

# 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

**M.Sc., PHYSICS**  
**SYLLABUS & REGULATIONS**

**FOR CANDIDATES ADMITTED FROM 2018 - 2019**  
**ONWARDS UNDER AUTONOMOUS - OBE PATTERN**

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

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## **About the College**

Vivekananda 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 Tiruchengode Namakkal 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 fulfill 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 center 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.

<b>S. No.</b>	<b>TOPICS</b>
<b>REGULATIONS</b>	
1	SCOPE OF THE COURSE
2	SALIENT FEATURES
3	OBJECTIVES OF THE COURSES
4	ELIGIBILITY FOR ADMISSION
5	DURATION OF THE COURSE
6	CONTINUOUS INTERNAL ASSESSMENT
7	QUESTION PAPER PATTERN
8	PASSING MINIMUM
9	ELIGIBILITY FOR EXAMINATION
10	CLASSIFICATION OF SUCCESSFUL CANDIDATES
11	PROCEDURE IN THE EVENT OF FAILURE
12	COMMENCEMENT OF THESE REGULATIONS
13	LIST OF ELECTIVES
14	LIST OF EXTRA DISCIPLINARY COURSES
15	COURSE PATTERN
<b>SYLLABUS FOR YEAR I (Semester I)</b>	
<b>COURSE PATTERN WITH PAPERS</b>	
1	Core I – Mathematical Physics
2	Core II – Classical and Statistical Mechanics
3	Core III – Advanced Electronics
4	Elective – I: Nanoscience
<b>SYLLABUS FOR YEAR I (Semester II)</b>	
<b>COURSE PATTERN WITH PAPERS</b>	
1	Core IV – Electromagnetic Theory
2	Core V – Quantum mechanics - I
3	Core VI - Spectroscopy
4	Elective – II: Bio Physics
5	Core Practical I – Advanced Electronics Experiments
6	Core Practical II – Advanced Physics Experiments - I
<b>SYLLABUS FOR YEAR II (Semester III)</b>	
<b>COURSE PATTERN WITH PAPERS</b>	
1	Core VII-Condensed Matter Physics
2	Core VIII – Quantum Mechanics – II
3	Core IX – Microprocessor And Microcontroller
4	EDC – Applied Polymer Chemistry
5	Human Rights

**SYLLABUS FOR YEAR II (Semester IV)****COURSE PATTERN WITH PAPERS**

1	Core X – Nuclear Particle Physics
2	Core XI – Communication Systems
3	Elective – III: Thin Film Technology
4	Core Practical – III – Microprocessor And Microcontroller Experiments
5	Core Practical – IV - Advanced Physics Experiments - II
6	Project Work

## M.Sc. (Physics)

### **I. SCOPE OF THE COURSE**

**M.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 two 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.

### **I. 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 (M.Sc. Physics) shall be required to have passed an Under Graduate degree, i.e. B.Sc., (Physics or Applied Sciences) of the Periyar University or an examination of some other University accepted by the syndicate as equivalent there to shall be permitted to be eligible.

#### V. DURATION OF THE COURSE

- ✓ The course shall extend over a period of two academic years consisting of four 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 five 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 two Tests - 10 Marks
2. Seminar - 5 Marks
3. Assignment - 5 Marks
4. Attendance - 5 Marks

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Total = 25 Marks

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 the questions (Objective Type)	(20 x 1 = 20 Marks)
Part - B Answer all the following questions (Either or Type)	(5 x 5 = 25 Marks)
Part – C Answer any three questions	(3 x 10 = 30 Marks)

## **VII. PASSING MINIMUM**

In the University Examinations, the passing minimum shall be 40 % out of 75 Marks for theory (38 marks) and 40% out of 60 marks for practical. (24 Marks).

## **VIII. 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.

## **IX. 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.

## **X. COMMENCEMENT OF THESE REGULATIONS**

These regulations shall take effect from the academic year 2018 - 2019 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2018 - 2019 and thereafter.

### LIST OF CORE PAPRES

<b>S.No</b>	<b>Code</b>	<b>Course Title</b>
1.	18P1PH01	Mathematical Physics
2.	18P1PH02	Classical and Statistical Mechanics
3.	18P1PH03	Advanced Electronics
4.	18P2PH04	Electromagnetic Theory
5.	18P2PH05	Quantum mechanics –I
6.	18P2PH06	Spectroscopy
7.	18P3PH07	Condensed matter Physics
8.	18P3PH08	Quantum mechanics –II
9.	18P3PH09	Microprocessor and Microcontroller
10.	18P4PH10	Nuclear and Particle Physics
11.	1842PH11	Communication System

### LIST OF ELECTIVES

<b>S.No</b>	<b>Code</b>	<b>Course Title</b>
12.	18P1PHE01	Nano Science
13.	18P2PHE02	Crystal Physics
14.	18P4PHE03	Thin Film Technology
15.	18P1PHE04	Bio Physics
16.	18P2PHE05	Non Linear Dynamics
17.	18P4PHE06	Sensors and Actuators

**LIST OF EXTRA DISCIPLINARY COURSE**

<b>S.No</b>	<b>Code</b>	<b>Course Title</b>
1.	18P3PHED1	Solar Energy
2.	18P3PHED2	Electronics Appliances
3.	18P3PHED3	Medical Physics

**SCHEME OF CURRICULUM – M.Sc., PHYSICS**

(For the candidates admitted during the academic year 2018 - 2019 onwards)

Sem	Subject Code	Course	Subject Title	Hrs/ week	Credit	Exam Hrs	Int. marks	Ext. marks	Tot. marks
I	18P1PH01	Core – I	Mathematical Physics	6	5	3	25	75	100
	18P1PH02	Core – II	Classical and Statistical Mechanics	6	5	3	25	75	100
	18P1PH03	Core – III	Advanced Electronics	6	4	3	25	75	100
	18P1PHE01	Elective – I	Elective – I: Nano Science	4	4	3	25	75	100
	18P2PHP01	Core Practical	Practical – I: Advanced Electronics Experiments	4	-	4	-	-	-
	18P2PHP02	Core Practical	Practical - II – Advanced Physics Experiments - I	4	-	4	-	-	-
			Total	30	18	20	100	300	400
II	18P2PH04	Core-IV	Electromagnetic Theory	6	5	3	25	75	100
	18P2PH05	Core-V	Quantum Mechanics - I	6	5	3	25	75	100
	18P2PH06	Core-VI	Spectroscopy	6	5	3	25	75	100
	18P2PHE02	Elective-II	Elective – II: Bio Physics	4	4	3	25	75	100
	18P2PHP01	Core Practical-I	Practical - I: Advanced Electronics Experiments	4	4	4	40	60	100
	18P2PHP02	Core Practical-II	Practical - II: Advanced Physics Experiments - I	4	4	4	40	60	100
			Total	30	27	20	180	420	600
III	18P3PH07	Core-VII	Condensed Matter Physics	5	5	3	25	75	100
	18P3PH08	Core-VIII	Quantum Mechanics - II	6	5	3	25	75	100
	18P3PH09	Core-IX	Microprocessor and Microcontroller	5	5	3	25	75	100
	18P3CHED1	EDC	Applied Polymer Chemistry	4	4	3	25	75	100
	18P4PHP03	Core Practical -III	Practical - III: Microprocessor Experiments	4	-	4	-	-	-
	18P4PHP04	Core Practical -IV	Practical – IV: Advanced Physics Experiments - II	4	-	4	-	-	-
	18P3HR01		Human Rights	2	2	3	25	75	100
			Total	30	21	23	125	375	500

IV	18P4PH10	Core – X	Nuclear and Particle Physics	5	5	3	25	75	100
	18P4PH11	Core - XI	Communication Systems	5	5	3	25	75	100
	18P4PHE03	Elective - III	Elective – III: Thin Film Technology	4	4	3	25	75	100
	18P4PHP03	Core Practical	Practical - III: Microprocessor Experiments	4	4	4	40	60	100
	18P4PHP04	Core Practical	Practical - IV: Advanced Physics Experiments - II	4	4	4	40	60	100
	18P4PHPR01	Core - XI	Project work	8	8	3	50	150	200
Total				30	30	20	205	410	700
<b>Overall Total (I &amp; II Year)</b>				<b>120</b>	<b>96</b>	<b>83</b>	<b>610</b>	<b>1505</b>	<b>2200</b>

#### 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	<b>Core paper</b>	6	15	90	11	5	990	54
I	<b>Core practical</b>	4	15	60	4	4	240	16
II	<b>Elective</b>	4	15	60	3	4	180	12
II	<b>EDC</b>	4	15	60	1	4	60	4
-	<b>Human Rights</b>	2	15	15	1	1	15	2
-	<b>Project Work</b>	1	15	15	1	8	15	8
<b>TOTAL CREDIT</b>								<b>96</b>

## SEMESTER - I

<b>Programme Code</b>	<b>M.Sc.,</b>	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P1PH01	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	6	<b>CORE - I: MATHEMATICAL PHYSICS</b>	<b>Semester</b>	I
			<b>Credits</b>	5

### Course Objectives

1. This course covers a broad spectrum of mathematical techniques essential to the solution of advanced problems in physics.
2. The main objective of this course is to provide the student with the repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To apply advanced mathematical and computational techniques to complex physics problems.
K2	CO2	To introduce basic concepts and skills in <i>matrix</i> algebra. In addition, We first define the dot product or inner product of <i>n-vectors</i> .
K3	CO3	To apply <i>Laplace transform</i> for analyzing continuous time signals and to understand the relation to Fourier transforms.
K4	CO4	To study gamma and beta functions of complex variable. Further, we prove some properties of gamma and beta functions of complex variables.
K5	CO5	<i>Group theory</i> is the study of symmetry. When we are dealing with an object that appears symmetric, <i>group theory</i> can help with the analysis.

### **Unit – I: Complex Analysis**

**10**

Functions of complex variable, Cauchy – Riemann condition, Differential equation, Cauchy integral theorem, Cauchy integral formulas, Taylor's Series,

Laurents's Series, Residue theorem, Evaluation of definite integrals, Contour integration.

**Unit – II: Vectors, Tensors and Matrices**

**12**

Linear vector spaces - Subspaces - Linear independants and orthogonality of vectors, Hilbert's space - Transformation of coordinates, Summation convention, Contravariant, Covariant and mixed tensors, Rank of tensor, Kronecker delta, Symmetric and Antisymmetric tensors, Contraction of tensor, Characteristic equation of a matrix, Eigen values and Eigen vectors, Cayley - Hamilton theorem, Reduction of a matrix to diagonal form, Jacobi method, Sylvester's Theorem.

**Unit – III: Fourier Transforms and Laplace Transforms**

**14**

Fourier Transform, Properties of Fourier transform, Fourier transform of derivative, Fourier's sine and cosine transform of derivative complex representation of Fourier series, Fourier's integral, different forms of Fourier integrals-Application of Fourier Transformation in Interferometer.

Laplace Transform, Properties of Laplace transform, Laplace transform of derivative function, Laplace transform of integrals, Laplace transform of periodic function, Inverse Laplace transform, Properties of inverse Laplace transform, Laplace transform of some special functions, Evaluation of integral using Inverse Laplace Transform, Applications of Laplace Transform.

**Unit – IV: Special Functions and Differential Equations**

**14**

Beta function, Symmetry property of beta function, Evaluation of beta function, Transformation of beta function, Different forms of beta function, Evaluation of gamma function, Transformation of Gamma function, Reduction of definite integrals to gamma function, Relation between Beta and Gamma functions, Dirac delta function.

Solution for Bessel, Legendre, Lagure and Hermite differential equations - Properties - Generating functions, Rodrigue's formula, Orthogonal properties, Recurrence relation.

## Unit – V: Group Theory

10

Basic Definition, Multiplication Table, Sub groups, Cosets and Classes, Direct Product groups, Point group, Space groups, Rotation groups, Symmetry elements and symmetry operations, Representation theory, Homomorphism and Isomorphism, Reducible and Irreducible representation, Schur's Lemma, The great Orthogonality theorem, Character Table -  $C_{2V}$  and  $C_{3V}$  as examples, Treatment of molecular structure.

Power point presentation, Seminar, Quiz, Assignment

### Books for Study:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House (2004).
2. Mathematical Physics, Satyaprakash, Sultan Chand and Sons (2004).
3. Mathematical Physics, P.K. Chattopadhyay, Wiley Eastern India (1990).
4. Chemical applications of group theory, F.A. Cotton, Wiley Eastern India.
5. Elements of group theory for physicist, A.W Joshi, New age international Publishers.

### ONLINE SOURCES:

1. <https://www.khanacademy.org/math/differential-equations/laplace-transform>
2. <https://www.khanacademy.org/math/linear-algebra#vectors-and-spaces>
3. <https://www.khanacademy.org/math/linear-algebra#matrix-transformations>

PSO CO	PS01	PS02	PS03	PS04	PS05
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

## SEMESTER - I

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P1PH02	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	6	<b>CORE - II: CLASSICAL AND STATISTICAL MECHANICS</b>	<b>Semester</b>	I
			<b>Credits</b>	5

### Course Objectives

1. The main goal of the course is to introduce students to classical mechanics and its applications in physics.
2. Classical & Statistical mechanics is studied rigorously using advanced mathematical and numerical techniques.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To develop fundamental concepts in mechanics more rigorously as needed for further study in physics and technology.
K2	CO2	To contribute to the development of the students thinking process through the understanding of the theory.
K3	CO3	Application of this knowledge to the solution of the practical problems.
K4	CO4	To develop fundamental concepts in Classical Statistics.
K5	CO5	To develop fundamental concepts in Quantum Statistics.

### **Unit – I: Fundamental Principles and Lagrangian Formulation 12**

Mechanics of a system of particles – Conservation laws – Constraints, Generalized coordinates - D' Alembert's principle – Lagrange's equation of motion from D'Alembert's principle– Application of Lagrange's formulation – Linear Harmonic oscillator – Simple pendulum - Hamilton's principle – Derivation of Lagrange's equation of motion from Hamilton's principle - Conservation theorems and Symmetry properties.

**Unit – II: Hamilton’s Formulation****12**

Hamilton’s Canonical equations of motion - Physical Significance of H - Hamilton’s Canonical equations from variation principle - Principle of least action - Canonical transformations - Poisson brackets - Properties - Hamilton - Jacobi method - Harmonic oscillator problem using Hamiltonian Jacobi method - Lagrange’s brackets - Properties.

**Unit – III: Rigid Body Motion****12**

Generalized coordinates for Rigid Body Motion - Euler Angles – Eulerian theorem - Angular Velocity - Angular Momentum of a rigid body – Motion of symmetrical top - Moments and Products of Inertia - Euler’s equation of motion.

**Relativistic Approach**

Lorentz transformation - Kinematic effects of Lorentz transformation - Mass energy equivalence - Lagrangian formulation of Relativistic mechanics - Hamiltonian Formulation of Relativistic mechanics.

**Unit – IV: Classical Statistics****12**

Phase Space - Ensemble - Definition of Micro Canonical - Canonical and Grand Canonical ensembles - Liouville’s theorem - Microstates and Macro states – Sterling’s formula, Entropy in statistical mechanics - Partition function - Doppler broadening of spectral lines - Principle of equipartition of energy - connection between Partition function and thermodynamically quantities.

**Unit – V: Quantum Statistics****12**

Identical particles and Symmetry requirements – Maxwell - Boltzman Statistics, Bose -Einstein Statistics and Fermi - Dirac statistics - Ideal Bose Einstein gas and its application: Black body radiation and Planck Radiation Law - Gas degeneracy – Bose - Einstein Condensation - Random walk and Brownian motion - Ideal Fermi Dirac gas: Electron gas - Thermionic emission - Pauli’s theory of Paramagnetism.

Power point presentation, Seminar, Quiz, Assignment

**Books for Study:**

1. Classical Mechanics, Gupta and Kumar, Pragati Prakashnan, Meerut, 2005.
2. Statistical Mechanics, Gupta and Kumar, Pragati Prakashnan, Meerut, 2005.
3. Statistical Mechanics, B.K. Agarwal and M. Eisner, New Age International, 2nd Edition, New Delhi, 1998.
4. Statistical Mechanics, Satya Prakash, Pragati Prakashan, Meerut, 2005.

**Books for Reference:**

1. Classical Mechanics, H. Goldstein, Narosa Publishing House, New Delhi, 2005.
2. Classical Mechanics, C.R.Mondal, Prentice - Hall of India, New Delhi.

**ONLINE SOURCES:**

1. <https://www.britannica.com/science/classical-mechanics>.
2. <https://www.chegg.com/homework-help/definitions/classical-mechanics-2>.

<b>PSO</b> <b>CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - I

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P1PH03	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	6	<b>CORE - III: ADVANCED ELECTRONICS</b>	<b>Semester</b>	I
			<b>Credits</b>	4

### Course Objectives

1. The aim of the course is to introduce the students to the advanced concepts of electronics.
2. Acquire basic knowledge of advanced electronics such as Operational Amplifier, Memory and Optoelectronic Devices etc.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the basics of Operational Amplifier.
K2	CO2	To learn the Operational Amplifier applications and Waveform Generators.
K3	CO3	Implement the advanced electronic circuits with the help of Filters and Data Converters.
K4	CO4	To understand the concept about Fabrication IC.
K5	CO5	To learn the working principle of Optoelectronic Devices.

### **Unit – I: Operational Amplifier**

**12**

**Operational amplifiers:** Basic information - Ideal op-amp - Open loop operation - Feedback in ideal op-amp - Inverting and Non-inverting amplifier, Voltage Follower, Differential amplifier, CMRR.

DC Characteristics - Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC Characteristics - Frequency Response, Stability of an Op-amp, Frequency Compensation, Slew rate - Electrical Parameters.

**Unit – II: Analog Computation and Waveform Generators****12**

Basic Op-amp Applications - Sample and hold circuits, Logarithmic amplifiers, Antilogarithmic amplifiers. Analog multiplier - Analog divider - Differentiator - Integrator - Analog Computation - Solving Simultaneous equation and Differential equation.

Sine wave oscillator - RC Phase shift oscillator - Wein - Bridge oscillator, Comparator, Schmitt trigger, Astable and Monostable multivibrators - Triangular wave generator.

**Unit – III: Filters and Data Converters****12**

RC Active filters - First order low pass filter, Second order active filter, Higher order low pass filter, High pass active filter, Band pass filters and Band reject filters.

Basic DAC techniques - Weighted resistor DAC, R-2R Ladder DAC. ADC-Counter type, Successive approximation A/D convertor, Dual - Slope ADC, DAC/ADC Specifications: Resolution, Accuracy, Linearity and Stability.

**Unit – IV: IC Fabrication****12**

Basic monolithic IC's – Thin film fabrication - Epitaxial growth – Masking – Etching - Impurity diffusion, Fabricating monolithic resistors, Diodes, Transistors, Inductors and Capacitors.

IC 555 timer - Description of the functional diagram, Mono stable multivibrator - Astable multivibrator - Bi-Stable multivibrator - Schmitt trigger.

**Unit – V: Memory and Optoelectronic Devices****12**

Architecture of ROM - PROM, EPROM, EEPROM, EAROM. RAM - Static RAM - Dynamic RAM and Integrated RAM - Compact Disk. Solar cells – LED - Photo diode - Pin Diode – LCD – LDR.

Power point presentation, Seminar, Quiz, Assignment

**Books for Study:**

1. Handbook of Electronics, Gupta and Kumar, Pragati Prakashnan, Meerut.
2. Linear Integrated Circuits, D. Roy, New Age Publications.
3. Semiconductor Devices, S.M. Sze, Wiley Publications.
4. Principles of Electronics, V.K.Mehta, S.Chand Publication.

**Books for Reference:**

1. Electronic Measurement and Instrumentation, William Cooper, TMG Hill.
2. Operational Amplifier, Gayakwad, TMG Hill.
3. Integrated Electronics, J.Milman and C.C. Halkias, McGraw Hill (1972).
4. Digital Electronics, V.K.Puri, Tata McGraw-Hill Publication.

**ONLINE SOURCES:**

1. [www.khanacademy.org/science/physics/electronics/operational-amplifier](http://www.khanacademy.org/science/physics/electronics/operational-amplifier).
2. [www.khanacademy.org/science/physics/electronics/memory](http://www.khanacademy.org/science/physics/electronics/memory) and optoelectronic devices.

<b>PSO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO</b>					
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - I

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P1PHE01	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	4	<b>ELECTIVE - I: NANOSCIENCE</b>	<b>Semester</b>	I
			<b>Credits</b>	4

### Course Objectives

1. To provide the basic skills required to understand, develop, and design Nanomaterials.
2. To enhance the research interest in Nanotechnology.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the basics physical and chemical properties of Nanoparticles.
K2	CO2	To learn the various techniques to fabricate the nanoparticles in different synthesis methods.
K3	CO3	To understand the Characteristics of nano particles using multiple techniques of fabrication.
K4	CO4	To understand the semiconducting properties of the nanomaterials based on the size and Characteristics of nano particles.
K5	CO5	To utilize the Nanomaterial in common usage of electrical appliances based on their properties.

### **UNIT - I: Basic Properties of Nanoparticle**

**12**

**Particle Size:** Top down and bottom up ideas, particles shape; Size effect and properties of nano-particles; Particle density; Melting point; Surface tension; Wettability; Specific surface area and pore; Composite structure; Crystal structure; Surface characteristics; Mechanical properties; Electrical properties; Magnetic properties; Optical properties; Concept of vacuum technology.

**UNIT - II: Nanofabrication and Nan patterning****8**

Sol - gel Synthesis - Hydrothermal Synthesis – CVD method - Optical, X-ray, and electron beam lithography - Self - assembled organic layers - Microwave techniques.

**UNIT - III: Characterization Techniques****11**

Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) -Atomic Force Microscope (AFM) - Scanning Tunneling Microscope (STM), XRD – Working Principle, Instrumentation and applications - Photoluminescence (PL) Spectroscopy - UV Spectroscopy analysis - Elemental dispersive EDAX analysis.

**UNIT - IV: Nano Systems****8**

Quantum dot - Quantum wire - Quantum Hall effect - C<sub>60</sub>- Basics of fullerenes - Carbon nano - tubes and its applications - Tunnel diode - Molecular transistor - Single electron transistor - Spin polarized transistor - Thin film self assembly.

**Unit - V: Applications of Nanomaterial****9**

Optoelectronic properties of molecular materials - Nanotechnology devices: OLEDs, OTFTs. Bioelectronics and biosensors: Charge Transport - DNA and Protein functional systems, Electronic noses and biosensors.

**Books for Study:**

1. Roland Wiesendanger – Scanning Probe Microscopy and Spectroscopy – Methods and Applications – Cambridge University Press (1994).
2. Joel I. Gersten, Frederick W. Smith – The Physics and Chemistry of Materials; John Wiley and Sons (2001).
3. Bhushan Bharat, Fuchs Harald, Tomitori Masahiko – Applied Scanning Probe Methods IX Characterization – Springer (2008).
4. John C. Vickerman; Surface Analysis (The principal Techniques); John Wiley and Sons (2003).

5. E. Wolf ; Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience Second Edition, Wiley-VCH (2006).
6. D. Briggs, M.P. Seah; Practical Surface Analysis-Auger and X-ray Photoelectron Spectroscopy, Wiley Interscience (1990).
7. Sergei N. Magonov, Myung-Hwan Whangbo; Surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis, VCH Publishers (1996).
8. John H. Davies, The Physics of Low Dimensional Semiconductors: An Introduction, Cambridge University Press (1998).
9. M.S.Ramachandra Rao, Shubra Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley (2016).
10. Nano: The Essentials, T. Pradeep, TMG Hill.
11. Nanoscale materials in chemistry, Kenneth, John Wiley and Sons.
12. Science and technology of nanostructured magnetic materials, George, Plenum Press, New York.

**ONLINE SOURCES:**

<https://www.google.com/search?q=Basic%20Properties%20of%20Nanoparticle+filetype%3Adoc>

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=2ahUKEwiO\\_cDVnvcAhXJqY8KHTN2D\\_YQFjAEegQIBhAC&url=http%3A%2F%2Fwww.lehigh.edu%2F~inmatpac%2Fsyllabus%2Fs2004mat398.doc&usg=AOvVaw18OmcUT7mNM2qfDrdLTkkG](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=2ahUKEwiO_cDVnvcAhXJqY8KHTN2D_YQFjAEegQIBhAC&url=http%3A%2F%2Fwww.lehigh.edu%2F~inmatpac%2Fsyllabus%2Fs2004mat398.doc&usg=AOvVaw18OmcUT7mNM2qfDrdLTkkG)

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	✓	✓	✓	✓	✓
C02	✓	✓	✓	✓	✓
C03	✓	✓	✓	✓	✓
C04	✓	✓	✓	✓	✓
C05	✓	✓	✓	✓	✓

**SEMESTER - II**

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P2PH04	<b>Title</b>	<b>Batch</b>	2018 - 2020
<b>Hrs/Week</b>	6	<b>CORE - II: ELECTROMAGNETIC THEORY</b>	<b>Semester</b>	II
			<b>Credits</b>	5

**Course Objectives**

1. To enhance the basic skills electromagnetic fields and their applications in Physics.
2. To provide the basic skills required to understand, develop, and design various physics applications involving electromagnetic fields.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the basics properties of of Electromagnetic fields.
K2	CO2	To learn the Multipole expansion, Electrostatic energy – Dielectrics.
K3	CO3	To learn how the Maxwell’s equation to propose that light is an Electromagnetic wave.
K4	CO4	To understand the Propagation of an electromagnetic wave in free space.
K5	CO5	To Understand the concept of ionized particles.

**Unit – I: Electrostatics****14**

Coulomb’s law – Field due to point and continuous charges - Gauss Law and its application - Laplace and Poisson’s equations - Solution of Laplace equation in spherical Coordinates – Point charge in front of a conducting sphere - Multipole expansion. Electrostatic energy – Dielectrics - Polarization and Displacement vectors, Boundary conditions - Dielectric sphere in a uniform field - Molecular polarizability and Electrical susceptibility - Electrostatic energy in dielectric medium - Clausis-Mossotti equation.

**Unit – II: Magnetostatics****10**

Biot-Savart's law - Divergence and curl of magnetic induction - Magnetic vector potential - Ampere's circuital law - Magnetic field of a localized current distribution - Magnetic moment and force on a current distribution in an electric field - Magneto static energy - Magnetic induction and Magnetic field in a macroscopic media - Concept of magnetic dipole - Boundary conditions - Uniformly magnetized sphere - Magnetic Scalar & Vector Potential – Characteristics.

**Unit – III: Electromagnetics****10**

Faraday's law of induction - Maxwell's equation in free space and isotropic media - Maxwell's displacements current - Vector and Scalar potential - Boundary conditions on the field at interfaces - Relation between field theory and circuit theory - Gauge transformation, Lorentz Gauge - Coulomb gauge - Conservation laws for a system of charges - Poynting theorem.

**Unit - IV Wave Propagation****14**

Propagation of an electromagnetic wave in free space - Conducting and Non conducting medium - Skin depth, Reflection and Transmission at dielectric boundaries – Polarization - Fresnel's Law - Interference, Coherence and Diffraction - Guided waves - Wave guides - Propagation of waves in rectangular wave guide, Inhomogeneous wave Equation and Retarded potentials, Field and Radiation due to an oscillating electric dipole.

**Unit – V: Plasma Physics****12**

Plasma - Debye length - Plasma oscillations - Plasma behaviour in a magnetic field - Boltzmann equation - Magnetohydrodynamic equations - Electron plasma oscillations - Debye shielding problem - Plasma confinement in a magnetic field - Pinch effect - Magneto hydrodynamic waves - Alfvén waves - Dynamics of charged particle in uniform electromagnetic fields - Plasma arc welding technique.

### **Books for Study:**

1. Introduction to Electromagnetics, Griffith, Prentice Hall of India.
2. Classical Electrodynamics, J.D. Jackson, John Wiley Publishers.
3. Electromagnetic Waves and Fields, Paul Corson and Dale, CBS Publishers.
4. Fundamentals of Electromagnetics, M.A. Wazed, TMC Publishing.
5. Basic Electromagnetics with Application, N. Narayana, Prentice Hall of India.
6. Electromagnetic Theory and Applications, Umesh Sinha, Tech India Publications.
7. Electromagnetic Waves and Radiating Systems, Edward and Keith, Prentice Hall of India.
8. Foundations of Electromagnetic Theory, John Reitz, Narosa Publishing House.
9. Electro magnetic Theory And Electro Dynamics, Sathya prakash.

### **ONLINE SOURCES:**

<https://www.google.com/search?q=http%2F+electromagnetic+theory&ie=utf-8&oe=utf-8&client=firefox-b-ab>

<https://www.google.com/search?q=hppt%2F+magnetostatics&ie=utf-8&oe=utf-8&client=firefox-b-ab>

<b>PSO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO</b>					
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - II

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P2PH05	<b>Title</b>	<b>Batch</b>	2018 - 2020
<b>Hrs/Week</b>	6	<b>Core V: QUANTUM MECHANICS - I</b>	<b>Semester</b>	II
			<b>Credits</b>	5

### Course Objectives

1. The primary objective of this course is to develop familiarity with the physical concepts and facility with the mathematical methods of quantum mechanics
2. A secondary, but still very important objective is to cultivate your skills at formulating and solving physics problems.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	Familiarize the concept of dynamical quantities, Schrodinger, Heisenberg and Dirac representation.
K2	CO2	Understand the role of spin, orbital angular momentum and their commutation relations. Evaluation of Clebsch Gordon Coefficients.
K3	CO3	Analyze the concept of Hilbert Space, Matrix Theory of Harmonic Oscillator.
K4	CO4	Analyze the approximate methods needed to formulate quantum mechanical problems.
K5	CO5	Apply the concept of time dependent perturbation theory to develop Fermi Golden Rule, approximation methods.

### **Unit – I: General Formalism of Quantum Mechanics**

**12**

Expectation values of dynamical quantities - Probability of current density - Ehrenfest theorem - Uncertainty principle - Relations - Simultaneous measurability of observables - Dirac's notation, Schrodinger, Heisenberg and Dirac representation (Pictures) - Momentum representation.

**Unit – II: Angular Momentum****12**

Orbital Angular Momentum - Spin Angular Momentum - Total Angular Momentum Operators - Commutation relations of Total Angular Momentum with Components - Ladder operators - Commutation Relation of  $J_z$  with  $J^+$  and  $J^-$ , Eigen values spectrum of  $J^2$ ,  $J_x$ ,  $J_y$  and  $J_z$ , Matrix Representation of  $J^2$ ,  $J_z$ ,  $J^+$  and  $J^-$ , Addition of angular momenta: Clebsch Gordon Coefficients – Properties and its Evaluation.

**Unit – III: Matrix Formulation of Quantum Mechanics****12**

**Eigen values, Eigen vectors:** Characteristic equation of a matrix, Schrödinger, Heisenberg and Interaction matrix representation.

**Dirac's Bra and Ket vectors:** Dual Space, Hilbert Space, Projection Operator, and Matrix Theory of Harmonic Oscillator.

**Unit – IV: Approximation Methods****12**

Time Independent Perturbation Theory in Non - Degenerate Case, Ground State of Helium Atom, Degeneracy - Stark Effect in Hydrogen – Spin - Orbit interaction - Variation Method & its application to Hydrogen Molecule - WKB Approximation.

**Unit - V: Time Dependent Perturbation Theory****12**

Time Dependent Perturbation Theory - First and Second Order Transitions - Transition to Continuum of States: Fermi Golden Rule - Constant and Harmonic Perturbation – Transition Probabilities - Selection Rules for Dipole Radiation - Adiabatic and Sudden Approximation - Charged Particle in an Electromagnetic Field.

**Books for Study:**

1. Quantum Mechanics – Theory and Problems by S. L. Kakani and H.M. Chandalia, Sultan Chand & Sons, 2007.
2. Advanced Quantum Mechanics, Satya Prakash, Kedar Nath Ram Nath Publications.

3. A text book of Quantum Mechanics, Mathews and Venkatesan, TMG Hill.
4. Quantum Mechanics, Claude, Frank and Bernard, John Wiley Interscience.
5. Quantum Mechanics, Jasprit Singh, John Wiley Interscience.
6. Quantum Mechanics, Ghatak and Loganathan, Macmillan India.
7. Quantum Mechanics, Aruldas, Prentice Hall of India.
8. Quantum Mechanics, Leonard, TMG Hill.
9. Quantum Mechanics, Eugen, John Wiley Interscience.

**ONLINE SOURCES:**

1. <http://alan.ece.gatech.edu/ECE6451/Lectures/ECE6451L4PostulatesOfQMAndOperatorsVer2.pdf>
2. [https://www.phas.ubc.ca/~mcmillan/rqpdfs/5\\_qm\\_in\\_one\\_dimension.pdf](https://www.phas.ubc.ca/~mcmillan/rqpdfs/5_qm_in_one_dimension.pdf)
3. [http://courses.physics.ucsd.edu/2009/Fall/physics130b/Ang\\_Mom.pdf](http://courses.physics.ucsd.edu/2009/Fall/physics130b/Ang_Mom.pdf)
4. <https://datagrid.hu/boda/Boda-sajat/Rush/Matek/Math-ChemPhys/Ch12.pdf>
5. <http://web.ift.uib.no/AMOS/nazila/LaserAndLight/node10.html>

PSO CO	PS01	PS02	PS03	PS04	PS05
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

## SEMESTER - II

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P2PH06	<b>Title</b>	<b>Batch</b>	2018 - 2020
<b>Hrs/Week</b>	6	<b>CORE VI: SPECTROSCOPY</b>	<b>Semester</b>	II
			<b>Credits</b>	5

### Course Objectives

1. To provide the basic knowledge of interpreting different spectra.
2. To study the spectroscopic methods for quantitative and qualitative analysis.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the basics of Microwave Spectroscopy.
K2	CO2	To learn the vibrational and rotational energy of the molecules by using IR and Raman spectroscopy.
K3	CO3	To study the excitation of electronic spectroscopy.
K4	CO4	To understand the concept about NMR & NQR Spectroscopy.
K5	CO5	To learn the working principle of ESR & Mossbauer Spectroscopy.

### Unit – I: Microwave Spectroscopy

12

Rotation of molecules and their Spectra, Diatomic molecules, Intensity of line spectra, The effect of isotropic substitution, Non - rigid rotator and their spectra, Polyatomic molecules (Linear and Symmetric top molecules), Classical theory of Raman Effect, Pure Rotational Raman Spectra (Linear and Symmetric top molecules), Stark effect – Microwave Spectrometer.

**Unit – II: IR and Raman Spectroscopy****12**

Vibrational energy of diatomic molecules, Simple Harmonic Oscillator, Anharmonic oscillator, Diatomic vibrating rotator, Vibration - Rotation spectrum of carbon monoxide, Breakdown of Born - Oppenheimer Approximation, Influence of rotation on the spectra of polyatomic molecules (Linear and Symmetric top Molecules).

Raman Effect, Quantum Theory of Raman Effect, Selection Rules, Degree of depolarization, Rotational Raman Spectrum, Vibrational Raman Spectrum, Structure determination using IR and Raman spectroscopy, Principles and Working of Raman Spectrometer.

**Unit - III: Electronic Spectroscopy****12**

Born - Oppenheimer Approximation, Vibrational Coarse and their progressions - Franck-Condon Principle - Dissociation energy and their products - Rotational fine structure of electronic - Vibration Transition - Molecular Orbital theory - Spectrum of molecular hydrogen -Change of shape on excitation - Chemical analysis by electronic spectroscopy - Re-emission of energy by excited molecule- Instrumentation of UV Photoelectron Spectroscopy – Zeeman Effect.

**Unit – IV: NMR & NQR Spectroscopy****12**

**NMR Spectroscopy:** Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes - Principle and Working of High Resolution - NMR Spectrometer -Chemical Shift - Applications of NMR Spectroscopy.

**NQR Spectroscopy:** Fundamental requirements - General Principle - Experimental detection of NQR frequencies - Interpretation and Chemical explanation of NQR Spectroscopy.

**Unit – V: ESR & Mossbauer Spectroscopy****12**

**ESR Spectroscopy:** Basic Principles, ESR Spectrometer - Reflection Cavity and Microwave bridge - ESR Spectrum - Hyperfine Structure.

**Mossbauer Spectroscopy:** Mossbauer Effect, Recoilless emission and absorption- Mossbauer Spectrum: Experimental techniques - Hyperfine interaction - Chemical isomer Shift – Doppler velocity shift - Magnetic hyperfine interaction - electric quadrupole interaction.

**Books for Study:**

1. Vibrational Spectroscopy, Sathyanarayana, New Age International Publications.
2. Molecular Structure and Spectroscopy, Aruldas, Prentice Hall of India.
3. Fundamentals of Molecular Spectroscopy, Banwell, TMG Hill.
4. Spectroscopy I, Straughan and Walkar, Chapman and Hall.

**References:**

1. Spectroscopy II, Straughan and Walkar, Chapman and Hall.
2. Modern Molecular Spectroscopy, Randhava, Macmillan India.
3. Nuclear Magnetic Resonance, Rahman, Springer Verlag.
4. C. N. Banwell, Fundamentals of Molecular Spectroscopy (McGraw Hill, New York, 1981).

**ONLINE SOURCES:**

1. [www.khanacademy.org/science/physics/spectroscopy/microwave\\_spectroscopy](http://www.khanacademy.org/science/physics/spectroscopy/microwave_spectroscopy).
2. [www.khanacademy.org/science/physics/spectroscopy/IR/raman\\_spectroscopy](http://www.khanacademy.org/science/physics/spectroscopy/IR/raman_spectroscopy).
3. [www.khanacademy.org/science/physics/spectroscopy/electronic\\_spectroscopy](http://www.khanacademy.org/science/physics/spectroscopy/electronic_spectroscopy)
4. [www.khanacademy.org/science/physics/spectroscopy/nmr/nqr\\_spectroscopy](http://www.khanacademy.org/science/physics/spectroscopy/nmr/nqr_spectroscopy).
5. [www.khanacademy.org/science/physics/spectroscopy/esr/mossbauer\\_spectroscopy](http://www.khanacademy.org/science/physics/spectroscopy/esr/mossbauer_spectroscopy).

<b>PSO</b> <b>CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - II

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P2PHE02	<b>Title</b>	<b>Batch</b>	2018 - 2020
<b>Hrs/Week</b>	4	<b>ELECTIVE: BIO PHYSICS</b>	<b>Semester</b>	II
			<b>Credits</b>	4

### Course Objectives

1. To provide the basic skills required to understand, develop, and design Radiation biology.
2. To provide basic knowledge in the research area of Biophysics.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the basics properties of of Biophysics.
K2	CO2	To learn the Radio activity- Natural radiation Biological effects of radiation.
K3	CO3	To analyze the DNA-RNA-conformation.
K4	CO4	To understand the Movement of organisms Bacterial motion-chemical memory in primitive organisms.
K5	CO5	To analyze the Applications of Biophysics.

### UNIT – I:

8

Ionization energy electron affinity - chemical bonding - electronegativity – strong bonds secondary bonds. Energies-forces-bonds: Interatomic potentials for strong and weak bonds -bond energies. Rates of reaction: reaction kinetics- water, acids, bases and aqueous reactions. Transport process: Diffusion – viscosity-thermal conduction.

**UNIT – II:****8**

Radiation Biology: Radio activity- Natural radiation (Cosmic rays) – Artificial (or) Induced radioactivity – Radioactive disintegration – Geiger-muller counter – Crystal counter: Method of detection of disintegration frequency – Biological effects of radiation.

**UNIT – III:****8**

Biomolecules and biological energy Biological polymers: Nucleic acids-DNA-RNA-conformation-proteins protein folding. Biological Membranes: Historical background-membrane chemistry and structure-membrane physics. Biological energy: Energy consumption respiration-photosynthesis-ATP synthesis.

**UNIT – IV:****8**

Movement of organisms Bacterial motion-chemical memory in primitive organisms-muscular movement-human performance, nerve signals and memory Excitable membranes: Diffusion and mobility of Ions-resting potential Nerve signals: Passive response-Nerve impulses (action potentials)- nervous system.

**UNIT – V:****8**

Control of movement Primary of movement-Ballistic control in a simplified visual system-more sophisticated-modes of control-structure of muscle fibres-central pattern generators-conditioned reflexes-volition-and Free will-consciousness Passive versus active in mental processing.

**Book for Study**

1. Rodyney M.J.Cotterill, Biophysics: An introduction, John Wiley and sons Publications.
2. Roland Glacer, Biophysics, Springer Publications.
3. P.K.Srivastava, Elementary Biophysics An introduction, Narosa Publishing House.
4. M.V.Volkenshtein, Biophysics, Mir Publications, Moscow.
5. Vasantha Pattabi and N. Gautham, Biophysics, Narosa Publishing House.

## ONLINE SOURCES:

<https://www.google.com/search?q=http%2Fwww.biophysics&ie=utf-8&oe=utf-8&client=firefox-b-ab>

<https://www.google.com/search?q=http%2F+radiation+physics&ie=utf-8&oe=utf-8&client=firefox-b-ab>

<b>PSO</b> <b>CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

**SEMESTER - III**

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P3PH07	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	5	<b>CORE - VII: CONDENSED MATTER PHYSICS</b>	<b>Semester</b>	III
			<b>Credits</b>	5

**Course Objectives**

1. This subject provides an advanced introduction to condensed matter physics.
2. To challenge the students to expand their knowledge of condensed matter physics and provide a foundation for further advanced studies.
3. To understand the role of quantum effects and acquire a fundamental understanding of a range of physical phenomena in condensed matter systems.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the energy of an electron motion in crystal.
K2	CO2	To learn the free electron theory of metals.
K3	CO3	To study the properties and applications of magnetic materials.
K4	CO4	To learn the basics of superconducting materials and applications.
K5	CO5	To implement the advanced semiconductor devices.

**UNIT- I: Electron Energy Bands****14**

Basic concepts of energy bands - Fermi surface - Density of states - The Bloch's Theorem - Kronig Penney model - Zone schemes for energy bands - Brillouin zones - Energy bands in a general periodic potential - Motion of an electron in one dimensional lattice - Effective mass of an electron - Effective band gap and band overlapping - Anomalous skin effect - De Hass van Alphen effect.

**UNIT – II: Free Electron Theory of Metals****12**

Free electron in metals - Drude Lorentz free electron theory – Electrical conductivity -Thermal conductivity - Weidemann Franz law - Sommerfield free electron theory – Mattiessen’s Rule - Thermionic emission - Relaxation time – Collision time - Mean free path -Quantum theory of free electrons - Escape of electrons from metal - Potential energy of an electron outside the metal.

**UNIT – III: Diamagnetism, Paramagnetism and Ferromagnetism****12**

Diamagnetism – Langevin classical theory of Diamagnetism – Paramagnetism - Weiss theory of paramagnetism - Quantum theory of Paramagnetism – Demagnetization of a paramagnetic salt – Determination of susceptibility of para and diamagnetism using Guoy’s method – Ferromagnetism – Spontaneous magnetization in ferromagnetic materials – Quantum theory of ferromagnetism – Curie - Weiss law – Weiss molecular field – Ferromagnetic domains – Antiferromagnetism – Ferrimagnetism.

**UNIT – IV: Superconductivity****12**

Superconductivity and its historical perspective - Critical Temperature - Persistent current - Energy gap and its Temperature dependence - Type I and Type II superconductors - BCS theory - Flux quantization - London equation - Josephson tunneling effect - DC and AC Josephson effect — Power Applications of superconductors - High temperature Superconductors - High temperature Ceramic Superconductors.

**UNIT – V: Semiconductor Devices****10**

Hall effect in semi conductors – Vacuum level and Work function of metals – Solar cells, Qualitative ideas of MEM’s, Spintronics, Quantum Dots (QD’s) & Molecular Electronics - LED and Photodiode.

**Book for Study:**

1. Solid State Physics - S.O. Pillai, New Age Publication, 2<sup>nd</sup> Edition, 2002.
2. Solid State Physics – Gupta & Saxeena, Pragatti Praashan, 9<sup>th</sup> Edition, 2004.

**Book for References:**

1. Introduction to Solid State Physics - C.Kittel (John Wiley and Sons), 7<sup>th</sup> Edition, 2005.
2. Material Science, S.L.Kakani, Amit Kakani, New Age International Publishers, 2<sup>nd</sup> Edition, 2010.
3. Superconductivity Fundamentals and Applications – Werner Buckel, Reinhold Kleiner -VCH Publications, 2<sup>nd</sup> revised and enlarged edition 2004.

### **ONLINE SOURCES:**

1. <https://physics.ku.edu/research/condensed-matter-physics>
2. <https://physics.uiowa.edu/research/condensed-matter-and-materials-physics>
3. [https://en.wikipedia.org/wiki/Condensed\\_matter\\_physics](https://en.wikipedia.org/wiki/Condensed_matter_physics)

<b>PSO CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

### SEMESTER - III

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P3PH08	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	6	<b>CORE - VIII: QUANTUM MECHANICS - II</b>	<b>Semester</b>	III
			<b>Credits</b>	5

#### Course Objectives

1. To acquire knowledge of non-relativistic and relativistic quantum mechanics.
2. The ability to understand concepts and to perform calculations of scattering of particles.
3. The ability to critically understand and evaluate modern research utilizing quantum theory in condensed matter, nuclear and particle physics.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the theoretical ideas of Einstein coefficients and stimulated emissions.
K2	CO2	To understand the basic ideas of nuclear scattering.
K3	CO3	To understand the multiple electron atoms and its
K4	CO4	To understand the relativistic theory for a free
K5	CO5	To understand the quantum field theory.

#### **UNIT - I: Semi classical Theory of Radiation**

**12**

Emission & Absorption of radiation – Electric dipole approximation – Einstein's Transition probabilities and A & B Coefficients – Selection rules – Quantization of radiation field – Interaction with matter – Spontaneous & Stimulated emissions.

#### **Quantum theory of Valence Bond**

VB method – Hückel – London theory of Hydrogen molecule in VB method – Refinements of Simple MO and VB approximations.

#### **UNIT - II: Scattering Theory**

**12**

Scattering cross section-Scattering amplitude - Green's function – Partial wave analysis – Phase shifts – The scattering amplitude in terms of phase shift – Scattering by Coulomb potential - Low energy scattering: Scattering length and effective range – Scattering by a perfectly rigid sphere.

### **UNIT – III: Many Electron Atoms**

**12**

Indistinguishable particles – Symmetrical and Anti symmetrical wave functions - Pauli's Exclusion principle – Inclusion of spin – Spin functions for two electrons - Spin functions for three electrons - Helium atom – Central field approximation – Thomas Fermi model of the atom – Hatree Equation – Hatree - Fock Equation.

### **UNIT – IV: Relativistic Wave Equation**

**12**

Klein - Gordan Equation – Dirac's equation for a free particle - Dirac Matrices - Covariant form of dirac equation - Probability density and current density - Plane wave solution - Negative energy states - Hydrogen atom.

### **UNIT – V: Quantum Field Theory**

**12**

Quantization of the wave fields – Classical Lagrangian equation – Classical Hamiltonian equation – Field Quantization of the non relativistic Schrodinger equation – Creation, Destruction and Number Operators - Anti Commutation Relations – Quantization of Electromagnetic Field.

#### **Books for Study:**

1. Quantum Mechanics – G Aruldas - Prentice Hall of India, 2006.
2. Quantum Mechanics – Satyaprakash - Sultan Chand Publishers, 2013.
3. Quantum Mechanics – Gupta Kumar Sharma - Jaiprakash Nath Publications, Meerut, 2013.

#### **Books for References:**

1. A text Book of Quantum Mechanics – P. M.Mathews & K.Venkatesan –Tata Mc Graw Hill, 2004.
2. Introduction to Quantum Mechanics – David J.Griffths – Pearson Prentice Hall, 2<sup>nd</sup> edition, 2009.
3. Quantum Mechanics –V. Devanathan – Narosa Publishing – New Delhi, 2006.
4. Quantum Mechanics – A.K.Ghatak and S.Loganathan – McMillan India, 2003.
5. Quantum Mechanics – L. I. Schiff - Tata Mc Graw Hill, 2010.

#### **ONLINE SOURCES:**

- 1.<https://nptel.ac.in/syllabus/115104045/>
- 2.<https://www.ntnu.edu/studies/courses/TFY4205/>
- 3.<https://www.ntnu.edu/studies/courses/TFY4205/>

<b>PSO</b> <b>CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

### SEMESTER - III

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P3PH09	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	5	<b>CORE - IX: MICROPROCESSORS AND MICROCONTROLLERS</b>	<b>Semester</b>	III
			<b>Credits</b>	5

#### Course Objectives

1. The Basic knowledge and buildings blocks of computers and its processors.
2. To operate the processors and controllers with basic idea.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To study the basics of 8085 microprocessors and its architecture.
K2	CO2	To understand the instruction sets & programme of 8085 microprocessors.
K3	CO3	To study the applications of microprocessors.
K4	CO4	To implement the architecture of 8051 microcontroller.
K5	CO5	To understand the programme of 8051 microcontroller.

#### **UNIT – I: EVOLUTION AND ARCHITECTURE OF MICROPROCESSORS 8085**

**12**

Evolution of Microprocessors – INTEL 8085 microprocessor Pin configuration – Pins and their functions - Bus system – Control and status signals – Externally initiated signals including interrupts - Architecture – ALU – Flags – Registers. Timing and Sequencing: Insertion cycle, Machine cycle -Halt state and Wait state.

Interrupts: Types of interrupts – Hardware and Software interrupts–masking and unmasking interrupts.

#### **UNIT – II: MICROPROCESSORS 8085 INSTRUCTION SETS & PROGRAMMING**

**12**

Assembly language - Instruction sets of 8085 – Stacks – Counters – Subroutines – MACRO - Delay Subroutine - Examples of Assembly language Programming - 8bit addition - 8bit subtraction - 16 bit Addition - 16 bit Subtraction - 16 bit Multiplication - 16 bit Division - The Largest and Smallest number in a data array – Sorting - Sum of a series - Factorial of a given number.

**UNIT – III: APPLICATIONS OF MICROPROCESSORS****12**

Address space – Partitioning – interfacing – Memory and I/O interfacing –I/O ports: Non programmable I/O port INTEL 8212 - Programmable Peripheral Interface (PPI) INTEL 8255 - Programmable Interval (Counter) Timer (PIT) INTEL 8253.

Data Transfers: Types of parallel and serial data transfer schemes – Direct Memory Access (DMA) controller INTEL 8257. 8085A interrupt system: Software & hardware interrupts – interfacing - Working and Programming of PIC 8259 with 8085.

**UNIT – IV: ARCHITECTURE OF MICROCONTROLLER 8051****12**

Introduction – Comparison between microcontroller and microprocessors - Architecture of 8051 – Key features of 8051– Memory organization Data memory and program memory - Internal RAM organization – Special function registers – Control registers – I/O ports – Counters and Timers – Interrupt structure.

**UNIT – V: PROGRAMMING THE MICROCONTROLLER 8051****12**

Instruction set of 8051 – Arithmetic, Logical, Data move jump and call instructions - Addressing modes – Immediate, register, direct and indirect addressing modes – Assembly language programming – Simple programs to illustrate arithmetic and logical operations (Sum of numbers, biggest and smallest in an array, Ascending and descending order program in an array) – Software time delay.

**Books for Study:**

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar, III Edition, Penram International Publishing, 1997.
2. Fundamentals of Microprocessor and Microcomputers, B. Ram, V Edition, Dhanpat Rai Publications (P) Ltd. New Delhi, 2003.
3. The 8051 Microcontroller – Architecture, Programming & Applications, Kenneth J. Ayala, II Edition., Penram International, India, 1996.

**Books for Reference:**

1. M.Gilmore, Microprocessor Principles and Application, TMH, 2<sup>nd</sup> edition, (1995).
2. Aditya P.Mathur, Introduction to Microprocessors, Tata McGraw Hill Company, III edition, 2006.

**ONLINE SOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc18\\_ec03](https://onlinecourses.nptel.ac.in/noc18_ec03)
2. <https://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/notused/Microprocessors%20and%20Microcontrollers-/Learning%20Material%20-%20Microprocessors%20and%20microcontrollers.pdf>
3. <https://www.elprocus.com/microprocessor-and-microcontroller/>

<b>PSO CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - IV

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P4PH10	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	6	<b>CORE - X: NUCLEAR AND PARTICLE PHYSICS</b>	<b>Semester</b>	IV
			<b>Credits</b>	5

### Course Objectives

1. Explain central concepts, laws and models in nuclear and particle physics.
2. Interpret basic experiments.
3. Use basic laws and relations to solve simple problems.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
<b>K1</b>	<b>CO1</b>	To understand basic structure of nucleus and its
<b>K2</b>	<b>CO2</b>	To explore the mechanism of nuclear reactions and scattering process.
<b>K3</b>	<b>CO3</b>	To understand the various types of nuclear
<b>K4</b>	<b>CO4</b>	To understand the nuclear decay process and
<b>K5</b>	<b>CO5</b>	To learn the classification of elementary particles and their properties.

### **UNIT - I: NUCLEAR MODELS**

**12**

Basic nuclear properties: Size, shape and charge distribution–spin and parity–determination of nuclear mass–binding energy–semiempirical mass formula–nuclear stability–Liquid drop model–Shell Model –Prediction of Magic numbers and energy levels by shell model–Optical Model – Collective model of Bohr and Mottelson.

### **UNIT II NUCLEAR REACTIONS**

**12**

Nuclear reactions and reaction mechanism, Types of reactions and conservation laws – Energetics of nuclear reactions–Q-value equation–Scattering and reaction cross sections– Compound nucleus reactions–Direct reactions–Stripping, Pick up reactions–Partial Wave analysis of nuclear reaction cross-section–Breit-Wigner one level formula- continuum theory of nuclear reaction.

### **UNIT - III: NUCLEAR INTERACTIONS**

**12**

Nature of Nuclear forces–Exchange forces–Two body problem–ground state of deuteron- Magnetic moment–quadrupole moment–Tensor forces–Nucleon-nucleon interaction–NP scattering, PP scattering at low energy, non- central-Meson theory of nuclear forces –Yukawa potential–Nucleon-Nucleon scattering- form of nucleon-

nucleon potential–Effective range theory–Spin dependence of nuclear forces–Charge independence and charge symmetry of nuclear forces – Isospin formalism.

**UNIT – IV: NUCLEAR DECAY**

**12**

Gamow’s theory of alpha decay & Fermi’s theory of beta decay –Total decay rate–Mass of the neutrino–Angular momentum and parity selection rules–Allowed and forbidden decays –Comparative half-lives–Neutrino physics Neutrino Hypothesis–Helicity–Non-conservation of parity–Multipole transitions in nuclei–Angular momentum and parity selection rules–Internal conversion–Nuclear isomerism.

**UNIT – V: ELEMENTARY PARTICLE PHYSICS**

**12**

Types of interaction between elementary particles – Hadrons-leptons-mesons-Baryons-hyperons-pions-Symmetries and conservation laws–Elementary ideas of CP and CPT invariance- Gellman–nishijima formula–SU(2) and SU(3) multiplets–Gell-Mann-Okubo mass formula for octet and decuplet–Quark model- color flavor-weak and strong interactions- Basic concepts of relative kinematics.

**Books for Study and References:**

1. D. Griffiths, Introduction to Elementary Particle Physics, Harper & Row, New York., 2006.
2. R. R. Roy and B.P. Nigam, Nuclear Physics, New age Intl. New Delhi, 2005.
3. M.L. Pandya and R.P.S. Yadav, Elements of Nuclear Physics 7<sup>th</sup> edition, Kedar Nath Ram Nath, Delhi, 2003.
4. H. A. Enge, Introduction to Nuclear Physics, Addison-Wesley, Tokyo, 2006.
5. Y. R. Waghmare, Introductory Nuclear, Physics, Oxford-IBH, New Delhi, 2006.
6. Ghoshal, Atomic and Nuclear Physics, Vol. 2, 2008.
7. B. L. Cohen, Concepts of Nuclear Physics, TMH, New Delhi, 2006.

**ONLINE SOURCES:**

- 1.[https://onlinecourses.nptel.ac.in/noc18\\_ph02/course](https://onlinecourses.nptel.ac.in/noc18_ph02/course)
- 2.[https://en.wikipedia.org/wiki/Particle\\_physics](https://en.wikipedia.org/wiki/Particle_physics)
- 3.<https://physics.uiowa.edu/research/nuclear-and-particle-physics>

PSO CO	PS01	PS02	PS03	PS04	PS05
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

## SEMESTER - IV

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P4PH11	<b>Title of the Subject</b>	<b>Batch</b>	2018 – 2020
<b>Hrs / Week</b>	6	<b>CORE - XI: COMMUNICATION SYSTEMS</b>	<b>Semester</b>	IV
			<b>Credits</b>	5

### Course Objectives

1. The working principles of communication systems.
2. How to handle the communication elements.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To develop the theoretical ideas of propagation of signals.
K2	CO2	To make them understand that basics of fiber optic cables and transmission mechanism.
K3	CO3	To understand that production of microwave system and LOS, OTH systems.
K4	CO4	To understand that orbital classification and communication through satellites.
K5	CO5	To make them fundamentals of cellular communication and types of mobile systems.

### **UNIT – I: MODULATION SYSTEMS**

**12**

Theory of Amplitude modulation-Theory of frequency modulation-Theory of phase modulation-pulse code modulation-pulse width modulation-Sampling theorem-low pass and band pass signals, PAM, Channel BW for a PAM signal, Natural Sampling, Flat top Sampling, Signal recovery through holding, Quantization of signals, Differential PCM delta modulation-Delta modulation-Adaptive Delta modulation- BPSK, QPSK.

### **UNIT – II: FIBER OPTICS COMMUNICATION**

**12**

Basics of Fiber Optics-Classification-Single mode and multimode, Step index and Graded index. Acceptance angle, Numerical Aperture, Fiber Losses-Attenuation, Absorption, Leaky modes, Bending losses, Transmission losses, and Core and cladding losses. Chromatic and modal dispersion. Splicing and connectors.

**UNIT – III: MICROWAVE COMMUNICATION SYSTEM****12**

Microwave Generation–Multicavity Klystron–Reflex Klystron–Magnetron–Travelling Wave Tubes (TWT)-Propagation modes, Microwave communication system. Analog Microwave Communication-LOS microwave system-OTH microwave system-Digital Hierarchies, Digital Microwave Systems, Bandwidth efficiency.

**UNIT – IV: SATELLITE COMMUNICATIONS****12**

Orbital Satellites, Geostationary Satellites, Orbital Patterns, Look angles, Orbital Classifications, Spacing and frequency allocation, Radiation Pattern, foot prints, satellite system link models, satellite system link equation. Non-ideal system parameters. INSAT communications satellites. Multiple Accessing Frequency Hopping, Channel Capacity. RADAR.

**UNIT – V: MOBILE COMMUNICATION****12**

Evaluation and fundamentals–cellular structure and planning–frequency allocations– propagation problems–Base station antennas and mobile antennas–type of mobile system– access method –TDMA, FDMA and CDMA– DIGITAL Cellular Radio.

**Books for Study:**

1. Electronic Communication Systems –George Kennedy& Davis, Tata McGraw Hill, 2006, 4<sup>th</sup> Edition.
2. John M. Senior, Optical Fiber Communications, Second Edition, PHI, 2009, 6<sup>th</sup> Edition.
3. Microwave and Radar Engineering-M. Kulkarni, Umesh Publications, 2009, 5<sup>th</sup> Edition.
4. Dennis Roddy, Satellite Communications, Second edition, Mc graw Hill, 2006, 4<sup>th</sup> Edition.
5. Wireless Communication Principles & Practice – Theodore S. Rappaport, 2002, 2<sup>nd</sup> Edition.

**Books for References:**

1. Taub and Schiling, Principles of Communication Systems, Second edition, Tata Mc Graw Hill, 2010, 3<sup>rd</sup> Edition.
2. Simon Haykin, Communication system, Third edition John Wiley & Sons, Inc.2007, 4<sup>th</sup> Edition.
3. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall, Inc, 2005, 6<sup>th</sup> Edition.
4. Wayne, Electronic Communication Systems, 2004, 6<sup>th</sup> Edition.

**ONLINE SOURCES:**

1. [https://en.wikibooks.org/wiki/Communication\\_Systems](https://en.wikibooks.org/wiki/Communication_Systems)
2. <https://www.elprocus.com/what-is-a-communication-system-and-its-basic-elements/>

<b>PSO CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

## SEMESTER - IV

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science (Physics)</b>	
<b>Course Code</b>	18P4PHE03	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	4	<b>ELECTIVE - III: THIN FILM TECHNOLOGY</b>	<b>Semester</b>	IV
			<b>Credits</b>	4

### Course Objectives

1. To examine the electrical properties in metallic thin films.
2. To explore the transport properties of semi conducting and insulating film.
3. To know how the optical properties of thin film is utilized in solar cell applications.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand that preparation of thin films by various methods.
K2	CO2	To make them understand that the formation of thin films and its growth control.
K3	CO3	To make them learn about electrical characteristics of thin films.
K4	CO4	To make them learn about dielectric behavior of thin films.
K5	CO5	To understand that the application of thin films in research and in industry.

### **Unit - I: Preparation of Thin Films**

**12**

Study of thin film vacuum coating unit-Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Physical vapour deposition- Thermal evaporation-electron beam evaporation-Sputtering-Study of glow Discharge- Experimental set up for DC and RF magnetron sputtering, Pulsed laser deposition and Ion beam assisted deposition. Chemical vapour deposition-CVD, MOCVD and PECVD processes. Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization-Nucleation and growth of thin films – four stages of film growth.

## **Unit - II: Deposition Monitoring and Control**

**8**

Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique-Fringes of equal chromatic order (FECO) method-Ellipsometry (qualitative only).

## **Unit - III: Electrical properties**

**8**

Sheet resistance-size effect-Electrical conduction in thin metallic films-Calculation of mobility- Effect of ageing and annealing - Oxidation - Agglomeration.

## **Unit - IV:**

**11**

**Dielectric Properties:** DC conduction mechanism-Low field and high field conduction. Breakdown mechanism in dielectric films-AC conduction mechanism. Temperature dependence of conductivity. **Structure and Optical Properties:** Study of structure of thin films using x-ray diffraction method-Calculation of particle size-Optical constants of thin films – UV spectrophotometer-Transmittance, absorption, determination of band gap.

## **Unit - V: Application of Thin Films**

**9**

Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area)-Trimming of thin film resistors-sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials-Capacitor structures-Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics-Thin film solar cells – antireflection coatings.

### **Books for Study:**

1. Hand book of Thin films Technology: L I Maissel and R Clang, New York: McGraw-Hill, 1970.
2. Thin film Phenomena : K.L. Chopra, NewYork: Mc Graw-Hill, 1969.
3. Thin films processes – J.L.Vilsan

### **Books for References:**

1. Physics of thin films, Vol. 12, First edition Georg Hass Maurice H. Francombe John L. Vossen, 1982.
- 2 . Thin films solar cells –K.L. Chopra and S. R. Das, 1983.
- 3 . Vacuum deposition of thin films – L.Holland , 1956.
- 4 . The use of thin films in physical investigation–J.C.Anderson, 1966.
- 5 . Thin films technology – R.W.Berry, P.M.Hall and M.T. Harris, Princeton, London: Van Nostrand, 1968.

**ONLINE SOURCES:**

1. <https://www.tno.nl/en/focus-areas/industry/expertise-groups/thin-film-technology/>
2. [http://www.oxford-vacuum.com/background/thin\\_film.htm](http://www.oxford-vacuum.com/background/thin_film.htm)
3. <http://www.semicore.com/news/81-what-is-thin-film-deposition>

<b>PSO CO</b>	<b>PS01</b>	<b>PS02</b>	<b>PS03</b>	<b>PS04</b>	<b>PS05</b>
<b>CO1</b>	✓	✓	✓	✓	✓
<b>CO2</b>	✓	✓	✓	✓	✓
<b>CO3</b>	✓	✓	✓	✓	✓
<b>CO4</b>	✓	✓	✓	✓	✓
<b>CO5</b>	✓	✓	✓	✓	✓

### SEMESTER - III

<b>Programme Code</b>	M.Sc.,	<b>Programme Title</b>	<b>Master of Science</b>	
<b>Paper Code</b>	18P3PHED1	<b>Title of the Subject</b>	<b>Batch</b>	2018 - 2020
<b>Hrs / Week</b>	4	<b>EDC: SOLAR ENERGY</b>	<b>Semester</b>	III
			<b>Credits</b>	4

#### Course Objectives

1. Energy resources around us.
2. Threatening to our energy resources.
3. How to conserve energy.

<b>Knowledge Level</b>	<b>CO Number</b>	<b>CO Statement</b>
K1	CO1	To understand the natural energy sources.
K2	CO2	To understand the basics of solar energy and its advantages, disadvantages.
K3	CO3	To learn about the principle of solar cell.
K4	CO4	To understand the fundamentals of biomass energy.
K5	CO5	To learn the energy storage devices.

#### **UNIT – I: Introduction to Energy Sources**

**9**

Classification of Energy sources - Worlds reserve of commercial energy sources and their availability - Geothermal energy - wind energy - Ocean thermal energy conversion - Energy from waves and tides (basic ideas) - Merits and Demerits.

#### **UNIT – II: Solar Thermal Energy**

**9**

Renewable energy sources - Solar energy - Solar water heater - Solar space heating and cooling - Solar thermal technologies - Solar cooker - Solar Pond - Merits and Demerits of solar energy.

**UNIT – III: Solar Cell****9**

Photo voltaic effect - Performance of solar cell - Choice of materials for solar cell - Basic requirements for obtaining an effective solar cell - Power generation by using solar cell.

**UNIT – IV: Biomass Energy Fundamentals****9**

Biomass energy – Classification – Photosynthesis - Biomass conversion technology -Advantages and Disadvantages of biomass energy.

**UNIT – V: Energy Storage****9**

Introduction - Liquid media storage - Solid media storage - Ground collector - Chemical storage.

**Books for Study:**

1. G.D. Rai, Non Convantional Energy Sources, 4<sup>th</sup>, 5<sup>th</sup> Edition, 2011.
2. G.D. Rai, Solar Energy Utilization, 5<sup>th</sup> Edition, 2011.
3. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company, 3<sup>rd</sup> Edition, 2005.

**Books for References:**

1. D.S. Chauhan, S.K. Srivastava, Non Conventional Energy Sources, Ed.V, first edition, 2004.
2. Solar Energy, Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa Publications, 2004.

**ONLINE SOURCES:**

1. <https://www.renewableenergyworld.com/solar-energy/tech.html>
2. [https://en.wikipedia.org/wiki/Solar\\_power](https://en.wikipedia.org/wiki/Solar_power)

PSO CO	PS01	PS02	PS03	PS04	PS05
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

**Credit: 4**

**Max. Hours: 60**

**PRACTICAL – I**  
**ADVANCED ELECTRONICS**

**PAPER CODE: 18P2PHP01**

1. FET Characteristics and construct FET amplifier circuit.
2. Design Phase shift oscillator.
3. Construct Schmitt trigger using Ic555& IC 741.
4. Design square wave generator using Ic555 & IC741.
5. Design monostable multivibrator using Ic741 & IC 555.
6. Binary addition and subtraction using Ic 7483.
7. BCD counter- Seven segment display.
8. UJT Characteristics and construct saw tooth wave oscillator.
9. Multiplexer and De-Multiplexer.
10. Decoder and encoder.
11. Analog computation –solving simultaneous equation.
12. Shift registers using 7476/7473 IC
13. Study of Flip Flops using IC 7400
14. Design second order butter worth active filter circuit – Low pass, high pass and band pass filters using IC 741
15. Design of R/2R ladder and Binary weighted method of DAC using IC 741

**Credit: 4**

**Max. Hours: 60**

**PRACTICAL-II**  
**ADVANCED EXPERIMENTS**

**Paper Code: 18P2PHP02**

1. Determine the Young's Modulus of the material of the given plate by forming elliptical fringes. Repeat the experiment at least twice by changing the position of the suspended masses.
2. Determine the Young's Modulus of the material of the given plate by forming hyperbolic fringes. Take 2 sets of readings.
3. Using the given experimental setup determine the value of Stefan's constant. Assuming the solar constant 'S'. Calculate the temperature of the SUN.
4. Find the thickness of the air film in FP etalon.
5. Determine the compressibility of the given solution by using an ultrasonic interferometer. Repeat the experiment at least for four different concentrations and hence draw the concentration vs. compressibility graph.
6. Determine the compressibility of the given four liquids/solution by using an ultrasonic interferometer.
7. Determine
  - (a) Hall voltage and Hall coefficient
  - (b) Number density of the charge carriers and
  - (c) Hall angle and mobility.

Repeat the experiment for a different value of magnetic field.

8. Measure the diameter of a circular aperture, the diameter of a thin wire and diameter of sleeve using Fresnel's diffraction phenomenon.
9. Determine the wavelength of the laser light by using transmission grating and determine the number of lines in a transmission grating.

**Credit: 4**

**Max. Hours: 48**

**PRACTICAL – III**

**MICROPROCESSOR**

**Paper Code: 18P4PHP03**

1. 8 Bit Decimal Addition and Subtraction
2. 8 Bit Multi-byte Addition and Subtraction
3. Number Conversion: BCD to Binary, Binary to BCD, ASCII to Hexadecimal and Hexadecimal to ASCII
4. 16 bit Addition and Subtraction
5. 16 bit Multiplication and Division
6. 16 bit Square of a number and 16 bit Square root of a number
7. Sum of simple series and Factorial of a number
8. ADC interfacing
9. Stepper motor interfacing
10. Interfacing of an 8 bit DAC Converter and Waveform generation-  
Triangular, Saw tooth, Sine, Square, Rectangular
11. Traffic light controller
12. Finding the Largest/Smallest number in a data array
13. Ascending/Descending order in a given array
14. Multibyte decimal addition
15. Data transfer Program

**Credit: 4**

**Max. Hours: 48**

**PRACTICAL – IV**

**ADVANCED GENERAL EXPERIMENTS-II**

**Paper Code: 18P4PHP04**

1. Rydberg constant-grating –Hydrogen spectrum.
2. Magnetic susceptibility – Quincke’s method
3. Magnetic susceptibility – Guoy’s method.
4. Band gap of a semiconductor – Four probe method.
5. Rydberg constant -Solar Spectrum.
6. Thermal conductivity of a good conductor – Forbe’s method.
7. Coefficient of Viscosity - Searle’s Viscometer.
8. Charge of an electron using Spectrometer.
9. Determination of wavelength - Michelson’s Interferometer.
10. Charge of an electron - Milikan’s oil drop method
11. Compressibility of the Liquid - Ultrasonic Diffractometer.
12. Temperature Coefficient & Energy Band Gap of a Thermistor.