VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).
(Affiliated to Periyar University, Approved by AICTE & Accredited by NAAC)

DEPARTMENT OF PHYSICS

III-B.Sc., PHYSICS
SYLLABUS & REGULATIONS

FOR CANDIDATES ADMITTED FROM 2017 - 2018
ONWARDS UNDER AUTONOMOUS - CBCS PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS
Angammal Educational Trust
Elayampalayam, Tiruchengode (Tk.), Namakkal (Dt.)

AUTONOMOUS

About the College

Vivekanandha College of Arts and Sciences for Women (Autonomous) was established and hailed into Women's Educational Service in the Year 1995. Angammal Educational Trust Chaired by the great Educationalist 'VidhyaRathna' Prof.Dr. M. KARUNANITHI, B.Pharm., M.S., Ph.D., D.Litt., sponsors this college and other institutions under the name of the great Saint Vivekanandha. Our institutions are situated on either side of TiruchengodeNamakkal Main Road at Elayampalayam, 6 kms away from Tiruchengode. This is biggest women's college in India with more than 7500 girl students and more than 18 departments. The strength of the college was just 65 at the time of its establishment. With the dedication, work, sacrifice and long vision of the chairman, this institution has grown into a Himalaya stage. As a result of which UGC, New Delhi, awarded 2f and 12b, extended Autonomous status for second cycle. The National Assessment and Accreditation Council reaccredited with grade 'A' for its successful performance.

As an Autonomous Institution, academic professionals of the college framed Curriculum and Syllabi in consultation with all its stakeholders to cater the needs of the young women to fulfil the women empowerment and present Industrial needs to the local benefits. The students are empowering with confidence and required skills to face the society.

Quality Policy

To provide professional training by establishing a high level centre of learning that provides quality education at par with the international standards and Provide excellence education with well equipped infrastructure to all the rural women.

Our Vision

To be an academic institution exclusively for women, in dynamic equilibrium with the social and economic environment, strive continuously for excellence in education, research and technological service to the nation.

Our Mission

The mission of our institution is to discover, teach and apply knowledge for the intellectual, cultural, ethical, social and economic growth of women students.

12	NMEC – II: Industrial Chemistry - II	
SYLLABUS FOR YEAR III (Semester V)		
1	COURSE PATTERN WITH PAPERS	
2	Core – V: Electricity and Magnetism	
3	Core – VI:Basic Electronics	
4	Core - VII: Solid State Physics	
5	Elective – I: Quantum Mechanics and Relativity	
6	SBEC – III: Digital Electronics	
7	SBEC – IV:Bio Medical Instrumentation	
8	Core Practical – III	
9	Core Practical - IV	
SYLLABUS FOR YEAR III (Semester VI)		
1	COURSE PATTERN WITH PAPERS	
2	Core - VIII: Atomic Physics	
3	Core - IX:Nuclear Physics	
4	Elective – II: Electronics and Communication	
5	Elective – III:Numerical Methods	
6	SBEC – V:Microprocessor and its Application	
7	SBEC – VI: Electrical Appliances	
8	Core Practical –III	
9	Core Practical –IV	

BATCH: 2017- 2020								
Sem	**Subject Code**	**Part**	**Subject Title**	**Hours**	**Credit**	**Marks**		
V	17U5PHC05	III	**CORE–IV:**Electricityand Magnetism	5	5	25	75	100
	17U5PHC06	III	**CORE–V:** Basics Electronics	5	5	25	75	100
	17U5PHC07	III	**CORE–VI:** Solid State Physics	5	5	25	75	100
	17U5PHE01	III	**ELECTIVE–I:** Quantum Mechanics and Relativity	5	5	25	75	100
	17U5PHS03	IV	**SBEC–III:**Digital Electronics	2	2	25	75	100
	17U5PHS04	IV	**SBEC–IV:**Biomedical Instrumentation	2	2	25	75	100
	17U6PHCP03	III	Major Practical – III	3	4	-	-	-
	17U6PHCP04	III	Major Practical – IV	3	4	-	-	-
	TOTAL			**30**	**32**	**150**	**450**	**600**

BATCH: 2017- 2020								
Sem	**Subject Code**	**Part**	**Subject Title**	**Hours**	**Credit**	**Marks**		
VI	17U6PHC08	III	**CORE–V:**Atomic Phyics	5	5	25	75	100
	17U6PHC09	III	**CORE–VI:** Nuclear Physics	5	5	25	75	100
	17U6PHE02	III	**ELECTIVE-II:**Electronics and Communication	5	5	25	75	100
	17U6PHE03	III	**ELECTIVE–III:** Numerical Methods	5	5	25	75	100
	17U6PHS05	IV	**SBEC–V:** Microprocessor and its Application	2	2	25	75	100
	17U6PHS06	IV	**SBEC–VI:** Electrical Appliances	2	2	25	75	100
	17U6PHCP03	III	Major Practical – III	3	4	25	75	100
	17U6PHCP04	III	Major Practical – IV	3	4	25	75	100
	17U6EX01	V	Extension Activities	-	1	-	-	-
	TOTAL			**30**	**33**	**200**	**600**	**800**

REGULATIONS

I. SCOPE OF THE COURSE

B.Sc. (Physics),the recent developments in Physical sciences, has been included in the enriched syllabus to meet out the present day needs of academic and research, institutions and industries**.** The program expects a serious commitment of the student to take up challenging study schedules and assignments. The course involves a blend of theoretical education and practical training which run concurrently for a period of three years and equips a student with knowledge, ability, skills and other qualities required for a professional accountant.

The uniqueness of the program is its content and topic coverage, the teaching methodology and the faculty. The syllabus has been designed at a level equal to that of professional courses. The teaching methodologies include classroom lectures, industrial visits, orientation, internship, case study and research work. Focus is also on developing soft skills of the students. For Core subjects, Outsource Guest Lectures by Industrialists and Professional Men will be arranged to enable the students to get wider exposure.

II. SALIENT FEATURES

- ✓ Course is specially designed for a higher level Career Placement.
- ✓ Special Guest lectures from Industrialists will be arranged.
- ✓ Exclusively caters to students interested in pursuing higher studies.
- ✓ Special Industry Orientations and Training are parts of the Degree Course.
- ✓ Project work is included in the syllabus to enhance conceptual, analytical & deductive skills.

III. OBJECTIVES OF THE COURSE

- ✓ The new syllabus throws light on the recent and emerging areas of Physics.

- ✓ Enable the students understand Physics and make them more relevant to the society.
- ✓ Develop the analytical ability in students so that they are become objective in solving problems.
- ✓ Help the students learn practical skills in a better way.
- ✓ Inculcate research aptitude in students.
- ✓ Enable the students to go to higher levels of learning Physics.
- ✓ Improve the employability of the students.
- ✓ To inspire the students to apply their knowledge gained for the development of society in general.

IV. ELIGIBILITY FOR ADMISSION

Candidates seeking admission to the first year Degree course (B.Sc. Physics) shall be required to have passed Higher Secondary Examination with Physics as one of the Subjects conducted by the Government of Tamil Nadu.

V. DURATION OF THE COURSE

- ✓ The course shall extend over a period of three academic years consisting of six semesters. Each academic year will be divided into two semesters. The First semester will consist of the period from July to November and the Second semester from December to March.
- ✓ The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekanandha College of Arts and Sciences for Women with the approval of Periyar University.
- ✓ Each subject will have six hours of lecture per week apart from practical training at the end of each semester.

VI. CONTINUOUS INTERNAL ASSESSMENT

The performance of the students will be assessed continuously and the Internal Assessment Marks will be as under:

1. Average of three Test - 15 Marks
2. Assignment - 5 Marks
3. Attendance - 5 Marks

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Total = 25 Marks

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The distribution of attendance marks is given as follows,

76-80 % - 1 Mark

81-85 % - 2 Marks

86-90 % - 3 Marks

91-95 % - 4 Marks

96-100 % - 5 Marks

VII. Question Paper Pattern:

Question Paper Pattern for the Examinations

Time: 3 Hours **Maximum Marks: 75**

Part A: Answer all of the following (choose the best answer) (20 x 1 = 20 Marks)

Part B: Answer all questions (Either or type) (5 x 5 = 25 Marks)

Part C: Answer any three of the following questions (3 x 10 = 30 Marks)

VIII. PASSING MINIMUM

In the University Examinations, the passing minimum shall be 40 % out of 75 Marks for theory (30 marks) and 40% out of 60 marks for practical. (24 Marks).

IX. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the University Examination only on earning 75 % of attendance and only when her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

X. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination of Core Courses (main and allied subjects) and securing marks

a) 75 % and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
b) 60% and above but below 75 % shall be declared to have passed the examinations in first class without Distinction.
c) 50%and above but below 60% shall be declared to have passed the examinations in second class.
d) All the remaining successful candidates shall be declared to have passed the examinations in third class.
e) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of three consecutive academic years from the year of admission only will be eligible for University rank.

XI. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2017-2018 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2017- 2018 and thereafter.

XII.COURSE PATTERN

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN

(AUTONOMOUS)

SYLLABUS FRAME WORK 2017 – 2018 Onwards

Subjects	Inst. Hour/Week	Credit	Exam hours	Internal	External	Total Marks	Subjects	Inst. Hour/Week	Credit	Exam hours	Internal	External	Total Marks
YEAR I													
Semester I							**Semester II**						
Language I	6	3	3	25	75	100	Language II	6	3	3	25	75	100
English I	6	3	3	25	75	100	English II	6	3	3	25	75	100
Core I	5	5	3	25	75	100	Core II	5	5	3	25	75	100
Core I Practical	3	0	3	40	60	100	Core I Practical	3	3	3	40	60	100
Allied I	5	3	3	25	75	100	Allied II	5	3	3	25	75	100
Allied I Practical	3	0	3	40	60	100	Allied I Practical	3	4	3	40	60	100
Valued Added Course	2	2	3	25	75	100	Valued Added Course	2	2	3	25	75	100
Total	**30**	**16**	**21**	**205**	**495**	**700**	**Total**	**30**	**23**	**21**	**205**	**495**	**700**
I Y EAR TOTAL									**39**	**42**	**410**	**990**	**1400**
YEAR II													
Semester III							**Semester IV**						
Language III	6	3	3	25	75	100	Language IV	6	3	3	25	75	100
English III	6	3	3	25	75	100	English IV	6	3	3	25	75	100
Core III	4	5	3	25	75	100	Core IV	4	5	3	25	75	100
Core II Practical	3	0	3	40	60	100	Core II Practical	3	3	3	40	60	100
Allied III	4	3	3	25	75	100	Allied IV	4	3	3	25	75	100
Allied II Practical	3	0	3	40	60	100	Allied II Practical	3	3	3	40	60	100
SBEC I	2	2	3	25	75	100	SBEC II	2	2	3	25	75	100
NMEC I	2	3	3	25	75	100	NMEC II	2	3	3	25	75	100
Total	**30**	**19**	**24**	**230**	**570**	**800**	**Total**	**30**	**25**	**24**	**230**	**570**	**800**

II YEAR TOTAL								83	90	870	213	3000
YEAR III												
Semester V							**Semester VI**					
Core V	5	5	3	25	75	100	Core VIII	5	5	3	25	75	100
Core VI	5	5	3	25	75	100	Core IX	5	5	3	25	75	100
Core III Practical	3	0	3	40	60	100	Core III Practical	3	4	3	40	60	100
Core IV Practical	3	0	3	40	60	100	Core IV Practical	3	4	3	40	60	100
Core VII	5	5	3	25	75	100	Core X	5	5	3	25	75	100
Elective I	5	5	3	25	75	100	Elective II	5	5	3	25	75	100
SBEC III	2	2	3	25	75	100	SBEC V	2	2	3	25	75	100
SBEC IV	2	2	3	25	75	100	SBEC VI	2	2	3	25	75	100
							Extension work	0	1	0	0	0	100
Total	**30**	**24**	**24**	**230**	**570**	**800**	**Total**	**30**	**33**	**24**	**230**	**570**	**900**
TOTAL CREDIT FOR THE COURSE									**140**	**138**	**1330**	**3270**	**4700**

Distribution of Duration and Credit under Different Papers

Part	Paper	Hours/Week	Weeks/Semester	Hour/Paper	No. of Papers	Credit/Paper	Total Hours	Total credit
I	**Language**	4	15	60	4	3	240	12
II	**English**	4	15	60	4	3	240	12
III	**Core paper**	5	15	75	9	5	675	45
III	**Core practical**	3	15	45	4	3/4	180	14
III	**Allied**	5	15	75	4	3	300	12
III	**Allied practical**	6	15	90	2	3	180	6
IV	**Value Education**	4	15	60	2	2/4	120	6
IV	**SBEC**	2	15	30	6	2	180	12
III	**Elective**	3	15	60	2	5/4	120	14
IV	**NMEC**	2	15	30	2	3	60	6

IV	**Extension work**	1	15	15	1	1	15	1
TOTAL								**140**

LIST OF CORE PAPERS:

S.No	Course code	Course title
1.	17U1PHC01	Properties of Matter and Acoustics
2.	17U2PHC02	Heat and Thermodynamics
3.	17U3PHC03	Optics
4.	17U4PHC04	Mechanics
5.	17U5PHC05	Electricity and Magnetism
6.	17U5PHC06	Basic Electronics
7.	17U5PHC07	Solid State Physics
8.	17U6PHC08	Atomic Physics
9.	17U6PHC08	Nuclear Physics

XIII. LIST OF ELECTIVES

S.No	Course code	Course title
1.	17U5PHE01	Quantum Mechanics and Relativity
2.	17U6PHE02	Electronics and Communication
3.	17U6PHE03	Numerical Methods
4.	17U6PHE04	Nanoscience
5.	17U6PHE05	Astrophysics
6.	17U6PHE06	Mathematical Physics

LIST OF SKILL BASED ELECTIVES

S.No	Course code	Course title
1.	17U3PHS01	Laser Technology
2.	17U4PHS02	Energy Physics
3.	17U5PHS03	Digital Electronics
4.	17U5PHS04	Biomedical Instrumentation
5.	17U6PHS05	Microprocessor and its Application
6.	17U6PHS06	Electrical Appliances

XV. NON MAJOR ELECTIVE COURSE

S.No	Code	Course Title
1	17U3PHN01	Essentials of Electricity
2	17U4PHN02	Physics in Everyday Life

XVI. ALLIED PHYSICS

S.No	Course Code	Course Title
1	17U1PHA01	Allied Physics – I
2	17U2PHA02	Allied Physics - II

Credit: 5

Max. Hours: 60

ELECTRICITY AND MAGNETISM

Paper Code: 17U5PHC05

Subject Description: This paper presents the basic principle of charged body, when they are in rest and also under motion.

Goal: To enable the students in order to learn the basic principles theory and concepts of Electricity.

Objective:

- To gain knowledge about the principle and working of electrical circuits.
- Acquire basic knowledge about handling electrical circuits.
- Know about types of electricity.

Unit - I: Electrostatics 12

Introduction - Electric field and Electric intensity – Force between a point charge and linear charge distribution - Electrostatic potential - Potential and intensity at a point due to a dipole - Electric potential at a point due to an electric quadrupole and a charged sphere - Electric potential energy - Energy of a system of charges-Gauss theorem - Applications of gauss theorem - Coulomb's law-Mechanical force experienced by unit area of a charged surface - Energy stored per unit volume in an electric field – Capacitor - Capacitance of a spherical and cylindrical capacitor - energy of a charged capacitor - loss of energy due to sharing of charges.

Unit - II: Magnetic Effect of Electric Current 12

Faraday's law of electromagnetic induction - Lenz law - Fleming's right hand rule - Oersted's experiment-Laplace's law or Ampere's law - Magnetic field at the centre of a circular coil carrying current-Magnetic field at a point due to a straight conductor carrying current - Magnetic field at a point on the axis of a circular coil carrying current - Magnetic field at a point on the axis of a Solenoid - Force experienced by a conductor carrying current placed in a magnetic field of Uniform Intensity - Force between two conductors carrying current - Self

induction - Mutual Induction - Ballistic galvanometer - Damping correction - uses.

Unit - III: Heating Effectn of Electric Current 12

Introduction – Heat developed in a conductor carrying current – Callendar and Barnes Continues flow method - Temperature of a conductor carrying electric current - Applications of heating effect of electric current - Measurement of Electric power.

Thermoelectricity - Laws of thermoemf-intermediate metals, intermediate tempetarure - S.G. Starling method for Peltier and Thomson effect - Thermodynamics of thermocouple - Determination of π and σ - Thermoelectric diagrams and their uses.

Unit - IV: Alternating Current Circuits 12

AC- measurement of AC - Power factor – RMS, Average value of current and emf - LR, LC and LCR Circuits (Series and Parallel) - Growth and decay - Power factor in LR and CR circuits - AC and DC motors - Types of windings –Series, Parallel and Compound Windings - Transformers - Three phase, delta and star connections – Choke coil – Tesla coil- Skin effect.

Unit - V: Electrical Measurements 12

Definitions - Practivcal units - Laws of resistance - Current density - Kirchaff' laws - Whestone Bridge - Sensitiveness of a Wheatstone's Bridge - Carey-Foster's Bridge - Determination of temperature coefficient - Kelvin's Double Bridge – Potentiometer - determination of internal resistance of a cell - Comparison of EMF's of Two cells - Measurement of thermoemf - Measurement of potential difference and current – Calibration of Voltmeter and Ammeter (High and low range).

Books for Study:

1. Electricity and Magnetism – R.Murugesan, S. Chand, (2008).
2. Electricity and Magnetism - Brijlal and Subramaniam, S.Chand& Co New Delhi, (2003).
3. Electricity and Magnetism, Brijlal and Subramaniam, S. Chand & Co, New Delhi (2016).

Books for Reference:

1. Fudamentals of Magnetism and Electricity - D.N.VasudevaS.Chand, (2002).

2. Electricity and Magnetism - Nagaratanam and Lakshminarayanan, 3rd revised edition, The National Pub. Co. (1994).
3. Electricity and Magnetism - K.K.Tewari, S.Chand, (2009).
4. Electricity and Magnestsim – D C Tayal, 2nd revised edition, Himalaya Pub House, (1990).

Credit: 5

Max. Hours: 60

BASIC ELECTRONICS

Paper Code: 17U5PHC06

Subject Description: This paper presents the fundamentals of electronics and its theory which will be used forstudies solving problems during research work.

Goal: To enable the students to acquire the knowledge of electronics and to apply the principles for the situation of different physical problems.

Objectives: To acquire knowledge and apply it to

- Various electronics instruments.
- To apply the development of the electronic instruments.
- To motivate the students to apply the principles of electronics in their day – to – day life.
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Unit - I: Band Theory of Solids 10

Semiconductors - Energy band description of semiconductors- Intrinsic semiconductor - Extrinsic Semiconductor – n-type semiconductor - p-type semiconductor - Charge on n-type and p-type semiconductors - Majority and minority carriers – pn junction - Volt-ampere characteristics of pn junction - Zener diode - LED Photo diode - Tunnel diode.

Unit - II: Transistor 12

Transistor - Basic configurations - CB,CE and CC mode - Transistor action - Relation between α, β and γ - DC load line - DC bias and stabilization -AC load line, transistor biasing -Fixed bias - Voltage divider bias – Transistor as a two part network - h parameter.

Unit - III: Amplifiers and Oscillators 14

Amplifiers:

Amplifiers – Definition of gain, Frequency response, desibel and band width - Classification of amplifiers - Single stage and Multi stage RC couples CE amplifier - Class A,B,C - Power amplifiers - Feedback amplifier - General theory of feedback - Principles of negative voltage feedback – Advantages - Emitter follower.

Oscillators:

Oscillators **-** Criteria for oscillation - Construction and operation of Hartley Oscillator - Colpitt's Oscillator - Wien's Bridge Oscillator - Phase Shift Oscillator - Piezo-Electric Oscillator.

Unit - IV: Semiconductor Devices **14**

Construction, working, characteristics, parameters and applications of FET – MOSFET - Comparison between FET and Transistor – Photodiode - LED - Tunnel diode – Photo transistor - UJT - UJT relaxation oscillator – SCR - SCR as a switch.

Unit - V: Operational Amplifiers **10**

Op amp - Pin configuration - Characteristics of Op amp - Virtual ground - Off-set voltage - Inverting amplifier - Non- inverting amplifier - Differential amplifier - Common mode rejection ratio – Application - op-amp as Adder-Subtractor – Integrator – Differentiator – Comparotor.

Multivirators:

IC 741 Astable, Monostable and Bistablemultivibrators.

Books for Study:

1. V K Mehta, Principles of Electronics, S.Chand and Company Ltd., (2012).
2. B.L. Theraja, Basic Electronics (Solid state), S. Chand & Co., (2006).
3. R S Sedha, A text book of Applied Electronics, S.Chand& Company Ltd., (2002).

Books for References:

1. Hand book of Electronics by Gupta Kumar, Published by Pragati Prakashan, (2010).
2. D. Chattopadhyay et al., Foundations of Electronics 2nd edition, Wiley Eastern Ltd, New Delhi, (1988).
3. Dennis Le Croissette, Transistors, Prentice-Hall of India New Delhi, (1988).
4. Gupta & Kumar, Hand book of Electronics, PragatiPrakhasan, Meerut, (2012).

Credit: 5

Max. Hours: 60

SOLID STATE PHYSICS

Paper Code: 17U5PHC07

Subject Description: This paper presents the fundamentals of solids and its bond theory which will be used forstudying solids and how they are formed.

Objectives: To acquire knowledge of

- To know the formation and structure of different solid materials.
- To motivate the students in order to apply the principles of Solid State Physics in their research studies.

Unit - I: Crystal Structure **14**

Crystalline and Amorphous solids - Crystal structure: basis and crystal structure - Primitive lattice cell and unit cell - Bravais lattices in two dimensions and in three dimensions – Lattice planes and Miller indices - interplanar distance - spacing between planes in SC, FCC and BCC - Atomic packing - Atomic radius-lattice constant and density - Crystal structures (SC, HCP, FCC, BCC) - other cubic structures Diamond, Sodium chloride and Cesium chloride.

Unit - II: Crystallography and Crystal Imperfections **12**

X-rays: Bragg's law - Laue method - Rotating crystal method - Powder photograph method.

Bonding in Solids: (Qualitative Treatment) Ionic-Covalent - Metallic-Molecular bonds.

Crystal Defects: (Qualitative Study): Frenkel defect - Schottky defect - Edge dislocation - Screw dislocation.

Unit - III: Magnetic Properties **12**

Different types of magnetic materials - classical theory of diamagnetism (Langevin's theory) - Langevin's theory of paramagnetism - Weiss theory of paramagnetism - quantum theory of ferromagnetism - anti ferromagnetism - ferrites-general properties of superconductivity - Meissner effect - BCS theory - entropy and heat capacity - Energy gap - Type I and II superconductors.

Unit - IV: Dielectrics **12**

Definition of dielectrics - Different types of electric polarization - Frequency and temperature effects on polarization - Dielectric loss - Clausius - Mosotti relation - Determination of dielectric constant - Dielectric breakdown - Properties of different types of insulating materials.

Unit - V: Advanced Materials **10**

Polymers – Ceramics - super strong materials - cermets high temperature materials -thermoelectric materials – electrets - nuclear engineering materials - plastics metallic glasses -optical materials - fiber optic materials & uses.

Books for Study:

1. Solid State Physics by Gupta, Kumar, Nath& Co., (2013).
2. Modern Physics R. Murugeshan and KiruthigaSivaprasath, S. Chand & Co, New Delhi, (2016).
2. Material Science - M. Arumugam, Anuradha Agencies, (2004).
4. Solid State Physics, S. O. Pillai, New Age International (P) Limited, (2006).

Books for Reference:

1. Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons, 8th Edition, (2004).
2. Materials Science and Engineering, V. Raghavan, Prentice Hall (India) Ltd., (2004).
3. Introduction to Solids - Leonid V. Azaroff, Tata Mc-Graw Hill, (2004).
4. Solid State Physics - A.J. Deckker,Macmillan India, (2004).

Credit: 5

Max. Hours: 60

QUANTUM MECHANICS AND RELATIVITY

Paper code: 17U5PHE01

Subject Description: This paper presents the fundamentals of wave mechanics, Schrödinger's wave equation and its applications.

Goal: To enable the students to acquire the problem solving ability and to apply the Schrödinger's wave equation for the situation of different physical problems.

Objectives: To acquire knowledge and apply it to

- Various physical problems.
- To develop the problem solving ability.
- To motivate the students to apply Schrödinger's equation or solving problems in wave mechanics, nuclear physics etc.,

Unit - I: Wave Nature of Matter **10**

Mechanics - Comparison of Classical and Quantum ideas - Dual Nature of Matter - Expression for de-Broglie wavelength – de Broglie concept of stationary orbits - G.P Thomson experiment - Expression for group velocity - Group Velocity for de Broglie waves - Relation between wave velocity and group velocity - Wave packet.

Unit - II: Wave Mechanics – I **12**

Heisenberg's Uncertainty Principle - physical significance of Heisenberg's Uncertainty relation - Illustration of Uncertainty principle - Heisenberg's gamma ray microscope - Diffraction of a beam of electrons by a slit - Operators in quantum mechanics - Operators for Momentum, K.E, Total energy - Linear operator - Adjoint operators – Commutators - Commutation relation between position and momentum - Commutation relation between Spin and Angular momentum - Ladder operators L_+, L_-.

Unit - III: Wave Mechanics – II **14**

Wave function for a free particle - physical interpretation of the wave function - equation of motion of matter wave - Schroedinger'equation (time independent, time dependent and for free particle) - orthogonal, normalized and orthonormal wave function - expectation values of dynamical quantities -

probability current density - Ehrenfest's theorem - Helium atom - Eigen value and Eigen function equation.

Unit - IV: Applications of Wave Mechanics 12

Application of Schrodinger's equation to one dimensional problems - free particle - finite square potential well - particle in a rectangular potential step - reflection and transmission co-efficient of rectangular potential barrier - application of a barrier penetration - α decay-linear harmonic oscillator - Rigid rotator - Hydrogen atom.

Unit - V: Relativity 12

Special theory of relativity - Postulates of special theory of relativity - length contraction - time dilation - reference systems - inertial and non-inertial frames - Galilean transformation equations - Lorentz transformation equations - the Ether hypothesis - the Michelson - Morley experiment-– variation of mass with velocity - Mass-Energy relation- Elementary ideas of general theory of relativity.

Books for Study:

1. Modern Physics, R. Murugesan, S.Chand& Co., New Delhi, (2005).
2. Modern Physics, R. Murugeshan and KiruthigaSivaprasath, S. Chand & Co, New Delhi, (2016).
3. V.K. Thangappan, Quantum mechanics, New Age International, (1993).
4. G. Aruldass, Quantum Mechanics, Prentice–Hall of India Pvt. Limited, (2002).
5. Relativity and Quantum Mechanics, P.K. Palanisamy, Scitech Publications (India) Pvt Ltd, Kumbakonam, (2007).

Books for Reference:

1. A text book of quantum mechanics, P.M Matheews&K.Venkatesan, Published by Tata McGraw Hill, New Delhi, (1989).
2. Quantum Mechanics, Satya Prakash, Swati Saluja, Published by KedarNath Ram Nath, (2019).
3. Quantum Mechanics, V. Devanathan, Narosa Pub. House, Chennai, (2005).
4. Quantum Mechanics, S. P. Singh, M. K. Bagde, S. Chand & Co, New Delhi, (2002).
5. AjoyGhatak& S. Loganathan, Quantum Mechanics, Springer, (2004).

Credit: 2

Max. Hours: 24

DIGITAL ELECTRONICS

Paper code: 17U5PHS03

Subject Description: This paper presents basic principles of digital electronics. This paper gives deep knowledge to the students regarding number system, arithmetic building blocks, memories and data processing circuits.

Goal: To enable the students to learn the basic principles, theory and concepts of number system memories and data processing circuits counters

Objectives

To give description for the students in order to

- Learn the logic circuits
- Acquire basic knowledge of binary addition
- Understand the action and application of counters
- Get a deep knowledge of various memories used in computer circuits

Unit – I: Number System **5**

Binary number system - Conversion - binary to decimal - decimal to binary - octal numbers - hexadecimal numbers, ASCII Code.

Unit – II: Logic Gates **5**

The basic Gates (OR, AND, NOT), Universal logic gates - NAND/NOR- DEMORGAN'S Theorems - XOR and XNOR Gates - Half adder - Full adder - Half subtractor - Full subtractor using logic gates.

Unit – III: Combination of Logic Circuits **5**

Boolean algebra - Solving boolean equations - Karnaugh map method for simplifying expressions - Product of sums (POS) - Sum of products (SOP), NAND - NAND, NOR - NOR Gates.

Unit – IV: Registers **4**

Shift registers - Series and Parallel loading – Counters - 4 bit binary ripple counter - BCD counter - Ring counter.

Unit – V: Timing Circuits and Flip-Flops **5**

555 Timer – Astable, Monostable and Bistable - Multivibrators - R-S Flip-Flop, D Flip-Flop, J-K Flip-Flop, Master-Slave Flip-Flop.

Books for Study:

1. Digital Principles and Applications, Donald P. Leach and Albert P. Malvino, 5th (1994).
2. Digital Electronics, D. A. Godse and A.P. Godse, Technical Publlsher, Pune, (2008).
3. Digital Electronics, Virendra Kumar, New Age International Publishers, (2007).
4. Digital Electronics, Avinashi Kapoor and L. K. Maheswari, Principles and Practice, Macmillan India Limited, (2004).
5. V. Vijayendran, Digital Fundamentals. S. Viswanathan Printers and Publishers Pvt. Ltd., (2009).

Books for References:

1. Integrated circuits, K.R Botkar, Khanna Publications, (1987).
2. Integrated Electronics, Analog and Digital Circuits and Systems, J. Millman and C. C. Halkias, Tata McGraw - Hill Education, New Delhi, (1991).
3. Morris Mano, Digital Logic and Computer Design, Pearson Education (2004).

Credit: 2

Max. Hours: 24

BIO - MEDICAL INSTRUMENTATION

Paper code: 17U5PHS04

Unit – I: Biopotential Electrodes **5**

Design of medical instruments - Components of the bio-medical instrument System - electrodes: Micro electrodes-depth and needle electrodes - surface electrodes.

Unit – II: Biopotential Recorders **5**

Electrocardiography (ECG) - Electromyography (EMG) - Electroretinography (ERG) - Electrooculography (EOG).

Unit – III: Physiological Aid Devices **4**

Pacemakers - External and Internal pacemakers - Different modes of operation - Artificial heart valves - Anesthesia machine – Blood Pressure measurement.

Unit - IV: Specialised Medical Equipment **4**

Blood cell counter - Electron microscope - X-Ray machine – Image intenisifiers – Angiography.

Unit – V: Safety Instrumentation **6**

Radio Monitoring instruments - Microshock and Macroshock – Endoscopes - Computer Tomography - Ultrasonic image instrumentation-MRI instrumentation.

Books for Study:

1. Bio-Medical Instrumentation, Dr. M. Arumugam, Anuradha Agencies, (2002).
2. Bio Instrumentation, John G. Webster, editor John Wiley & Sons, Inc, (2004).
3. Biological Instrumentation and methodology, P.K. Bajpai, S Chand & Co, (2010).
4. Medical Instrumentation: Application and Design, John G. Webster, John Wiley & Sons Inc, Fourth Edition, (2009).

Books for Reference:

1. Bio-medical instrumentation, Dr. M. Arumugam, Anuradha Agencies, (2009).
2. Handbook of Biomedical Instrumentation, Dr R.S. Khandpur: Blood Cell Counters, Chapter (McGraw-Hill Professional, Third Edition, (2014).
3. Handbook of Biomedical Instrumentation, Dr R.S. Khandpur, McGraw Hill Education (India) Private Limited, Kindle Edition, (2014).

Credit: 5

Max. Hours: 60

ATOMIC PHYSICS

Paper code: 17U6PHC08

Subject Description

Analysis of positive rays, Isotopes, atomic structures, models in various aspects, spectral lines subjected to magnetic fields, light inducing electron emission, X –rays and their diffraction.

Goals and Objectives

- To provide a detailed study of atom, nucleus and their properties.
- To learn the matter-matter and light-matter interactions and therefore understanding the working of atomic power stations.
- To learn the behavior of atom in various states.

Unit – I: Positive Ray Analysis **10**

Discovery-Properties of positive rays– e/m of positive rays - Thomson's Parabola method – Aston's mass spectrograph - Bain's bridge's mass spectrograph – Critical potential – Ionization potential – Excitation potential-Methods of excitation - Determination of Critical Potential – Franck and Hertz's experiment.

Unit – II: Photo Electricity **12**

Photoelectric emission – Laws – Lenard's experiment – Richardson & Compton experiment - Einstein's photoelectric equation – Experimental verification of Einstein's Photoelectric equation by Millikan's experiment – Photoelectric cells and applications.

Unit – III: Vector Atom Model **10**

Introduction-Sommerfield atom model-Rutherford atom model-Bohr atom model-Various quantum numbers, L-S and JJ Coupling – Pauli's exclusion principle – Electronic configuration of elements and periodic classification – Magnetic dipole moment of electron due to orbital and spin motion – Bohr magnetron – Stern and Gerlach experiment.

Unit – IV: Fine Structure of Spectral Lines **15**

Spectral terms and notations – Selection rules – intensity rule and interval rule – Fine Structure of sodium D lines –Fine structure in Alkali spectra –

Spectrum of Helium – Zeeman effect – Larmour's theorem – Debye's quantum mechanical explanation of the normal Zeeman effect – Anamolous Zeeman effect – theoretical explanation, Lande's 'g' factor and explanation of splitting of D1 and D2 lines of sodium – Paschen back effect and Stark effect.

Unit – V: X- Rays **13**

Introduction-Production of X-Rays – Absorption of X-Rays - Bragg's Law – Bragg's X-ray spectrometer – Origin and analysis of continuous X-ray spectrum and characteristic X-ray spectrum –Mosley's law and its importance – Compton effect – Derivation of expression for change in wavelength - its experimental verification.

Books for Study:

1. Modern Physics, R. Murugesan, S.Chand& Co., New Delhi, (2005).
2. Modern Physics, R. Murugeshan and KiruthigaSivaprasath, S. Chand & Co, New Delhi, (2016).
3. Modern Physics, J.B. Rajam, S. Chand & Co, (2004).
4. Atomic and Nuclear Physics – N.Subramaniam and Brijlal.Published by S Chand & Company Pvt Ltd, (2004).

Books for References:

1. "Concept of Modern Physics: ArthusBeiser, McGraw Hill Ed.V, (1999).
2. Atomic and Nuclear Physics by H. Semat and J.R. Albright, Chapman and Hall, (2003).
2. Atomic and Nuclear Physics by S.N. Ghoshal, S. Chand & Co, (2004).

Credit: 5

Max. Hours: 60

NUCLEARPHYSICS

Paper Code: 17U6PHC09

Subject Description: This paper presents the fundamentals of formation of nucleus, composition of nucleus with their energy.

Goal: To enable the students to acquire knowledge of the nuclear energy, fission and fusion with particle accelerator.

Objectives: To acquire knowledge and apply it to

- Study the structure of nucleus.
- Know the formation of nucleus and their binding energy.
- To motivate the students to analyze the energy released by the nucleus during the fission and fusion process and therefore understanding the working of Nuclear power stations.

Unit – I: Nuclear Properties **10**

Classification and Properties of nuclei - Bindingenergy - Nuclearstability - Massparabola - Nuclear isomerism - Nuclearforces - Magneticdipolemomentofnuclei.

Nuclear models: Liquid drop model - Shell model.

Unit – II: Nuclear Radiations **13**

Detectors: Basicprinciplesofparticledetectors-Ionization chamber- G.M counter- Characteristics - Proportional counter - Wilson cloud chamber- Bubble chamber - Scintillation counters - Photomultipliers.

Accelerators: Synchrocyclotron–Synchrotron– Electron and proton synchrotron.

Unit – III: Natural Radioactivity **10**

Alphadecay - Geiger-Nuttallaw - Gamow'stheory - Neutrino theoryof betadecay - Half life period – Mean life – Decay constant – Relation between them – Fajan's Soddy displacement law - Magnetic Spectrograph - Gammaemission - Selectionrules -Interactionofchargedparticles with matter- Internal conversion - Law of radioactive disintegration - Law of successive disintegration – Carbon dating.

Unit – IV:NuclearReactions **15**

Nuclear reactions – Types - Nuclear energy equations - Calculation of Q – value - Nuclear artificial transmutations - Transuranic elements.

Nuclear Fission and Fusion

Bohr - Wheeler'stheory – Fission Process - Chain reactions - Nuclear Reactor-Principle - Pressurized water reactor - Boiling water reactor - Fusion Reactor. Atom bomb - Fusion process– Hydrogen bomb - Carbon-nitrogen cycle, proton-proton cycle -Thermo nuclear reactions - Stellar energy.

Unit – V: ElementaryParticles **12**

Classifications - Fundamental interactions - Quantum Numbers – Baryon – Lepton – Strangeness - Hyper charge - Iso spin - Quark Model - Conservation law – Parity – Charge - CPT Theorem.

BooksforStudy:

1. Modern Physics By R.Murugasen, S.Chand& Co, 8th Edition, (2001).
2. V.Devanathan,NuclearPhysics, NarosaPublishing House(2006).
3. Nuclear physics by D. C. Tayal, Himalaya publishing house,Fifth edition, (2018).
4. NuclearPhysics:AnIntroduction, S. B.Patel,Wiley-Eastern,NewDelhi, (1991).
5. Concepts of Nuclear Physics, Bernald L. Cohen, TMH, (1971).

Books for Reference:

1. Conceptsof NuclearPhysics,B.L.Cohen, Tata McGraw Hill,New Delhi, (1988).
2. Nuclear Physics: Experimental andTheoreticalH. S. Hans, New AgeInternationalPublishers,NewDelhi, (2001).
3. ElementaryParticlePhysics:AnIntroduction, D.C.ChengandG.K.O'Neill,Addison-Wesley, (1979).
4. IntroductiontoElementaryParticles, D.Griffiths,WileyInternational, New York, (1987).
5. Basic Nuclear Physics and Cosmic rays, B.N. Srivatsava, PragtiPrakasham.

Credit: 5

Max. Hours: 60

ELECTRONICS AND COMMUNICATION

Paper code: 17U6PHE02

Unit – I: Modulation and Demodulation 10

Modulation– Necessity for modulation – Principles & representation of AM, FM and PM- Modulation factor – Percentage of modulation – Advantage and disadvantage– Demodulation – Essentials of demodulation – AM detector – AGC.

Unit – II: AM Transmitter and Receiver Fundamentals 13

Low level modulation – High level modulation – TRF receiver – Superheterodyne principle – Superheterodyne receiver – Double conversion receiver – Image frequency rejection – S/N ratio – Sensitivity – Selectivity – RF amplifier – Mixer – Local oscillator – IF amplifier.

Unit – III: Communication Elements 11

Variable frequency oscillator – Reactance modulator- PLL – Frequency multiplier – Power output amplifier – FM limiter- The discriminator – The ratio detector –AFC - Balanced modulator principle – Phase modulator – Frequency divider.

Unit – IV: Antennas and Propagation 12

The half wave dipole – Its Characteristics -Impedance and radiation pattern – The folded dipole – Characteristic impedance and radiation pattern – Parabolic reflector antenna - Parasitic array antenna- Features and applications Transmission line – Cable types – Co- axial and wire - pair – Maximum power transfer.

Unit – V: Communication Types 12

Communication – Components of a communication system – Wireless communication system Satellite communication fundamentals – Up Link – Down Link – RADAR- principle - transmitting systems – Fibre optic communication fundamentals – Advantages and disadvantages.

Books for Study:

1. Electronic Communication, Modulation and Transmission - Robert J. Schoenbeck, Universal Book Stall, Delhi, (1992).
2. Electronic Communication Systems –George Kennedy, Tata McGraw Hill 4th edition, (2006).
3. Hand book of Electronics - Gupta & Kumar, PragatiPrakhasan, (2005).

Books for References:

1. Principles of Communication Engineering – Anokh Singh, S.Chand&Co. Delhi, (1999).
2. Communication Electronics – N.D. Despande and others – Tat McGraw Hill, (2004).
3. Electronic Communication, Dennis Roddy and John Coolen, Prentice Hall Career and Technology, 4th edition, (1995).

Credit: 5

Max. Hours: 60

NUMERICAL METHODS

Paper code: 17U6PHE03

Subject Description: This paper presents the mathematical aspects to solve the physical problems.

Goal & Objectives: To acquire knowledge about

- Mathematical equations which can be applied in physical problems.
- To motivate the problem solving ability of students.

Unit – I: Curve Fitting **10**

Introduction - Normal equations - Method of averages – Least square fitting – Straight line fit – nonlinear curve fit.

Unit – II: Numerical Solution of Algebraic and Transcendental Equations 12

The iteration method – Regular Falsi Method - Newton – Raphson method – Euler's Method - Modified Euler'method - Rungekutta method for Second and third orders).

Unit – III: Simultaneous Linear Equations **12**

Solution of simultaneous linear equation - Gauss elimination method – Jordan method - Jacobi method modification – Gauss–Seidel method of iteration – Matrix method of inversion-eigen value and eigen vectors of a matrix.

Unit – IV: Interpolation **12**

Linear interpolation – Lagrange interpolation method – Newton forward and backward interpolation formula – Newton's interpolation formula for unequal intervals.

Unit – V: Numerical Integration **12**

Newton's forward and backward difference formula to compute derivatives – Numerical integration: the trapezoidal rule - Simpson's 1/3 rule – Simpson's 3/8 rule- Extended Simpson's rule – Gaussian quadrature formula.

Books for Study:

1. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, New Delhi, 3rd Edition (2003).
2. M.K. Jain, S.RA.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, (2003).
3. S.D. Conte, C. Boor, Elementary Numerical Analysis, McGraw –Hill,

Singapore, 3rd edition (1981).

Books for Reference:

1. Numerical Methods A.Singaravelu – Meenakshi Agency, Chennai, (2001).
2. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering Prentice-Hall of India, New Delhi, (1998).

Credit: 2

Max. Hours: 24

ELECTRICAL APPLIANCES

Paper code: 17U6PHS06

Subject Description: This paper presents the fundamental principle and working of electrical appliances

Goal & Objectives: To acquire knowledge about

- Handling household appliances.
- Know about the principle behind the working of appliances used in daily life.

Unit – I: Heating **5**

Electrical heating - modes of transfer of heat - methods of electric heating - resistance heating - induction heating - high frequency eddy current heating - dielectric heating.

Unit – II: Welding **5**

Resistance welding - Electric arc welding - DC and AC welding equipment - Energy storage welding - Occupational hazards due to chemical reactions - Industrial heating and welding.

Unit – III: Electricity **4**

Electrification by friction - Two kinds of electricity - Principle and types of Capacitor and resistance.

Unit – IV: Domestic Appliances I **5**

Theory and principle of operation of fans - Wet grinder - Mixer grinder - Refrigerator - Air conditioner and Air cooler- difference between them.

Unit – V: Domestic Appliances II **5**

Theory and principle of operation of DVD player - Washing machine - Induction stove- Iron box - Microwave oven.

Books for Study:

1. A text book in Electric power, P.L. Soni, P.V. Gupta & V.S. Bhatnagar, 2nd Edition (1995).
2. Utilisation of Electrical Energy, E.O. Taylor, Orient Longman, Orient Blackswan, (1971).
3. A Course in Electrical Power, J.B. Gupta, M/s. B.D. Jaataris& Sons, S. K. Kataria& Sons, (2009).
4. A text book in Electrical Technology, B.L. Teraja, S. Chand & Co., New Delhi Vol-1, (2010).

Books for Reference:

1. Electricity & Magnetism, R.Murugesan, S. Chand & Co., New Delhi, (2007).
2. Performance and design of A.C. Machines, M.G. Say, ELBS Third edition, (1980).
3. Theory of alternating current Machinery, Alexander Langsdort, 2nd edition, (2001).

Credit: 2

Max. Hours: 24

MICROPROCESSOR AND ITS APPLICATIONS

Paper code: 17U6PHS05

Subject Description: This subject deals with the functions and principles of Micro Processors.

Goal: To learn about function of micro processors and operate them by learning with different features.

Objectives: On successful completion of this subject the student should have

- The basic knowledge of computers and its processors.
- To operate the processors with basic idea.

Unit – I: Introduction **3**

Microprocessor - Evolution of microprocessor - Organization of microcomputer - Microprocessor programming - Assembly language programming.

Unit – II: Architecture **4**

Intel 8085 Microprocessor Architecture - ALU - Timing and Control unit - Data and Address bus - Pin Configuration - PSW.

Unit - III: Instruction Set **5**

Intel 8085 Instructions - Opcode and Operands - Instruction word size - Instruction cycle - Timing diagram - Addressing modes.

Unit - IV: Memories **5**

Counter - Stack – Subroutines - Stack pointer - Internal data bus – Mnemonics - Communication with microprocessor.

Unit – V: Simple Programs **7**

Programs for 8-bit (i) Addition (ii) Subtraction (iii) Multiplication (iv) Division (v) Greatest and Smallest number in an array of 8 - bit unsigned numbers (vi) Arranging numbers in Ascending and Descending order (vii) Sum of N-numbers.

Books for Study:

1. P.Mathur, Introduction to Microprocessor, TMH, 3rd edition, (2006).
2. M.Gilmore, Microprocessor Principles and Application, TMH, 2nd edition, (1995).
3. B.Ram, Fundamentals of Microprocessor and Microcomputers, Dhanpat Rai Publications, (2005).

Books for Reference:

1. Ramesh Gaonkar, Microprocessor Architecture Programming and application, Prentice Hall PTR, 5th edition, (2002).
2. A.K.Roy and K.M. Bunchandi, Advanced Microprocessor and peripherals, TMH, 2nd edition, (2009).

Credit: 4

Max. Hours: 36PAPER

CODE: 17U6PHP03

CORE PRACTICAL – III

Any 12 Experiments

1. Cantilever – Young's modulus mirror and telescope.
2. Deflectlection magnetometer – M and B_H –TAN C position.
3. Comparison of mutual inductance – BG.
4. Spectrometer – i-i' curve.
5. Spectrometer small angled prism.
6. Potentiometer – calibration of high range voltmeter.
7. Lee's disc – thermal conductivity of a good conductor.
8. Co-efficient of viscosity – under graduated Burette- Radius by Mercury pellet method.
9. FET - Characteristics.
10. UJT - Characteristics.
11. Hartley oscillator.
12. Colpitt's oscillator.
13. SCR – Characterisitics.
14. Microprocessor 8085 – Addition and Subtraction.
15. Microprocessor 8085 – Multiplication and Division.

Book for Refernces:

1. Practical Physics – C. C. Ouseph, U. J. Rao, V. Vjiayendran, 1st Edition, (2015)
2. Advanced Practical Physics, S.P Singh, and PragathiPrakasam,17th Edition, Vol – I, II.
3. P. R. Sasi Kumar, Practical Physics –, PHI, (2011).

Credit: 4

Max. Hours: 36

CORE PRACTICAL – IV

PAPER CODE: 17U6PHP04

Any 12 Experiments

1. Koenig's method –Uniform Bending.
2. Koenig's method –Non-Uniform Bending.
3. Cantilever – dynamic method.
4. Bifilar pendulum – Parallel threads.
5. Newton's rings – Refractive index of liquid.
6. Spectrometer - Dispersive power of a Grating.
7. Spectrometer – Cauchy's constant.
8. Potentiometer EMF of a thermocouple.
9. Field along the axis of coil – Vibration Magnetometer.
10. Carey foster bridge – temperature coefficient of resistance.
11. Astablemultivibrator using 555 timer.
12. Monostablemultivibrator using 555 timer.
13. Operational amplifier: intergrator and differentiator.
14. V-I characteristics of LED.
15. RS Flip-Flop using NAND and NOR gates.

Book for Refernces:

1. Practical Physics – C. C. Ouseph, U. J. Rao, V. Vjiayendran, 1st Edition, (2015).
2. Advanced Practical Physics, S.P Singh, and PragathiPrakasam,17th Edition, Vol– I, II.
3. P. R. Sasi Kumar, Practical Physics –, PHI, (2011).