TELANGANA UNIVERSITY

DEPARTMENT OF PHYSICS

M. Sc (PHYSICS)
SYLLABUS
2017-2018

G. Lalitha

DEPARTMENT OF PHYSICS
TELANGANA UNIVERSITY, NIZAMABAD – 503 322

M.Sc. (PHYSICS)
SCHEME OF INSTRUCTION AND EXAMINATION
2017-18
SEMESTER I

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exam In Hrs	Max. Marks	Credits
THEORY						
I	PHY 101	Mathematical Physics and Numerical methods	4	3	70+30*	4
II	PHY 102	Classical Mechanics	4	3	70+30*	4
III	PHY 103	Electromagnetic Theory	4	3	70+30*	4
IV	PHY 104	Electronics	4	3	70+30*	4
PRACTICALS						
V	PHY 151	Heat & Acoustics	6	3	70+30#	3
VI	PHY 152	Computer Programming	6	3	70+30#	3
Seminar			2			
Total			**28+2**		**600**	**22**

Note : * Internal Assessment (20 Marks for CBT and 10 Marks for seminar)
Internal Practical exam

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Semester I

Paper I (PHY 101) - Mathematical Physics and Numerical Methods

UNIT – I

Legendre's Differential Equation: Power series Solution – Legendre Functions of the first and second kind – Generating Function – Rodrigues' Formula – Orthogonal Properties – Recurrence Relations.

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 – Generating Function – Rodrigues' Formula – Orthogonal Properties – Recurrence Relations.

UNIT – II

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 of Fourier transforms.

Laplace Transform: Properties of Laplace transforms – Derivative of Laplace transforms - 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

Root Finding Methods: Bisection method – Secant method – Newton Raphson method for multiple roots – Muller method.

Numerical Differentiation: Forward Difference Quotient – Central Difference Quotient – First and higher order derivatives – Errors in derivatives.

Numerical Integration: Newton-Cotes methods, Simpson's One third and three eighth methods – Gaussian Quadrature methods.

Ordinary Differential Equations: Taylor Series Method – Euler's Method – Runge-Kutta second order method - Runge-Kutta fourth order method

UNIT – IV

Tensors: Transformation laws – Kronecker delta symbol – Contravariant and Covariant tensors – Rank of a Tensor – tensors of higher rank – addition and subtraction of tensors– outer product – contraction of tensors – Inner product. Quotient Law – Extension of rank of a tensor. Symmetric and anti symmetric tensors – Invariant tensors, Metric tensor – Christofell's symbols of first and second kind and transformation laws. Application of tensor to elasticity (simple stress and strain tensors only)

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Reference Books:

1. Applied Mathematics for engineers and Physicists – Lious A Pipes and Lawrance R. Rarvil.
2. Mathematical Physics – A. K. Ghatak, I.C. Goyal and S. L. Chua – Macmillan India Ltd.
3. Mathematical Methods – Mathews and Walker – Pearson Education.
4. Numerical Methods – E. Balaguruswamy, Tata McGraw – Hill Publishing Company Ltd.
5. Numerical Methods for Scientific and Engineering Computations – M. R. Jain, S. R. K. Iyengar and R. K. Jain – PHI Publisher.
6. Applied Numerical Methods for Engineers using MATLAB and C – Robert J. Schilling, Sandra L. Harris; Brooks/Cole Publishing.
7. Mathematical physics including Classical Mechanics by Satya Prakash
8. Tensor Analysis – By Schaum series

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Semester I
Paper II (PHY 102) - Classical Mechanics

UNIT–I

Newtonian Formalism: 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 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: Constraints, generalized coordinates, Principle of virtual work and D'Alembert's principle - Applications of D'Alembert's principle (lever, inclined plane, plane pendulum), Lagrange's equations from D'Alembert's principle - applications (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: Principle of Least Action and Hamilton's equations(motion of a particle in a central force field, projectile motion of a body), Cyclic coordinates and conservation theorems, Canonical coordinates and Canonical transformations, Conditions for a transformation to be canonical, Generating functions, Lagrange and Poisson brackets. Hamilton equations in Poisson bracket form.

UNIT–IV

Hamilton – Jacobi theory and Theory of Small Oscillations:
The Hamilton-Jacobi equation for Hamilton's principle function, the harmonic oscillator problem, Hamilton – Jacobi equation from Hamilton's characteristic function, Action-angle variables, the Kepler problem in action angle variables.
Analysis of the free vibrations of a linear triatomic molecule - Eigen value equation - Principal axis transformation - frequencies and normal coordinates,

Reference Books:

1. Classical Mechaincs : By Goldstein,Poole & Safko (Pearson 2002)
2. Classical Mechanics: By Rana & Joag (TMH)
3. Introduction to Classical Mechaincs: Takwale & Puranik (TMH)
4. Classical Mechaincs: By J.C. Upadhyaya
5. Classical Mechanics : P.V.Panat (Narosa 2005)
6. Lagrangian and Hamiltonian Mechanics: Calkin(Allied Publishers 2000)
7. Lagrangian Dynamics : Dave Wells (Schaum series 1967)
8. Classical mechanics of particles and rigid bodies : Kiran C Gupta (New Age International Publishers)

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Semester I
Paper III (PHY 103) - Electromagnetic Theory

UNIT –I

Electro-Static Potentials And Maxwell's Field Equations: Special techniques for calculating electrostatic potential: Poisson's and Laplace's equations - Solutions of Laplace's equations 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: 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 waves in conducting medium-Attenuation and Skin effect-Energy transmitted -Polarization of EM waves.

UNIT–III

Interaction of Electromagnetic Waves With Matter: 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-conducting and conducting medium-Metallic reflection and its applications-Dispersion in non-conductors-Normal and anomalous dispersion.

UNIT–IV

Electromagnetic Fields and Radiating Systems: 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: Lienard Wiechert potentials- Electromagnetic field of a charge in arbitrary motion.

Reference Books:

1. Classical Electrodyanamics by S.P.Puri, Tata Mc Graw-Hill Publishing Co.Ltd (2000).
2. Introduction to Eletrodynamics by D.J.Griffiths, Prentice-Hall of India (1998).
3. Electrodynamics by Gupta, Kumar and Singh, Pragathi Prakashan Publishing (2007).

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Semester I
Paper IV (PHY 104) – Electronics-I

UNIT – I

Semiconductor Devices: Characteristics of Tunnel Diode, Photo diode, BJT, JFET, MOS, CMOS, UJT, SCR, DIAC and TRIAC.
Opto-electronic Devices: Solar cells, Photo-detectors, LEDs.

UNIT – II

Regulated Power Supply: Basic Principles of Zener regulated, Transistorized Series regulated (Circuits using 723, 78XX) and Switching Mode Power Supplies (SMPS).
Wave Shaping: Integration and differentiation using passive elements. Clipping and Clamping circuits using diodes.

Amplifiers: h-parameter model of BJT, Biasing of Transistor, Self-bias, Single Stage RC coupled amplifier and its frequency response (using hybrid π model)

UNIT – III

Feedback Amplifiers: Classification of Amplifiers, The concept of feedback, Positive and Negative feedback. Advantages of Negative feedback. Emitter follower and Darlington pair.
Sinusoidal Oscillators (Using BJT's): Criterion for oscillations, Phase shift, Wein bridge, Hartley and Colpitts Oscillators, Crystal Oscillator.
Collector coupled Astable, Monostable, Bistable multivibrator and Schmitt trigger.

UNIT – IV

Modulation and Detection: Amplitude Modulation – Frequency components in an AM signal, Balanced Amplitude Modulator, Envelope and square law detectors. Frequency Modulation – Frequency components in FM signal, Basic Reactance modulator, FM discriminator. Phase Modulation.

Reference Books

1. Integrated Electronics by Millman and Hallkias
2. Pulse Digital & Switching Waveforms by Millman and Taub
3. Microelectronics by Millman & Grabel.
4. Fundamentals of electronics by J.D. Ryder
5. Electronic Communication System by Kennedy.

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4. Electricity and Magnetism by M.H.Nayfeh and M.K.Brussel, John Wiley and Sons (1985).
5. Classical Electrodynamics by J.D.Jackson, John Wiley and Sons (1999).
6. Foundations of Electromagnetic Theory by J.R.Rietz, F.J.Milford and Christy, Narosa publishing house (1986).
7. Engineering Electromagnetics by W.H.Hayt and J.A.Buck, Tata Mc-GrawHill(2001).
8. Electromagnetic waves and Radiating systems by E.C.Jordan and K.G.Balmain, Prentice-Hall(1968).
9. Electrodynamics Theory by Satya Prakash.

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Practical Paper – V (PHY 151)– HEAT & ACOUSTICS

1. Determination of Stefan's constant.
2. Study of variation of specific heat of graphite with temperature.
3. Temperature variation of resistance of a thermistor.
4. Coefficient of linear expansion of given material by Fizeau's method.
5. Estimation of errors.
6. Viscosity of water using oscillating disc.
7. Measurement of ultrasonic velocity in liquids using Debye-Sears method.
8. a). Ultrasonic velocity in liquids and liquid mixtures using ultrasonic interferometer.
   b). Calculation of compressibility.
9. Determination of ultrasonic velocity in solids.
10. Y and η of flat spiral spring.

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Practical Paper–VI (PHY 152):Computer Programming

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

Solution of non-linear equations

4. Newton-Raphson method.
5. Bisection method.

Numerical Integration

6. Trapezoidal rule.
7. Simpson's 1/3 and 3/8 rule.
8. Gaussian Quadrature. Solution of differential equations.
9. Eulers method.
10. Runge Kutta method.
11. Lagrange's interpolation.
12. Polynomial curve fitting method Solution of system of linear equations.
13. Gauss elimination method.
14. Gauss seidel method.

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2017-2018
SEMESTER II

Paper	Code	Subject	Instruction Hrs/ Week	Duration of Exam In Hrs	Max. Marks	Credits
THEORY						
I	PHY 201	Solid State Physics-I	4	3	70+30*	4
II	PHY 202	Quantum Mechanics-I	4	3	70+30*	4
III	PHY 203	Statistical Mechanics	4	3	70+30*	4
IV	PHY 204	Electronics-II	4	3	70+30*	4
PRACTICALS						
V	PHY 251	Optics	6	3	70+30#	3
VI	PHY 252	Electronics	6	3	70+30#	3
Seminar			2			
Total			**28+2**		**600**	**22**

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Semester II
Paper I (PHY201) – Solid State Physics - I

UNIT - I

Crystalline state and Structural Studies: Crystal translational vectors, unit cell, Bravais lattices, Crystal systems, Miller indices, symmetry operations, Point groups, Space groups and their notation. Crystal structures of fcc, bcc, hcp, CsCl, NaCl, ZnS and Diamond.

Bragg's law, Atomic structure factor, Geometrical structure factor and Debye Wallar factor. Concept of Reciprocal lattice, Concept of Brillouin zones. Experimental methods of x-ray diffraction of crystals- Laue and Powder methods. Determination of unit cell parameters of a cubic crystal. Elements of neutron and electron diffraction.

UNIT–II

Lattice Vibrations and Thermal Properties: Elastic waves in one-dimensional array of identical atoms. Vibrational modes of a diatomic linear lattice and dispersion relations. Acoustic and optical modes. 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 Gruneisen relation

UNIT-III

Band Theory and Semiconductor Physics: Failure of Free electron theory of metals. Bloch theorem, behavior of electron in periodic potentials, Kronig-Penney 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. Intrinsic semiconductors, band model, Fermi level, expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors. Hall effect in semiconductors.

UNIT - IV

Crystal Growth and Imperfections: Crystal growth from solution and melt, growth from vapour phase, Experimental techniques of growth from melt.

Classification of imperfections, Schottky and Frenkel defects, expressions for their equilibrium concentrations in metals and ionic crystals. Color centers and their models, Diffusion Mechanisms, Fick's laws of diffusion, Kirkendal effect, Ionic conductivity, Dislocations – edge and screw dislocations, Dislocation multiplication, Grain boundaries.

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Reference Books:

1. Solid State Physics : A.J. Deckker
2. Introduction to Solid State Physics : C. Kittel
3. Solid State Physics : R.L.Singhal
4. Elements of Solid State Physics : J.P.Srivastava
5. Elements of Solid state Physics : Ali Omar
6. Crystallography and Solid State Physics : A.R.Verma and O.N.Srivastava

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Semester II
Paper II (PHY202) – Quantum Mechanics - I

UNIT –I

Basics of Quantum Mechanics: Linear Vector space, Dirac's Ket and Bra notation, Eigen value equation, Eigen kets and Eigen values – 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 noncommuting Operators.

UNIT –II

Exactly Solvable problems: 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 operators method. Raising and Lowering operators, the number operator. Hydrogen atom-solution of the radial part of the Schrodinger equations.

UNIT – III

Time-independent Perturbation theory: Non-degenerate case –first and second order corrections. Perturbed harmonic oscillator and ground state helium atom. Degenerate case - linear Stark effect. Variation method- application to ground state of Helium atom. WKB approximation – alpha decay.

UNIT – IV

Time Dependent Perturbation Method: Time dependent perturbation theory. Transition probability– selection rules for transitions. Constant perturbation. Transition probability to closely spaced levels - Fermi's golden rule. Harmonic perturbation - transition probability rate. Interaction of an atom with electromagnetic radiation- electric dipole approximation. The Einstein Coefficients.

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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Semester II
Paper III (PHY203) – Statistical Mechanics

UNIT-I

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, Sackur-Tetrode equation

UNIT -II

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-transational, 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, rotons, super fluidity.
Ideal Fermi-Dirac gas-Energy and pressure of the gas, electronic specific heat, thermionic emission, white dwarfs.

UNIT - IV: (13 Hrs)

Fluctuations, mean square deviation, fluctuations in energy, volume and concentration, Brownian motion, Classification of phase transitions, 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 Satyaprakash and J.P.Agarwal(Ed.2002)
2. Statistical mechanics by Gupta and Kumar (Pragati Prakashan -2002)
3. Statistical Mechanics by B.K.Agarwal and M.Eisner
4. Statistical mechanics and properties of matter by E.S.R.Gopal
5. Statistical Physics by Battachargee
6. Statistical Physics byTony Guenauit
7. Heat and Thermodynamics by Zeemansky

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Semester II
Paper IV (PHY204) - Electronics–II

UNIT - I

Operational Amplifiers: Characteristics of Ideal operational Amplifier, Block diagram of an IC Op-Amp. Analysis of inverting amplifier, Non –inverting amplifiers, Integrator, Differentiator, summing amplifier, Difference amplifier, Comparator, Logarithm amplifier and exponential amplifier, Analog computation, Square wave, Rectangular wave, Triangular wave and Sine wave generators.

IC 555: Working of IC 555, Astable and Monostable Multivibrator circuits with 555.

UNIT – II

Logic Circuits: Boolean laws and theorems, SOP and POS representation, Min terms and Max terms, Karnaugh Maps (upto 4-variables), Tabulation method, Half adder and Full adder, Parity checker and Generator, Decoder/ Demultiplexer, Data selector/ Multiplexer, Encoder.

Flip-Flops: RS, D, JK and M/S JK flip flops.

Shift Registers: Types of registers, Serial in Serial out, Serial in Parallel out, Parallel in Serial out and Parallel in Parallel out Registers, IC 7496, Ring Counter.

UNIT – III

Counters: Ripple (Asynchronous) Counters, Divide by N Counter, Synchronous Counters, Decade Counter using Flip-Flops and ICs 7490, 7493.

D/A Converters: Variable Resistor Network type, R – 2R ladder type, 4 bit Binary Converter, D/A Accuracy and Resolution.

A/D Converters: Simultaneous Conversion, Counter method, Continuous A/D conversion, Successive approximation Conversion, Dual slope A/D conversion, A/D Accuracy and Resolution.

UNIT – IV

Microprocessor: Architecture of 8085 microprocessor, Introduction to Instruction set, Data transfer instructions, Arithmetic, Logic and Branch operations, Addressing modes, Assembly language programming- Examples.

Reference Books:

1. Integrated Electronics -- Millman and Halkies.
2. Microelectronics -- Milliman & Grabel
3. Operational amplifier – Gawkward
4. Principles of Digital Electronics – Gothman
5. Digital Principles and Applications Computer Electronics -- Malvino.
6. Microprocessors Architecture, Programming and Application with the 8085/8080 – Goankar

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Practical Paper – V (PHY 251) – OPTICS

1. The thickness of a film using Fresnel's Biprism.
2. Determination of Cauchy's constants by dispersion of light through a Prism.
3. Determination of wavelength and difference in the wavelength of the sodium light using Michelson interferometer.
4. Youngs's modulus of the given glass plate using Newton's ring method.
5. Poission's ratio of the given glass plate using Newton's ring method.
6. Wavelength of the sodium light by studying the diffraction and interference pattern obtained with single and double slit.
7. Photo elastic constants of given material.
8. Variation of the birefringence of the given crystals with wave length.
9. Determination of wavelength of given monochromatic light using Fresnel biprism.
10. Study of temperature variation of refractive index of air using Michelson's interferometer.
11. Study of double refraction of quartz and calcite crystals using spectrometer.
12. Determination of birefringence of a uniaxial crystal using constant deviation spectrometer.
13. Study of characteristics of phototransistor and verification of Malus law.
1. Study of elliptically polarized light
15. Determination of wave length of He-Ne laser radiation using diffraction grating.
16. Study of profile of laser beam.
17. Study of characteristics of injection laser.
18. Study of characteristics of LED.

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Practical Paper–VI (PHY-252): Electronics

1. RC coupled transistor amplifier.
2. RS phase shift oscillator.
3. Colpitt's oscillator.
4. Characteristics of OPAMP (IC741) and study inverting and non-inverting amplifiers.
5. Wein bridge oscillator.
6. Schmitt trigger with 741 and 555.
7. Astable multivibrator (555).
8. Switch mode power supply.
9. Regulated power supply with 723.
10. Regulated power supply with 74xx.
11. Triangular and square wave generator (741).
12. Monostable multi vibrator (555).
13. Sawtooth generator (555).
14. Voltage controlled oscillator (555).
15. Amplitude modulation and detection (555) .
16. D/A converter.
17. A/D converter.
18. Construction and verification of the following
    a. Logic gates/circuits using NAND gates (7400)
    b. AND, OR, NOT, NAND, Ex-OR
19. Half adder and full adder.
20. Flip flops RS, JK, D types.
21. Construction and verification of the following counters
    a. Divide by 10 counter with 7490
    b. Divide by 16 counter with 749
    c. Divide by 12 counter with 7492
    d. Divide by N counter with 7476
22. Construction of shift registers.
23. Logic circuits with discrete components.
24. Demorgan's laws.
25. Experiments using microprocessor (8085 kit).

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