Important terms of Biogas-Biomass, Biogas digester, Fermentation, Aerobic, Anaerobic, Slurry, Sludge, Scum, Manure, Retention time, Biomass energy resources, Raw materials for Biogas production, Energy content of Biomass, Applications of Biogas.

Unit- II Biomass Conversion Processes

Direct combustone, Incineration, Waste to energy incineration process, Waste incineration energy plant, Thermochemical conversion, Biochemical conversion, Gasification and pyrolysis fermentation, Biogas generation, Production of Biogas, Anaerobic digestion, Charcoal production, Production of Ethanol, Factors affecting generation of Biogas.

Unit- III Biogas Plants

Batch type Biogas plant, Continuous type Biogas plant, Movable drum type plant, Fixed dome type plant, Comparison between, Fixed dome type and movable drum type plants. Biogas plants in India(Deenabandhu Biogas plant, Gayatri model, Manipal model, Spherical Biogas plant, Mudjar Biogas plant, Site selection for Biogas plant.

Reference Books

1. Energy Technology – S.Rao, Dr.B.B.Parulekar(Khanna Publishers).
2. Non-Conventional energy resources – S.Hasan Saeed – D.K.Sharma.

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PHY 305 P

Paper – V (Practicals)
MODERN PHYSICS LAB – I (Common to all)

1. Hall Effect
2. Energy gap of a semiconductor
3. B-H curve
4. Dielectric Constant
5. Determination of Characteristics of GM Detector
6. Verification of Inverse square law
7. Estimation of efficiency of GM Detector
8. Illustration of distribution counts

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PHY EC 306 P

Paper – VI (Practicals)
ELECTRONICS COMMUNICATION LAB - I

Modulation & Demodulation Techniques

1. Amplitude Modulation & Demodulation.
2. Frequency Modulation & Demodulation.
3. Pulse Code Modulation & Demodulation.
4. Pulse Amplitude Modulation & Demodulation.
5. Pulse Width Modulation & Demodulation.
6. Pulse position Modulation & Demodulation.
7. ASK Modulation & Demodulation.
8. FSK Modulation & Demodulation.
9. PSK Modulation & Demodulation.
10. Analog and Digital Time Division Multiplexing and Demultiplexing.

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PHY NCE 306 P

Paper – VI (Practicals)
NON CONVENTIONAL ENERGY PHYSICS LAB - I

1. Power variation of PV modulus in Series and Parallel connection.
2. Power vs Load characteristics of SPV system
3. Variation of power output with intensity of solar radiation and load.
4. Study of Variation of power output from solar cell with different angles.
5. Determination of efficiency of SPV water pump.
6. Photovoltaic cell output characteristics.
7. Determine the normalized open circuit Voltage and Fill factor
8. Study of Variation of efficiency of thin film solar cell and crystalline solar cell.
9. Power variation of solar cell with wattage and energy.
10. Measurement of load and power factor for the electrical utilities
11. Experiments based on energy conversion and their utilization in electrical and mechanicalsystems.

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PHY-401 T

Paper – I
MODERN OPTICS AND SPECTROSCOPY
(Common for all Specialization)

Unit-I Principles of Lasers & Laser Systems

Emission and absorption of Radiation –Einstein Relations, pumping Mechanisms –Optical feedback - Laser Rate equations for two, three and four level lasers, pumping threshold conditions, Lasermodes of rectangular cavity –Properties of Laser beams. Classification of laser systems –Gas and Solid Lasers-Gas lasers and Energy level schemes: He- Ne,Co2. Solid State lasers: Ruby, Neodymium-YAG lasers

Unit- II Holography & Non-Linear optics

Basic Principles of Holography- Recording of amplitude and phase- The recording medium-Reconstruction of original wave front- Image formation by wave front reconstruction- Gabor Hologram-Limitations of Gabor Hologram-Off axis Hologram- Fourier transform Holograms- Volume Holograms, Applications of Holograms- Spatial frequency filtering.

Non-Linear Optics-Harmonic generation- Second harmonic generation- Phase matching condition-Optical mixing- Parametric generation of light –Self focusing of light.

Unit- III Atomic Spectra

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

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

Unit- IV Molecular Spectra

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

Reference Books:

1. Opto Electronics- An Introduction–Wilson & JFB Hawkes 2nd Edition.
2. Introduction to Fourier optics –J.W. Goodman
3. Lasers and Non-Linear optics –B.B. Laud
4. Optical Electronics –Ghatak &Thygarajan.
5. Principles of Lasers –O. Svelto
6. Atomic Spectra & Atomic Structure- Gerhard Hertzberg
7. Fundamentals of Molecular Spectroscopy - C.N. Banwell and EM Mc Cash
8. Atomic and Molecular Spectroscopy- Raj Kumar
9. Molecular Structure & Spectroscopy- G.Aruldhas
10. Introduction to Atomic Spectra- H.E.white

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PHY-402 T

Paper – II

PHYSICS OF PHONONS & NANOMATERIALS

(Common for all Specialization)

Unit-I: Phonons & Diffusion in solids

Theoretical back ground of lattice vibrations-Phonons and their properties–Crystal momentum–conservation - Neutron diffraction from phonons–Experimental verification of dispersion relation-Thermal conductivity–Role of phonons in Thermal conductivity–Normal and Umklapp processes–Photon– Phonon interaction–TO and LO phonons.

Solid state diffusion, Self-diffusion, diffusion mechanisms, Impurity diffusion, Fick's second law, Diffusion coefficient, experimental determination of diffusion coefficient, various methods. Random walk diffusion. Diffusion in a simple cubic structure, Diffusion under external field, Nernst-Einstein relation, Kirkendall shift. Ionic conductivity, Ionic conductivity of alkali halides and effect of divalent impurities on ionicconductivity.

Unit- II: Superconductivity

Occurrence of superconductivity. Experimental observations –persistent currents, effect of magnetic field, Meissner effect, Type I and type II superconductors. Isotope effect, entropy, heat capacity and thermal conductivity. Energy gap.

Theoretical explanations:-penetration depth, London equations. Cooper pairs and elements of BCS theory. Giaver tunneling, Josephson effects (Basic ideas only). Elements of high temperature superconductors (basic concepts).Applications of superconductors.

Unit- III: Classification & Synthesis of Nanomaterials

Introduction to Nanomaterials, Role of size in nanomaterials, Classification of Nano structuredmaterials-0D, 1D, 2D, 3D. Nanowires, Nanoclusters, Quantum wells

Synthesis routes and Methods: Top down, Bottom up. Physical methods: Inert gas condensation-Arc discharge-RF Plasma-vapour deposition. Chemical Methods: Chemical nucleation theory for cluster formation, Metal nanocrystal by reduction method. Hybrid methods: Sol-gel process

Unit- IV: Characterization Methods

Characterization: Introduction, Structure of Nanomaterials-X-Ray Diffraction (XRD)-The powder method. Electron Microscopy: Atomic Force Microscopy (AFM), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM).

Spectroscopy Techniques: Introduction, Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy, DSC, UV - VIS spectroscopy.

1. Reference Books:

2. Solid state physics - G.Burns;
3. Solid State physics- Dekker
4. Solid State physics-Wahab.
5. Textbook of Nanoscience and Nanotechnology-B.S.Murthy, P.Shankar, Baldev Raj, BB Rath andJames Murday, University Press, IIM, Metallurgy and Material Science.
6. Principles of Nanoscience and Technology, M.A.Shah, Tokeer Ahmad, Narosa Publishing House.
7. Springer Handbook of Nanotechnology – Bharath Bhushan
8. Chemistry of Nanomaterials: Synthesis, Properties and applications by C.N.R.Rao et al.
9. Nano Materials Handbook- Yury Gogosti

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PHY EC403T/A **Paper – III (A)**

OPTICAL FIBER COMMUNICATION
(Electronic Communication Specializations)

Unit-I: Optical Fiber Preparation &Wave guiding

Fiber Material Preparation Techniques; Outside Vapor Pressure oxidation, Vapor Axial Deposition, Modified Chemical Vapor Deposition, Plasma Activated Chemical Vapor Deposition. Fiber drawing processes-Double Crucible Method. Cable Designing, Splices & Connectors.

Wave Guiding: Electromagnetic Mode Theory for Optical Propagation, Mode theory of circular waveguides, Single mode fibers, Graded index fiber – WKB approximations for estimating number of modes.

Unit- II: Optical sources and detectors

Optical Sources: Basic Semiconductor Properties, Light source materials, internal quantum efficiency, modulation capability, transient response, power bandwidth product, Types of LightEmitting Diode(LED) Structures: Planar LED, Dome LED, Surface Emitter LED and Edge Emitter LED.

Optical Detectors: Characteristics of Photo detectors, Photo emissive Diode, Photoconductive Diodeand Photo Voltaic Diode, Injection laser diode, PIN Photo detector, Avalanche Photodiode(APD), Photo Transistor.

Unit- III: Communication systems

Review of Multiplexing techniques: Optical Time Division Multiplexing (OTDM), Subcarrier, Orthogonal frequency Division multiflexing(OFDM), Wavelength Division Multiplexing (WDM). Coarse wavelength division multiplexing, dense wavelength division multiplexing. Coherent optical fiber detection system, Coherent detection principle, Coherent system performance. Comparison of direct and coherent detection performance. Practical coherent system constraints.

Reference:

1. Optical Fiber Communication – Gerad Keiser 3rd Ed.MGH2000
2. Optical Fiber Communication – John M Senior, 2nd Ed.PHI,1999
3. Optical Fiber Communication – SC Guptha, PHI
4. Optical Fibers – T.Gowar
5. Optical Fiber Communication – Joseph C Palais PEA 4th Ed. 2nd Indian Reprint 2002
6. Optical Fiber Communication Principles and systems – A,SalvarajanS.Kar and T.Srinivas, TMH, 2002
7. Introduction to Fiber Optics- A. Ghatak and Tyagarajan(Cambridge UniversityPress)

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PHY EC403T/B **Paper – III (B)**

OPTO-ELECTRONICS AND COMMUNICATION
(Electronic Communication Specializations)

UNIT-I
LED, Laser Diodes, Light Source Linearity, Sources to Fiber Power Launching–Lensing Schemes– LED coupling to Single Mode Fibers, Fibers Splicing, Optical Fiber Connectors, Fundamental Receiver Operation , Digital Receiver Performance, Pre- Amplifiers types, Analog Receivers, Basic Applications and Types of Optical Amplifiers Semiconductors Optical Amplifier, spontaneous and stimulated emission, Einstein A&B coefficients, Optical pumping population inversion, rate equation. Modes of resonators and coherence length.

UNIT-II
Optical detectors-optical detector principle, absorption coefficient, detector, characteristics, Quantum efficiency, responsivity, response time-bias voltage, Noise in detectors P- N junction-photo diode, characteristics, P-I-N-photo diode, response, Avalanche photo diode (APD) multiplication process- BW - Noise photo transistor

UNIT-III
Optical fibers: modes of an optical fiber, multimode fibers, single mode fibers and their propagation characteristics. Dispersion management in optical fibers and link design considerations, Modal analysis of guided modes in symmetric step-index planar wave-guides, Optical fiber- numerical aperture, V-parameter, refractive index profile. Integrated optics: planar and channel waveguides. BER calculation, quantum limit, EDFA, Raman amplifier.

Reference Books:

1. Optical Communication- John M.Senior
2. Optical Communication -Gerd keiser
3. Optical communication and Systems- Pallies
4. Optical Electronics by Ghatak and Thyagrajan
5. Optical Communication by Gower
6. An Introduction to Electro Optic Devices by Kaminov
7. Optical Information Processing by FTS Yu
8. Optical Communication Components and Systems by J.H. Franz and V.K.Jain Narosa Publication House. ISBN 81-7319-145-x
9. Optical Fiber Transmission by J.E. Midwinter, john Wiley, 1979.
10. Understanding optical communication by H.Dutton, Prentice Hall.

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PHY NCE 403T/A **Paper – III (A)**

SOLAR THERMAL ENERGY

(NCEP Specializations)

Unit-I Heat transfer systems (15H)

Modes of heat transfer, Conduction mode of heat transfer- Fourier's Law of Heat Conduction, 1-D heat conduction through plane wall -composite walls-hallow cylinders-pipes. Thermal conduction, Thermal resistance - Analogy between heat and electricity flow, the energy balance.
Convection mode heat transfer: Mechanism of natural and forced convection, dimensionless numbers and their physical significance, Radiation heat transfer: blackbody- Sky Radiation, Combined heat transfer systems; Convection and Radiation in parallel, Convection and Conduction in series.

Unit- II Liquid Flat Plate Collector and Solar Concentrators (15H)

Liquid flat plate collector (LPC), materials for flat plate collector, Absorber plate, efficiency of flat plate collector, Overall heat loss coefficient of LPC , heat loss from the top of collector plate, selective surfaces of flat plate collector, Flat plate air heating collectors; Classifications of air heating collectors, testing of solar collector.

Classification of solar concentrators, Parameters characterizing concentrators, Thermodynamic limits to concentration, performance analysis of cylindrical parabolic collectors, compound parabolic collectors, materials for solar concentrators.

Unit- III Solar Energy Storage and Solar Energy Application (15H)

Need of thermal energy storage, thermal energy storage sensible heat storage, storage in phase change materials, storage irreversible chemical reactions. Solar water heating; Types of Solar Cookers: Direct (focusing) type, Indirect (box type), advanced type, Solar desalination.
Solar drying-basics of solar drying-types of solar dryers: Natural Convection type, mixed mode type. Solar Furnaces- Classifications of Solar Furnaces, components for solar furnaces, typical solar furnaces design and applications, basics of Solar Still, Wick type solar still, Solar energy for industrial use.

Reference Books:

1. Solar Energy: H P Garg and J Prakash (TMH)
2. Solar Energy: S P Sukhatme (TMH)
3. Solar Energy: G N Tiwari (Narosa)
4. Heat Transfer by J P Holman, McGraw Hill.
5. Heat Transfer: Principles and Applications by Dutta, Binay K, PHI Publication.

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PHY NCE 403T/ B **Paper – III (B)**

FUEL ENERGY APPLICATIONS

(NCEP Specializations)

UNIT-I:INTRODUCTION OF FUEL CELLS: Brief history; working of fuel cells, Concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output. Types of fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, evaluation of fuel cell, comparison of battery Vs fuel cell. Description of some commercially available fuel cell stacks, overview on research activities on fuel cells in world,

UNIT-II:FUEL CELL DESIGN AND PERFORMANCE: Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC.

UNIT-III:FUEL CELLS -APPLICATION AND ECONOMICS: Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of Hydrogen and fuel cell, Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology; future trends of fuel cells.

Reference Books:

1 Fuel cell Fundamentals, John Wiley and sons, Willey

2 Fuel cells: Principles and Applications, Viswanathan B and AuliceScibioh, University Press

3. Fuel Cell and Their Applications, Kordesch, K and G. Simader, Wiley-Vch, Germany.

4. Fuel Cell Handbook, A. J. Appleby and F. R. Foulkers, Van Nostrand, 1989.

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PHY EC404 T/A **Paper – IV (A)**

SATELLITE & MOBILE COMMUNICATION
(Electronic Communication Specializations)

Unit-I: Satellite Communication-I

Satellite orbit and Positioning, Satellite speed, height, Period, Angle of inclination. Geosynchronous orbits. Position coordinates, Azimuth and elevation. Satellite Communication systems – Repeaters and Satellite transponders, Frequency allocations for transponder channels. Satellite sub systems, Transponder configurations, Multi-channel Architecture, Satellite orbit control. Power subsystems, Telemetry, Command and Control sub systems.

Unit- II: Satellite Communication-II

Ground stations, Antenna sub systems, Receiver sub systems, Transmitter sub systems. Power sub systems, Telemetry and control Sub systems. International and Regional Satellites, Domestic satellites.

Satellite Applications: Communication satellites, Surveillance satellites, Navigation satellites. Global Positioning Systems (GPS) – Space segment, Control segment, Atomic clocks. GPS receivers, GPS applications.

Unit- III: Mobile – Cellular Communications

Introduction to Cellular Mobile System: Significance of cellular mobile systems, Frequency spectrum allocation. Trunking efficiency. A basic cellular system. Performance criteria, operation of cellular systems. Hexagonal shaped cells, planning a cellular system. Elements of cellular system design, Frequency Re-use, Co channel interference reduction factor, Hand off mechanism, Cell splitting. The concept of spread spectrum: Frequency hopping spread spectrum, direct sequence spread spectrum.

Reference Books:

1. Principles of Electronic Communication Systems- Louis E Frenzel, 3rd Ed.MGH
2. Composite satellite and cable television – R.R.Gulati, Revised 2nd Ed.New Age International
3. Mobile Cellular Telecommunications – William CY Lee, 2nd Ed. MGH
4. Mobile Communications – Jochan.H.Schiller
5. Wireless Digital Communications – Kamilo Feher
6. Communications – Dennis Roddy & John Coolen, PHI, 2000.
7. Principles of Communication system – H.Taub & D.L.Schilling,2nd Ed.TMH 1999
8. Electronic Communication Systems- George Kennedy, TMH
9. Cellular and Mobile Communications- V.Jeyasri, Arokiamary,1st Ed.Technical Pub.2009

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PHY EC404 T/B **Paper – IV (B)**

INTELLIGENT NETWORK FOR WIRELESS COMMUNICATION
(Electronic Communication Specializations)

UNIT-I Advance Intelligent Network (AIN)

AIN evaluation, characteristics and AIN elements and interfaces, SS7 Protocal models , SS7 network and ISDN (Integrated Services Digital Network) for AIN, AIN for mobile communication, ATM (Asynchronous Transfer mode(ATM) technology.

An Intelligent System: Future Public Land mobile telecommunication system. Future enhancement wireless information super highway.

UNIT-II Wireless Channel

Physical modeling for wireless channels, input/output model of wireless channel, time and frequency response.

Point to Point communication_ Detection in Rayeigh fading channel, time diversity, antenna diversity, frequency diversity.

Capacity of Wireless Channels_AWGN channel capacity, capacity of fading channels.

UNIT-III MIMO System (Multiple Input Multiple Output)

Introduction, Space Diversity and system based on space diversity, smart antenna system and MIMO, exploits multipath, space time processing, antenna considerations for MIMO channel modeling, MIMO channel measurement capacity, Space time coding, Advantages and Applications of MIMO, MIMO applications in 3G.

Reference Books:

1) Mobile Cellular Telecommunications by- TATA-MCGRAW-HILL
2) David TSC, P Viswanath."Fundamentals of wireless communication"-2006 ISBN 0-521-68749-7.
3) Andreas Molisch "wireless communications" – John Wiley & Sons, 2012.
4) Upen Dalal " wireless communications"- Oxford University Press, 2009.

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PHY NCE 404T/A **Paper – IV (A)**

ENERGY CONVERSION SYSTEMS

(NCEP Specializations)

Unit-I: Wind energy – Wind turbine-Wind Turbine Plants (15H)

Introduction to wind energy, origin of wind, Nature of wind , mean wind velocity, power in a wind stream, power of a wind turbine for given incoming wind velocity, wind turbine efficiency, forces on blades of a propeller, Wind form site selection.

Types of wind turbine, Construction and working of Horizontal axis wind turbine generator unit (mono, twin, three blades), yaw control, pitch control, Tethering effect, Blade design. Construction and working of vertical axis wind turbine generator unit (Darrieus Rotor, H – rotor), Blade design.

Grid connection, Energy storage requirements with wind energy systems, wind turbine generator with battery storage facility, wind turbine generator with diesel generator, wind turbine generator with Solar cell ,wind hybrid. Applications of wind energy, merits and limitations of wind energy.

Unit- II: Geothermal energy (15H)

Introduction, Nature of geothermal fields, Origin of geothermal resources, Non-uniform geothermal gradients ,Geothermal energy resources-Hydrothermal (convective) resources (vapor and liquid dominated systems), Geo pressured resources, Hot Dry Rock(HDR) resources (petro geothermal systems), Molten rock-chamber systems, comparison of flashed steam and total flow concept, , Advantages and Disadvantages of geothermal energy, Applications of geothermal energy.

Unit- III: Ocean Energy (15H)

Introduction, Ocean Thermal Electric Conversion (OTEC), methods of OTEC power generation, open cycle OTEC systems, closed of Anderson OTEC cycle, hybrid cycle, energy from tides, basic principle of Tidal power, Components of tidal power plants, operation methods of utilization of tidal energy, estimation of energy and power in simple single basic tidal systems & double cycle system. Ocean waves, Advantages and disadvantages of wave energy. Energy & power form waves, wave energy conversion devices.

Reference:

1. Energy Technology: S. Rao and Dr.B.B.Parulakar
2. Non conventional Energy Sources: G.D.Rao
3. Non conventional Energy Resources: S.Hasan saeed, D.K.Sharm.

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PHY NCE 404T/B **Paper – IV (B)**

RENEWABLE ENERGY TECHNOLOGIES

(NCEP Specializations)

Unit – I Wind Energy

Wind flow, Origin of wind, motion of wind, Velocity of wind, Vertical wind speed variation, Site selection, Power of wind, Conversion of wind, Efficiency of turbine, Energy storage, Grid connection.

Unit- II Biomass Energy

Energy content of Biomass, Materials for Biomass, Conversion of Biomass, Types of conversion process, Direct combustion of Biomass, Biomass based fluids, Charcoal production, Fermentation of producer gas (Gasification), Biogas production, Production of Charcoal, Structure and design of Biogas plant, Applications of Biogass.

Unit- III Biogas Plants

Introduction to Renewale Energy Hybrid System, Sustainability of hybrid renewable energy sources (HRES), Advantages of RES based hybrid energy system, Disadvantages of RES based hybrid energy system, Wind-Solar photovoltaic hybrid system, Installation procedure of Wind – Solar photovoltaic hybrid system, Operating procedure of Wind – Solar photovoltaic hybrid system, Wind-Biogas hybrid system, Installation procedure of Solar – Biogas hybrid system,

Reference Books

1. Energy Technology – S.Ro, Dr.B.B.Parulekhar, Khanna Publishers.
2. Renewable Energy Technology – By Chetan singh Solanki, PHI learning PVT Ltd.
3. Renewable Energy Technology – By Vinode thubre –Patil, Apeksha thombre patil-Nirali praksham publishers

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PHY 405 P

Paper – V (Practicals)
MODERN PHYSICS LAB – II (Common to all)

1. Conductivity – four probe method
2. Solar cell characteristics
3. Ultrasonic experiment (Diffraction method)
4. Zeeman effect
5. Absorption of beta rays in Al, Cu & Pb
6. Absorption of gamma rays in Al, Cu & Pb
7. Determination of range and maximum energy of beta particles

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PHY EC 406 P

Paper – VI (Practicals)
ELECTRONICS COMMUNICATION LAB - II

Microwaves and Optical Communication

1. Reflex Klystron characteristics.
2. Attenuation Measurements.
3. Waveguide Parameters measurements.
4. VSWR Measurements, Insertion loss or Attenuation.
5. Impedance and Frequency measurement.
6. Measurement of E-Plane and H-Plane characteristics.
7. Scattering parameters of magic Tee.
8. Measurement of Numerical Aperture.
9. Study the characteristics of optical source(LED).
10. Study of the characteristics of LASER Source.
11. Measurement of propagation loss, Bending loss and Connector loss.

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PHY NCE 406 P

Paper – VI (Practicals)
NON CONVENTIONAL ENERGY PHYSICS LAB - II

1. Characteristics of wind power and annual energy estimation from wind data.
2. Study of Solar energy trainer –Applications.
3. Hydrogen Fuel Cell characteristics & Production of hydrogen
4. Characteristics of Solar cooker
5. Study of Solar hot air collector/Solar dryer
6. Determination of efficiency of SPV water pump.
7. Determination of efficiency of DC/AC Inverter.
8. Study of hot water system
9. Study of storage battery- Charging and Discharging characteristics and maintenance.
10. Energy audit of the following installations
    a. Building Lighting
    b. Air Conditioning System
    c. Running Vehicles
11. Study of Solar collector – Efficiency
12. Efficiency of DC electric motors in pumping system.

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