ALAGAPPA UNIVERSITY

(A State University Established in 1985)
Karaikudi - 630003, Tamil Nadu, India

2017 — Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 — MHRD Govt. of India; UGC University Grants Commission — Graded as Category - 1 & Granted Autonomy

2018 — MHRD Government of India — Swachh Campus Rank : 4

2019 — nirf National Institutional Ranking Framework — Rank : 28

2019 — QS — India Rank : 20; BRICS Rank : 104; Asia Rank : 216

DEPARTMENT OF PHYSICS

M.Sc., PHYSICS

[Choice Based Credit System (CBCS)]

[For the candidates admitted from the academic year 2019-**2020**]

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I. Name of the Programme

The programme is named as Master of Science (M.Sc.) in Physics. The syllabus for this programme is framed under the rules of the Choice Based Credit System (CBCS) of this University and both Core and Elective courses were incorporated as its components. The CBCS enables the students to select variety of subjects as per their interest and requirement. Acquiring knowledge in the related fields is advantageous to the students. Fast learners can earn more credits than the stipulated minimum of **90 credits.**

II. Programme General Objectives

Physics is the natural science that involves the study of matter and its motion through space and time along with the related concepts such as energy and force. It is one of the most fundamental scientific disciplines. The main goal of Physics is to understand how the universe behaves. Physics explains the natural phenomena in the universe and often considered to be the most fundamental science. It provides a basis for all other sciences - without Physics, we could not have Biology, Chemistry, or anything else. Physics also makes significant contributions through advances in new technologies. One academic programme is necessary to create awareness to students in the emerging field and also it should teach basic concepts and developments of Physics to students to make them as scientist or technologists in this field. Hence our task is to introduce the M.Sc. programme in Physics to educate the undergraduate students in the fascinating fields. Rigorous and comprehensive in approach, this syllabus presents essential contents in a detailed, clear and direct way. The programme is structured in such a way to impart more knowledge in science, in particular in Physics.

Programme specific objectives

The major objectives of M.Sc. Physics programme are:

- To provide, thorough well designed studies of theoretical and experimental Physics, a worthwhile educational experience for all students.
- To acquire deep knowledge in fundamental aspects of all branches of Physics.
- To acquire basic knowledge in the specialized thrust areas like Classical Mechanics, Quantum Mechanics, Spectroscopy, Mathematical Physics, Electromagnetic Theory, Thermodynamics & Statistical Mechanics, Electronics, Microprocessor & Electronic Instrumentation, Condensed Matter Physics, Nuclear and Particle Physics, Materials Science etc.,

Programme outcome

On successful completion of the program the students will develop the ability and the skills that:

- are relevant to the study and practice of science,
- are useful in everyday life,
- are encouraging efficient and safe practice and effective communication,
- are encouraging research and development activities.

To develop attitudes relevant to science such as:

- Concern for accuracy and precision,
- Objectivity,
- Integrity,
- Enquiry,
- Initiative and
- Inventiveness.

III. Eligibility for Admission

A candidate who has passed B.Sc., Degree Examination with Physics or Applied Physics as main course of study of any University with allied subject of Mathematics and Chemistry or any of the B.Sc., Degree Examination with specialization such as Applied Physics, Electronics, Nuclear Physics, Biophysics, Nanoscience or any other specialization in Physics of some other University accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Degree in Physics of this University after a course of study of two academic years.

IV. Duration of the Programme

The Programme for the degree of Master of Science in Physics shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

V. Courses of Study: M.Sc. Physics (CBCS - Structure of the Programme)

M.Sc. Physics (CBCS - Structure of the Programme)

Sl. No.	Course Code No.	Title of the Course	No. of Credit	Contact Hours/Week	Marks		Total
					Internal	External	
I SEMESTER							
1	521101	Classical Mechanics	4	5	25	75	100
2	521102	Mathematical Physics-I	4	5	25	75	100
3	521103	Electronics	4	5	25	75	100
4	521104	Advanced Electronics Laboratory-I	4	8	25	75	100
5	-----	Elective Course	4	4	25	75	100
6	521106	Skill Development	3	3	100	----	100
Total			**23**	**30**			**600**
II SEMESTER							
7	521201	Quantum Mechanics-I	4	5	25	75	100
8	521202	Mathematical Physics-II	4	5	25	75	100
9	521203	Electromagnetic Theory	4	5	25	75	100
10	521204	Advanced Physics Laboratory	4	8	25	75	100
11	-----	Elective Course	4	4	25	75	100
12	*NME	NME-I/ Interdepartmental Course-I	2	3	25	75	100
	*SLC - I	MOOCs	**EC**	---	----	----	----
Total			**22+ EC**	**30**			**600**
III SEMESTER							
13	521301	Advanced Molecular Spectroscopy	4	5	25	75	100
14	521302	Quantum Mechanics-II	4	5	25	75	100
15	521303	Condensed Matter Physics-I	4	5	25	75	100
16	521304	Advanced Electronics Laboratory-II	4	8	25	75	100
17	-----	Elective Course	4	4	25	75	100
18	*NME	NME-II/ Interdepartmental Course-II	2	3	25	75	100
	*SLC - II	MOOCs	Extra Credit	---	----	----	----
		Village Extension Programme (3 days)	---	---			----
Total			**22+ EC**	**30**			**600**
IV SEMESTER							
19	521401	Condensed Matter Physics-II	4	4	25	75	100
20	521402	Nuclear and Particle Physics	4	4	25	75	100
21	521403	Thermodynamics and Statistical Mechanics	4	4	25	75	100
22	521444	Project & Viva-voce	7	14	25	75	100
23	-----	Elective Course	4	4	25	75	100
Total			**23**	**30**			**500**
GRAND TOTAL CREDIT			**90+ EC**				**2300**

*Note: *NME- Non Major Elective Course; *SLC- Self Learning Course; EC – Extra Credit*

Interdepartmental Courses/Non Major Electives				
1		Physics for Everyone	2	3
2		Analytical Instrumentation	2	3

ELECTIVE COURSES

Sl. No.	Course Code No.	Title of the Course	No. of Credit	Contact Hours/Week
I SEMESTER				
1.	521501	Digital Electronics Principles	4	4
2.	521502	Modern Optics	4	
3.	521503	Thin Film Physics	4	
		Any one course		
II SEMESTER				
4.	521504	Microprocessor and Instrumentation	4	4
5.	521505	Quantum Chemistry	4	
6.	521506	Communication Electronics	4	
		Any one course		
III SEMESTER				
7.	521507	Physics of Nanomaterials	4	4
8.	521508	Solar Energy Utilization	4	
9.	521509	Basic Concepts of Instrumentation	4	
		Any one course		
IV SEMESTER				
10.	521510	Elementary Numerical Analysis	4	4
11.	521511	Solid State Ionics	4	
12.	521512	Crystal Growth and Thin film Physics	4	
		Any one course		

VI. Semesters

An Academic year is divided into two semesters. In each semester, courses are offered in 18 teaching weeks including the duration of conduct of internal examination. Each week has 30 working hours spread over 5 days a week.

VII. Teaching Methodologies

The classroom teaching shall be through conventional lectures and use of OHP and Power Point presentations. The lecture shall be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill. In the laboratory, instruction shall be given for the experiments followed by demonstration and finally the students have to do the experiments individually. Periodic tests would be conducted and special attention shall be given to the slow learning students.

VIII. Examinations

The examination shall be three hours duration to each course at the end of each semester. The candidate failing in any course(s) will be permitted to appear for each failed course(s) in the subsequent examination. Practical examinations for M.Sc. programme in Physics shall be conducted at first, second and third semesters. At the end of fourth semester viva-voce will be conducted on the basis of the Project report submitted by the student.One internal and one external examiner will conduct the viva-voce jointly.

IX. Condonation

Student must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance have to apply for condonation in the prescribed form with prescribed fee. Students who have earned 69% to 60% of attendance should apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have attended below 60% are not eligible to appear for the examination and they shall re-do the semester after completion of the programme, with the prior permission of the Registrar of the University.

X. Question Paper Pattern

M.Sc Physics
521XXX: Course title
(2019-20 onwards)

Time: 3 Hours Max. Marks - 75

PART A: Answer all questions. All questions carry equal marks. (10 × 2 = 20 marks)
Two questions should be problem oriented.

1. *from UNIT I*
2. *from UNIT I*
3. *from UNIT II*
4. *from UNIT II*
5. *from UNIT III*
6. *from UNIT III*
7. *from UNIT IV*
8. *from UNIT IV*
9. *from UNIT V*
10. *from UNIT V*

PART B: Answer all questions either (a) or (b). (5 × 5 = 25 marks)
One either or question should be problem oriented.

11. (a) or (b) *from UNIT I*
12. (a) or (b) *from UNIT II*
13. (a) or (b) *from UNIT III*
14. (a) or (b) *from UNIT IV*
15. (a) or (b) *from UNIT V*

PART C: Answer any three questions. (3 × 10 = 30 marks)

16. *from UNIT I*
17. *from UNIT II*
18. *from UNIT III*
19. *from UNIT IV*
20. *from UNIT V*

XI. Evaluation

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points. Evaluation for each course shall be done by continuous internal assessment (CIA) by the concerned course Teacher as well as by an end semester examination (ESE) and will be consolidated at the end of the course. The components for continuous internal assessment are:

Two tests	- 15 marks (Third /repeat test for genuine absentees)
Seminar/Quiz	- 05 marks
Assignment	- 05 marks
Total	**25 marks**

Attendance need not be taken as a component for continuous assessment, although the student should put in a minimum of 75% attendance in each course. In addition to continuous evaluation component, the end semester examination, which will be a written examination of at least 3 hours duration, would also form an integral component of the evaluation. The ratio of marks to be allotted to continuous internal assessment and to end semester examination is 25:75. The evaluation of laboratory component, wherever applicable, will also be based on continuous internal assessment for 25 marks and an end-semester practical examination for 75 marks.

Distribution of marks for practical examinations

(CIA marks 25 + ESE 75 marks)

CIA	**Marks**
Two Model Practicals	25
ESE	**Marks**
Circuit Diagram / Diagram / Formula / Tables	10
Observation	20
Results	20
Viva – voce in practical	15
Record Note	10
Total	75

XII. Project Work

Project Work: 100 marks

Internal

Periodic Presentation of Learning 25 marks

External

Concise Project	50 marks
Viva-voce (Project Guide + External Examiner score)	25 marks
Total	**100 marks**

(a) Plan of work:

The student should prepare plan of work for the project, get the approval of the guide and should be submitted to the University during the fourth semester of their study. In case the student wants to avail the facility from other University/laboratory, they will undertake the work with the permission of the guide and Head of the Department (HOD) and acknowledge the alien facilities utilized by them. The duration of the project research shall be a minimum of three months in the fourth semester.

(b) Project work outside the Department:

In case the student stays away for work from the Department for more than one month, specific approval of the Head of the Department should be obtained.

(c) No. of copies/distribution of project work:

The students should prepare three copies of project work in bound volume and submit the same for the evaluation by Examiners. After evaluation, one copy is to be retained in the Department library and one copy for guide and one copy for the student.

(d) Format to be followed:

The format/certificate for project to be submitted by the student is given below:
Format for the preparation of project work:

(a) Title page
(b) Bonafide Certificate
(c) Acknowledgement
(d) Table of contents

CONTENTS

Chapter No.	TITLE	Page No.
1.	Introduction	
2.	Review of Literature	
3.	Materials and Methods	
4.	Results and Discussion	
5.	Summary	
6.	References	

Format of the Title Page:

TITLE OF THE PROJECT

Project Submitted in partial fulfilment of the requirement for the Degree of Master of Science in PHYSICS to the Alagappa University, Karaikudi -630 003.

By

Students Name:

Register Number:

Under the Guidance of

(Faculty Name)

University Emblem

Department of Physics

Alagappa University

Month and Year

Format of Declaration of the Candidate:

Name and class of the student

DECLARATION

I hereby declare that the Project entitled _____ submitted to ALAGAPPA UNIVERSITY for the award of the degree of MASTER OF SCIENCE is my original work and that it has not previously formed the basis for the award of any degree, diploma/associate-ship or any other similar title of any other University or Institution.

Signature of the Student

Signature of HOD

Format of the Certificate:

CERTIFICATE

This is to certify that the Project entitled ---------- submitted in partial fulfilment of the requirement of the degree of Master of Science in Physics to the Alagappa University, Karaikudi is a record of bonafide research work carried out by ---------- under my supervision and guidance and that no part of the project has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

Date: Signature of the Guide

Place:

Guidelines for the approval of M.Sc. Physics guides for guiding students in their research for submitting project work:

1. M.Sc. Physics (Partial fulfilment) Guide:
   a) A person seeking for recognition as guide should have:
      A Ph.D. Degree in Science discipline
      (or)
      M.Phil. / M.Sc. degree in Science with first class/second class should have 3 years of active teaching/research experience. He/She should have published at least one research paper in a National/International Journal authored solely or jointly.

2. Procedure for submitting application for the approval as guides:
   (i) The University shall on request give prescribed application form.
   (ii) The filled in applications should be submitted before the close of said date by the University.
   (iii) All such applications should be routed through the HOD with specific recommendations.
   (iv) All relevant proofs should be submitted along with the applications.

3. Approval:
   The committee constituted for the purpose will scrutinize the applications and recommend for approval/rejection. Orders will then be passed by the authority of the University and communicated to each member individually through the HOD.

XIII. Village Extension Programme (VEP)

The Sivaganga and Ramnad districts are backward districts, where a majority of the people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme (VEP) is to extend outreach programs in environmental awareness, hygiene and health to the rural masses of this region. The students in their third semester have to visit any one of the villages within the jurisdiction of Alagappa University and can arrange various programmes to educate the rural masses in the following areas for three days.

1. Environmental awareness 2. Hygiene and health

A minimum of two faculty members can accompany the students and guide them. This course is a compulsory one for all the students of the Department of Physics, Alagappa University.

XIV. Passing Minimum

The candidate shall be declared to have passed the examination if the candidate secures a minimum of 50% in the University external examination and 50% of the total (Int+Ext) marks. For the project work and viva-voce, a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in that course.

Candidate who does not obtain the required minimum marks for a pass in a course/Project report shall be required to reappear and pass the same at a subsequent appearance.

XV. Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First class. All other successful candidates shall be declared to have passed in the Second class.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in First class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the programme in the first instance and within a period of two academic years from the year of admission to the programme only are eligible for University Ranking.

A candidate is deemed to have secured first rank provided he/she

(i) should have passed all the courses in first attempt itself

(ii) should have secured the highest over all grade point average (OGPA)

XVI. Maximum Duration for the Completion of the Programme

The maximum duration for the completion of M.Sc. Physics Programme shall not exceed ten semesters.

XVII. Commencement of this Regulation

These regulations shall take effect from the academic year 2019-2020 i.e., for students who are to be admitted to the first year of the programme during the academic year 2019-2020 and thereafter.

XVIII. Transitory Provision

Candidates who were admitted to the M.Sc. Physics Programme of study before 2019-2020 shall be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of the examination of April/May 2020. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

XIX. Code and Grading

Legend

5	2	1	X	Y	Z

521 PHYSICS – M.Sc.

X Semester No.

Y Course 0 – core

1 – elective/interdisciplinary

Once the marks of the CIA and end-semester examination for each of the courses are available, they will be added. The marks, thus obtained will then be graded as per the scheme provided in Table 1.

Table 1: Grading of the Courses

Marks	Grade Point	Letter Grade
96 and above	10	S+
91 – 95	9.5	S
86 – 90	9.0	D++
81 – 85	8.5	D+
76 – 80	8.0	D
71 – 75	7.5	A++
66 – 70	7.0	A+
61 – 65	6.5	A
56 – 60	6.0	B
50 – 55	5.5	C
Below 50	0	F

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester is indicated respectively as **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).** These two are calculated by the following formula.

$$GPA = \frac{\sum_{i=1}^{n} Ci\, Gi}{\sum_{i=1}^{n} Ci}$$

Where 'Ci' - Credit earned for the course 'i' in any semester; 'Gi' - Grade Point obtained by the student for the course 'i' and 'n' - number of courses **passed** in that semester. **CGPA** (Cumulative Grade Point Average) = Average Grade Point of all the Courses starting from the first semester to the current semester.

XX. Syllabus:

CORE COURSES
SEMESTER – I

Course code: 521101	**CLASSICAL MECHANICS**	**Credits: 4**	**Hours: 5**
Objectives	➢ To impart knowledge to the students on the basic concepts and formulation involved in classical mechanics and its applications. ➢ To clarify the need of theory of relativity and to inculcate knowledge in rigid dynamics and oscillatory motion.		
UNIT I	**Lagrange and Hamilton Equations:** Kepler's laws of planetary motion- stability of orbit - Lagrangian formulation: System of particles-constraints and degrees of freedom-generalized coordinates, force and energy-conservation laws-conservations of linear and angular momenta-symmetric properties-homogeneity and isotropy - Lagrange's Equations for Simple Systems –non-holonomic systems-Classification of a Dynamical System — Principle of Virtual Work – D'Alembert's principle – Lagrange's Equations for General Systems – Hamilton's Equations – Ignorable Coordinates – The Routhian Function –Applications of Lagrange equations of motion: free particle in space-Atwood's machine**.**		
UNIT II	**Hamiltonian Methods:** Introduction – Hamilton's principle – Hamilton's principle for a Conservative System – Principle of Least Action – Characteristic Function and Hamilton-Jacobi Equation- Phase Space and Liouville's Theorem – Special Transformations – Lagrange Brackets – Poisson Bracket – Calculus of Variations.		
UNIT III	**Kinetics of a Rigid Body Motion:** Moments and Products of Inertia – Moment of Inertia of a Body about any Line – Through the origin of coordinate frame – The momental Ellipsoid – Rotation Coordinate Axes – Principal Axes and Principal Moments – Kinetic Energy of a Rigid Body Rotating about a Fixed Point – Angular Momentum of a Rigid Body – Eulerian Angles –Compound Pendulum-Euler's equations of motion – Torque free motion of a rigid body- Rotational motion of the Earth.		
UNIT IV	**Central Force Problem and Special Theory of Relativity:** Reduction to the equivalent one body problem-Centre of mass-Equation of motion and first integral-classification of orbits– Kepler problem: Inverse-Square law of force-Scattering in a central force field - transformation of scattering to laboratory coordinates - Theory of relativity, Equivalence of space and time-The Lorentz Transformation – Immediate Consequences of Lorentz transformations: contraction of length, time dilation, composition of velocities – The Mass of a Moving Particle – Equivalence of Mass and Energy.		
UNIT V	**Small Oscillations and Normal Modes:** Potential Energy and equilibrium-One dimensional oscillator: stable, unstable and neutral equilibrium - Two coupled oscillators-normal coordinates and normal modes-General theory of small oscillations: secular equation and eigen value equation- small oscillations in normal coordinates-Vibrations of a linear triatomic molecule.		

Reference and Textbooks:

Gutpa. S. L., Kumar, V & Sharma, H. V. (2017). *Classical Mechanics*. Pragati Prakashan, Meerut.

Gupta, A. B. (2014). *Fundamentals of Classical Mechanics*. Books & Allied (P) Ltd.

Herbert Goldstein. (2011). *Classical Mechanics*. Pearson publishers-3rd Edition.

Sankara Rao, K. (2011). *Classical Mechanics*. PHI Learning Private Limited, Newyork.

Upadhyaya, J. C. (2010). *Classical Mechanics*. Himalaya Publishing House- 2nd Edition

Outcomes	On successful completion of the course, a student will be able to ➢ Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics ➢ Understand the role of classical mechanics in modern calculations involved in modern physics

Name of the Course Teacher
Dr. M. Sivakumar

Course code: 521102	MATHEMATICAL PHYSICS – I	Credits: 4	Hours: 5
Objectives	➢ To provide a strong mathematical foundation in vector analysis and matrices. ➢ To elaborate the information on special functions and integral transforms.		
UNIT I	**Vector Analysis:** Introduction to vectors and product of vectors – Concept of Gradient, Divergence, Curl - Gauss's divergence theorem – Stoke's Theorem – Gauss's law and Poisson's Equation – Expression for Gradient, Divergence, Curl and Laplacian in Orthogonal, Cylindrical and Spherical Coordinates.		
UNIT II	**Matrices:** Introduction to Matrix – Types of matrices and their properties - Rank of a matrix – Cramer's rule - Characteristic equation - Eigen values, Eigen vectors – Adjoint of a matrix – Inverse of a matrix – Diagonalization of Matrices – Cayley-Hamilton's theorem - Problems.		
UNIT III	**Special Functions I:** Gamma and Beta function - Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue's formula - Orthogonality; Bessel's differential equation: Bessel polynomials - Generating functions - Recurrence relation - Rodrigue's formula – Orthogonality.		
UNIT IV	**Special Functions II:** Hermite differential equation – Generating functions – Hermite polynomials - Recurrence relations – Rodrigue's formula – Orthogonality; Laguerre differential equations – Generating functions - Laguerre polynomials - Recurrence relation - Rodrigue's formula – Orthogonality.		
UNIT V	**Integral Transforms:** Introduction and Definitions – Fourier Transforms – Cosine and Sine Fourier transforms – Linearity theorem – Parseval's theorem – Fourier Transform of Derivatives – Convolution Theorem – Laplace Transforms – Laplace Transform of Derivatives – Other Properties – Convolution or Faltungs Theorem – Inverse Laplace Transform-applications.		

Reference and Textbooks:

Dass, H.K, Rama Verma. (2010). *Mathematical Physics*. S. Chand and Company Ltd.

Erwin Kreyszig. (2015). *Advanced Engineering Mathematics*. 10th Edition. Wiley International Student Version.

Gupta, B. D. (2010). *Mathematical Physics*. 4th Edition. Vikas Publishing House Pvt. Ltd.

Parthasarathy, H. (2007). *Topics In Mathematical Physics*. Ane Books Pvt. Ltd.

Sathyaprakash. (2013). *Mathematical Physics*. Sultan Chand.

Outcomes	➢ The students will be able to acquire sound knowledge in mathematical physics which will be necessary to pursue other areas in physics. ➢ The students will be able to demonstrate an ability to use vector analysis, matrices and special functions in the solution of physical problems.

Name of the Course Teacher
Dr. R. Sivakumar

Course Code: 521103	ELECTRONICS	Credits: 4	Hours: 5
Objectives	➢ The objective of the course is to impart in depth knowledge about Semiconductors, Diodes, Transistors, Operational amplifiers, etc. to the students. ➢ The theoretical knowledge gained in the class room can be experimented in the practical classes.		
UNIT I	**Semiconductor diodes: -** Introduction to Semiconductor- Intrinsic and extrinsic semicondurctors-PN Junction diode – Forward and Reverse bias of diode – Characteristics of FB and RB of diode - Zener diode- Gunn diode- Tunnel diode- Photo diode - Schottky diode - Laser diodes - Characteristics and Applications.		
UNIT II	**Transistor biasing and optoelectronic devices: -** Transistor action - PNP-NPN transistors – Transistor Amplifier – Transistor connections - DC load line- operating point- Bias stability - Transistor biasing and stabilization- Need for biasing- Methods of Transistor biasing - h parameters – Classification of Amplifiers – Power amplifier – Push-pull amplifier - JFET – JFET Amplifier – Biasing -MOSFET - UJT- SCR – DIAC - TRIAC.		
UNIT III	**Operational amplifier applications: -** Operational Amplifier- CMRR-Slew rate - Instrumentation amplifier – V to I and I to V converter – Op-amp stages- Equivalent circuits - Sample and Hold circuits. Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder- Subtractor- Differentiator- Integrator- Electronic analog Computation solving simultaneous and differential equation – Schmitt Trigger – Triangular wave generator – Sine wave generator – Active filters: Low, High and Band pass first and second order Butterworth filters – wide and narrow band reject filters.		
UNIT IV	**Memories (semiconductor, optical and magnetic): -** Classification of memories and sequential memory – Static Shift Register and Dynamic Shift Register, ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM, Content Addressable Memory - principle, block diagram and operation. Programmable Logic Array (PLA) - Operation, Internal Architecture. Charge Couple Device (CCD) - Principle, Construction, Working and Data transfer mechanism – Flash memory – Content addressable memories (CAM).		
UNIT V	**A/D and D/A converter: -** Sampling theorem-Time division multiplexing – Quantization – DAC- Weighted resistor method – Binary Ladder network – ADC – successive approximation, Dual slope and Counter method – Voltage to Frequency conversion and Voltage to Time conversion – Comparators – Sample and Hold.		

Reference and Textbooks:-

Albert Malvino. David Bates. (2017). *Electronic Principles*: McGraw Hill.

Choudhary D. Roy. (2018). *Linear Integrated Circuits*. New Age International Publishers.

Mehta, V. K. (2014). *Principles of Electronics*. S. Chand and Company.

Robert L. Boylestad. Louis Nashelsky. (2014). *Electronics Devices and Circuit Theory*. New York, NY:

Salivahanan, S. (2017). *Linear Integrated Circuits*. McGraw Hill Education.

Outcomes	On successful completion of the course, a student will be able to ➢ Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp ➢ Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators, and data converters

Name of the Course Teachers: Dr. G. Ravi
Dr. R. Yuvakkumar

Course code: 521104	ADVANCED ELECTRONICS LABORATORY-I	Credits: 4	Hours: 8
Objectives	➢ To study the basic components in discrete electronics. ➢ To exercise the practical using devices and circuits employing the discrete components.		
	(Any Fifteen of the following) 1. Construction of 9V regulated D.C Power supply using Zener diode and Percentage of Regulation. 2. Transistor Characteristics – Common emitter (Input and Output characteristics) – Estimation of Hybrid parameters. 3. Two stage R.C Coupled transistor amplifier with and without feedback. 4. Transistor as a switch and Schmitt trigger. 5. Monostable multivibrator (Transistor). 6. Characteristics of a FET. 7. Design of FET amplifier - CS Configuration. 8. Design of FET amplifier – Two stage. 9. Characteristics of UJT. 10. Characteristics of SCR. 11. Relaxation oscillator (UJT). 12. Logic Circuits (Discrete components). 13. Transistorized Hartely and Colpitt's audio oscillator. 14. Transistor Astable multivibrator. 15. Phase shift audio oscillator (Basic parameter). 16. Operational amplifier (Basic parameters). 17. Push-Pull amplifier (Transistor). 18. Emitter follower (Transistor). 19. Transistor receiver – Single band. 20. Any other experiments of equal standard.		
Outcomes	On successful completion of the course, a student will be able to ➢ Understand the concept of discrete components. ➢ Understand the basic operations in electronic circuits.		

Name of the Course Teacher
Dr. M. Sivakumar

SEMESTER - II

Course code: 521201	QUANTUM MECHANICS - I	Credits: 4	Hours: 5
Objectives	➢ To impart knowledge on the fundamental aspects of quantum mechanics to the students. ➢ To build a thorough conceptual understanding of quantum mechanics and to develop a realistic impression of the subject		
UNIT I	**Foundations:** Postulates of quantum mechanics – Physical interpretation of wave function and probability current density – Types of Operators – Eigen function and eigen values – Degeneracy – Expansion coefficient – Heisenberg Uncertainty principle and applications – Wave particle duality – Schrodinger equation – both time dependent and independent – Commutator – Expectation values – Stationary states – Admissibility condition on wave function – Ehrenfest's theorem – Applications to one dimensional problems – Tunnel effect – Free particle		
UNIT II	**Discrete Eigen Value Problem:** Particle in a box – Particle in a square well potential - quantum mechanical tunneling – Square potential barrier – Alpha emission – Spherical symmetry systems – Particle in a central potential - Three dimensional harmonic oscillator – Rigid rotator – Application to diatomic molecules – Hydrogen atom – Separation of variables and solution of R,θ,Φ equation – Discussion of bound states and parity.		
UNIT III	**Representation Theories:** Hilbert space – Normalized and Orthogonal wave function – Dirac's ket and bra vectors – One dimentional Harmonic oscillator – Properties of stationary states – Solution using ladder operator and matrix representation - Schrődinger, Heisenberg and interaction pictures.		
UNIT IV	**Approximation Methods:** Time independent Perturbation theory – Non degenerate case – Degenerate case – Energy correction – Zeeman effect without electron spin – Stark effect in hydrogen atom – Variation method – Ground state of helium atom – Ground state of Deuteron – W.K.B approximation – Application to bound states.		
UNIT V	**Time Evolution:** Time dependent perturbation theory – Constant perturbation – Transition probability – Fermi golden rule – Periodic perturbation – Harmonic perturbation – Adiabatic and sudden approximation. Spontaneous emission – Stimulated emission – Einstein's A & B coefficients – Semi – classical and quantum theory of radiation – Rayleigh and Raman scattering – Selection rules – forbidden transitions.		

Reference and Textbooks:

Ajoy Ghatak and S. Lokanathan, S. (2012*). Quantum Mechanics Theory and Applications* McMillan, Fifth Edition.

Aruldhas, G. (2008). *Quantum Mechanics*. PHI Learning Private Limited, New Delhi.

David, J. (2015). *Introduction to Quantum Mechanics*. Griffiths, Pearson Education Ltd., Second Edition.

Mathews, P. M. and Venkatesan, K. (2010). *A text book of Quantum Mechanics*. McGraw Hill.

Thankappan, V. K. (2018). *Quantum Mechanics*. NewAge International Publishers - 4th Edition.

Outcomes	On successful completion of the course, a student will be able to ➢ Know the background for the main features in the historical development of quantum mechanics ➢ Understand the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states, time evolution and expectation values

Name of the Course Teacher: Dr. R. Subadevi

Course code: 521202	MATHEMATICAL PHYSICS – II	Credits: 4	Hours: 5
Objectives	➢ To elaborate the information on complex variable and orthogonal functions. ➢ To provide a strong mathematical foundation in tensor analysis and group theory.		
UNIT I	**Complex Variable:** Cauchy-Riemann Conditions – Cauchy's fundamental theorem - Cauchy's Integral Formula – Taylor and Laurent Expansions – Mapping – Conformal Mapping, Singularities – Calculus of residues and Contour integrals – Cauchy's residue theorem.		
UNIT II	**Application of PDEs and Orthogonal Functions:** Heat equation – Laplace and Poisson equation - Wave equation – Method of separation of variables – Green's Function – Sturm-Liouville theory - Self – Adjoint PDEs – Gram-Schmidt Orthogonalization process.		
UNIT III	**Tensor Analysis:** Definition of Tensors – Contravariant, covariant and mixed tensors – Rank of a tensor - Coordinate transformation – Summation convention – Summation of coordinates – Order of tensors - Transformation law – Algebraic operations of Tensors – Symmetric and anti-symmetric tensor - Quotient law – Cartesian Tensors – Dual tensors, irreducible tensors -Metric Tensors - Christoffel symbols - Geodesics.		
UNIT IV	**Group Theory:** Definition of group – Sub groups - Cyclic groups and abelian groups - Homomorphism and Isomorphism of groups – Classes - Symmetry operations and symmetry elements – Representations of groups: Reducible and Irreducible – Proof of the Orthogonality theorem – Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules) – Physical applications of group theory: Crystal – Symmetry operators – Crystallographic Point Groups.		
UNIT V	**Theory of Probability:** Definitions of Probability - Simple Properties – Random Variables – Probability Distribution - Binomial Distribution – Poisson Distribution – Gauss's Normal Distribution.		
Reference and Textbooks: Albert Cotton, F. (2009). *Chemical Applications of Group Theory*. 3rd Edition. Wiley India (P.) Ltd. Dass, H.K, Rama Verma. (2010). *Mathematical Physics*. S. Chand and Company Ltd. Erwin Kreyszig. (2015). *Advanced Engineering Mathematics*. 10th Edition. Wiley International Student Version. Gupta, B.D. (2010). *Mathematical Physics*. 4th Edition. Vikas Publishing House Pvt. Ltd. Sathyaprakash. (2013). *Mathematical Physics*. Sultan Chand.			
Outcomes	➢ The students will be able to create and solve mathematical models of physical phenomena using analytic and numerical methods. ➢ The students will be able to formulate, interpret and draw inferences from mathematical solutions.		

Name of the Course Teacher
Dr. R. Sivakumar

Course code: 521203	ELECTROMAGNETIC THEORY	Credits: 4	Hours: 5
Objectives	➢ To impart the understanding on the fundamental aspects of electromagnetic theory to the students. ➢ To promote thorough knowledge in the various processes occurring in the plasma.		
UNIT I	**Electrostatics, Magnetostatics and Electromotive Force:** Columb's law - Gauss's law in differential form –Applications of Gauss's law - Poisson's equation - Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics. Lorentz force– Biot-Savart Law – divergence and curl of B – Ampere's Law – Electromagnetic induction - comparison of magnetostatics and electrostatics – Magnetic vector potential -Ampere's Law in magnetized materials. Ohm's Law – electromotive force - Faraday's Law – induced electric field – inductance – energy in magnetic field.		
UNIT II	**Maxwell's Equation and Electromagnetic Waves:** Maxwell's equations – Poynting theorem - Wave equation in terms of scalar and vector potential – Transverse nature of electromagnetic wave- Conservation of energy and momentum, continuity equation. Propagation of plane electromagnetic waves in (a) free space, (b) Isotropic and Anisotropic non- conducting medium and (c) conducting medium-skin depth-Polarization of electromagnetic waves.		
UNIT III	**Applications of Electromagnetic Waves:** Boundary conditions at the surface of discontinuity - Reflection and refraction of electromagnetic waves at the interface of non-conducting media –Fresnel's equations – Reflection and transmission coefficients at the interface between two dielectric media -Brewster's law and degree of polarization -Total internal reflection. Generation of Microwaves – Klystron, Magnetron - Wave guides: Rectangular and cylindrical waveguides- Resonant cavities.		
UNIT IV	**Dispersion and Scattering of EM Waves:** Normal and Anomalous dispersion – Dispersion in Gases – Experimental demonstration of Anomalous dispersion in gases-Solids and Liquids – Clasusius Mossotti relation – Lorentz formula – scattering and scattering parameters - Theory of scattering of e-m waves – Polarization of scattered light – Coherence and incoherence of scattered light.		
UNIT V	**Plasma Physics:** Introduction - Conditions for plasma existence – Occurrence of plasma – charged particles in uniform constant electric field, in homogeneous magnetic fields, simultaneous homogeneous electric and magnetic fields, in nonhomogeneous magnetic fields – Magnetohydrodynamics – Magnetic confinement -Pinch effect-Instabilities- Plasma waves.		

Reference and Textbooks:

Chopra and Agarwal. (2010). *Introduction to Electromagnetic Theory*. K. Nath & Co., Meerut.

Griffith, D. J. (2013).*Introduction to Electrodynamics*. Pearson Education Ltd.-4th Edn.

Laud, B. B. (2011). *Electromagnetics*. Wiley Eastern Company.

Satya Prakash. (2016). *Electromagnetic Theory and Electrodynamics*. Kedarnath Ramnath & Co.

Saxena, A. K. (2013). *Electromagnetic Theory and Applications*. Narosa Publishing house.

Outcomes	On successful completion of the course, a student will be able to ➢ Describe the electro and magnetostatics Maxwell's equations and propagation of EM waves ➢ Describe the application of electromagnetic waves to reflection, refraction, dispersion and scattering.

Name of the Course Teacher
Dr. M. Sivakumar

Course Code: 521204	ADVANCED PHYSICS LABORATORY	Credits: 4	Hours: 8
Objectives	➢ The main objective of this practical paper is to exercise the practicals in various advanced analytical experiments to the students. ➢ To give basic knowledge on spectrometer and microscope experiments to the students.		
	(Any Fifteen of the following) 1. Michelson Interferometer 2. q, n, σ - Elliptical fringes. 3. q, n, σ - Hyperbolic fringes. 4. Ultrasonic Interferometer – Construction of oscillator and measurements. 5. Powder photograph – X-ray method. 6. Hall Effect – Mobility and Hall constant determination. 7. Susceptibility by Guoy's method. 8. Susceptibility by Quincke's method. 9. Reflection grating spectrometer. 10. Polarizability of liquids – Hollow prism – Spectrometer. 11. Young's modulus – Cornu's method. 12. Thermal expansion using optical air wedge. 13. Ultrasonic interferometer. 14. Electron spin resonance spectrometer. 15. Magnetic Hysteresis loop tracer. 16. Determination of Plank's constant using photocell apparatus. 17. e/m by Millikan's oil drop method. 18. e/m by Thompson's oil drop method. 19. Pockels effect. 20. G.M. Counter - probability, Absorption measurements, half life.		
Outcomes	On successful completion of the course, a student will be able to ➢ Understand the basic principles of the experiments. ➢ Understand simple concepts to demonstrate an experiment.		

Name of the Course Teacher
Dr. S. Sudhahar

SEMESTER – III

Course code: 521301	ADVANCED MOLECULAR SPECTROSCOPY	Credits: 4	Hours: 5
Objectives	➢ The overall goal of this course is to show how basic concepts of quantum mechanics can be utilized to quantitatively explain atomic and molecular spectra. Students should learn that spectroscopic data cannot be understood without quantum mechanics. ➢ To give advanced knowledge about the interactions of EM radiation with matter and their applications in spectroscopy like IR, RAMAN, NMR, ESR, NQR and Mossbauer.		
UNIT I	**Microwave Spectroscopy:** Rotation of Molecules -Rotational energy of a diatomic molecule – Rigid and non-rigid rotators – isotopic substitution – Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra -Stark effect – its importance in microwave spectroscopy – quadrupole hyperfine interaction - Rotational spectra of polyatomic molecules – pure rotational Raman spectra – diatomic linear molecule – symmetric top molecules- Molecular structure – using IR & Raman spectroscopy.		
UNIT II	**Infrared Spectroscopy:** Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules—Franck-Condon principle – intensity distribution – portrait parabolae – disassociation - predisassociation – mutual exclusion principle. Normal modes of vibration in crystal-Interpretation of vibrational spectra-Group frequencies-IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications.		
UNIT III	**Raman Spectroscopy** Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra. Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering. Photo acoustic Raman Scattering-Multi photon spectroscopy-Two photon absorption- Multiphoton absorption. X-ray spectra; rotational and vibrational spectra of diatomic molecules.		
UNIT IV	**Resonance Spectroscopy:** Basic principles – Quantum theory of NMR - magnetic resonance – relaxation processes- Bloch equations – chemical shifts. Dipole –Dipole interaction and spin lattice interaction- spin-spin coupling - Spectra and molecular structure – Fourier Transform NMR –Instrumentation – Applications. Basic principles – Quantum theory - g-factor – Nuclear Interaction and Hyperfine structure - Relaxation effects - Hyperfine interaction – line widths – ESR -NQR (principle only) spectrometer – Instrumentation – applications.		
UNIT V	**Nuclear Quadrupole Resonance and Mossbauer Spectroscopy:** Basic theory - Nuclear Electric quadrupole interaction – Energy levels – Transition frequency – Excitation and Detection – Effect of magnetic field – Instrumentation – applications. Mossbauer effect - recoilless emission and absorption - hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions – ` Instrumentation – applications – Electronic structure – molecular structure – crystal symmetry and molecular structures.		

<table>
<tr><td colspan="2">Reference and Textbooks:
Astrophysical and Experimental Perspectives), (Eds.), Springer-Verlag, Berlin.
Chaudhuri. Mekkaden, R.K, Raveendran, M.V, Narayan, A.V. (2010) Recent Advances in Spectroscopy (Theoretical,
Gunter Gauglitz, David, S. (2014). Handbook of Spectroscopy, 1- 4 Volume, 2nd Edition, John Wiley & Sons, Inc.
Rita Kakkar, (2015). Atomic and Molecular Spectroscopy Basic Concepts and Applications, Cambridge University Press.
Roderick Wasylishen, E. (2012) NMR of Quadrupolar Nuclei in Solid Materials, Ist Edition, Wiley.
Shu-Lin Zhang, (2012) Raman Spectroscopy and its Application in Nanostructures, John Wiley & Sons, Inc.</td></tr>
<tr><td>Outcomes</td><td>On successful completion of the course, a student will be able to
➢ How atoms and molecules absorb and emit light and how this process can be affected by magnetic and electric fields.
➢ The contributions of transitions between rotational, vibrational and electronic states to the spectra of diatomic molecules, vibrations and electronic structure of polyatomic molecules.</td></tr>
</table>

Name of the Course Teacher
Dr. N. Anandhan

Course code: 521302	QUANTUM MECHANICS – II	Credits: 4	Hours: 5
Objectives	➢ To impart in depth knowledge on the advanced theories of quantum mechanics to the students. ➢ To expose the mathematical techniques those are used to elucidate the physical concepts.		
UNIT I	**Theory of Angular Momentum:** Angular momentum of a system of particles –Angular momentum operators– Commutation relations – Commutation relations of J_z, J_+, J_- – Eigen values of J^2 and J_z–Matrix representation of angular momentum –Spin Angular momentum – Spin ½, spin 1 -Pauli spin matrices –Addition of two angular momenta – C.G. coefficients for j = ½ system only.		
UNIT II	**Self Consistent Field:** Identical particles – Particle exchange Operator – Symmetric and anti-symmetric wave functions – Exchange degeneracy – Pauli's exclusion principle– Central field approximation –Thomson-Fermi Model of the Atom –Hartree equation – Hartree-Fock Equation – Alkali atoms Doublet intensity and doublet separation - Periodic Table.		
UNIT III	**Relativistic Quantum Mechanics:** Schrodinger relativistic equation–Klein-Gordan equation – Interaction with electromagnetic field–Application to Hydrogen atom – Dirac's Relativistic Hamiltonian – Plane wave solution–Dirac matrices and properties – Spin of a Dirac particle – Negative energy states –Spin-orbit interaction.		
UNIT IV	**Elements of Field Quantization:** Quantization of wave fields – Classical Lagrangian equation – Classical Hamiltonian equation – Elements of field quantization for non-relativistic field –Creation, destruction and Number Operators – Anticommutation relations – Quantization of relativistic field- Klein Gordon field- Dirac Field – Quantization of Electromagnetic field.		
UNIT V	**Scattering Theory:** Scattering cross section – Scattering amplitude –Kinematics of scattering process – Green's function – Born approximation and its validity – Scattering by screened Coulomb potential. Partial wave analysis: – Asymptotic behaviour – Scattering amplitude in terms of phase shifts - Optical theorem – Low energy scattering – Resonant scattering –Ramsauer Townsend effect – Scattering by square well potential.		

Reference and Textbooks:

Ajoy Ghatak and Lokanathan, S. (2012). *Quantum Mechanics Theory and Applications* .McMillan, Fifth Edition.

Aruldhas, G. (2008). *Quantum Mechanics*. PHI Learning Private Limited, New Delhi.

Devanathan, V. (2011). *Quantum Mechanics*. Alpha Science International Ltd, United Kingdom. Edition.

Mathews, P.M. and Venkatesan, K.(2010).*A text book of Quantum Mechanics*. McGraw Hill, New Delhi.

Thankappan V. K. (2018). *Quantum Mechanics* .NewAge International Publishers - 4th Edition, New Delhi.

Outcomes	On successful completion of the course, a student will be able to ➢ Apply principles of quantum mechanics to calculate observables on known wave functions ➢ Grasp the concepts of spin and angular momentum, as well as their quantization and addition rules and to explain physical properties of elementary particles based on quantum mechanics

Name of the Course Teacher
Dr. R. Subadevi

Course code: 521303	CONDENSED MATTER PHYSICS - I	Credits: 4	Hours: 5
Objectives	➢ To give strong foundation in the conceptual understanding of the development of solid state physics with appropriate theoretical background. ➢ To impart knowledge about crystalline structures, lattice vibrations, to the students. Understanding the content of this course will be useful for the students to carry out research work after the completion of Master's degree.		
UNIT I	**Crystal Physics:** Crystal Structure - Symmetry and Physical Properties of Crystals – Point groups, Bravais lattices, Space groups, Crystal lattice and Crystal structure, Symmetry elements, Crystal systems – Type of lattices –Lattice representation - Simple symmetry operations - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.		
UNIT II	**Crystal Diffraction:** X-rays and their generation - Moseley's law – Absorption of X-rays –X-ray diffraction – Reciprocal lattice – Reciprocal lattice to SC, BCC and FCC crystals- Important properties of the Reciprocal lattice – Diffraction Intensity - The Powder method – Powder Diffractometry - The Laue method -The Rotating Crystal method - Neutron Diffraction - Electron diffraction Applications.		
UNIT III	**Crystal Imperfections and Ordered Phases of Matter:** Point imperfections – Concentrations of Vacancy, Frenkel and Schottky imperfections – Line imperfections – Burgers Vector – Presence of dislocation – Surface imperfections- Polorans – Excitons. Ordered phases of matter: Translational and orientation order - Kinds of liquid crystalline order - Quasi crystals - Superfluidity.		
UNIT IV	**Lattice Dynamics:** Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum. Heat Capacity: Specific heat capacity of solids – Dulong and Petit's law - Vibrational modes - Einstein model - Density of modes in one and three dimensions - Debye Model of heat capacity.		
UNIT V	**Theory of Electrons:** Free electron theory, Band structure of solids, metals, insulators and semiconductors – Density of States - Hall effect and magneto resistance – Wiedemann – Franz law - Bloch functions - Bloch theorem - Kronig – Penney model - Limitations of K-P model.		

Reference and Textbooks:

Bain, A. K. & Chand, P. (2017). *Ferroelectrics*. Wiley.

Charles Kittel. (2012). *Introduction to Solid State Physics* (8th ed). New Delhi: John Wiley & Sons. India Pvt. Ltd.

Patterson, J. D. Bailey B.C. (2012). *Solid-State Physics: Introduction to the Theory*, Springer Publications.

Pillai, S.O. (2006). *Solid State Physics*, New Age International.

Wahab, M. A. (2015). *Solid State Physics – Structure and Properties of Materials* (2nd ed). Narosa publishers.

Outcomes	On successful completion of the course, a student will be able to ➢ Classify metals, semiconductors and insulators anchored in the energy band structure. ➢ Gain knowledge in reciprocal lattice vectors, symmetrical crystals, relationship between Miller indices (hkl) and the distance between the lattice plains.

Name of the Course Teacher

Dr. K. Sankaranarayanan & Dr.S.Sudhahar

Course code: 521304	ADVANCED ELECTRONICS LABORATORY - II	Credits: 4	Hours: 8
Objectives	➢ To understand the basic operations in electronic circuits and the concept of ICs manufacturing. ➢ To exercise the practical in various advanced digital electronics to the students.		
	(Any Fifteen of the following) 1. Half adders and Full adders. 2. Integrator and Differentiator circuits using IC 741. 3. Active filters using IC 741. 4. A/D converter. 5. Encoder - Decoder circuits. 6. Square wave, Sine wave and Triangular wave generators using IC. 7. Multiplexer circuits. 8. Flip – Flop circuits using IC. 9. Study of Counters. 10. Monostable multivibrator using op-amp. 11. Astable multivibrator using op-amp and using IC 555. 12. Schmitt trigger using op-amp. 13. Demultiplexer circuits. 14. Logic gates using IC's. 15. BCD to 7 segment display and BCD decoder. 16. Shift register and ring counter. 17. Operation of 7489 RAMS. 18. Arithmetic operations – Microprocessor 8085. 19. Logical operations - Microprocessor 8085. 20. Code conversion - Microprocessor 8085. 21. Any of the experiments of equal standard.		
Outcomes	On successful completion of the course, a student will be able to ➢ Develop the programming skills of Microprocessor. ➢ Exercise the applications of electronic circuits.		

Name of the Course Teacher
Dr. N. Anandhan

SEMESTER - IV

Course code: 521401	CONDENSED MATTER PHYSICS - II	Credits: 4	Hours: 4
Objectives	➢ To impart knowledge in dielectrics, magnetism and superconductivity. ➢ To understand and study basic concepts in ferroelectrics, piezoelectrics and physics of nanosolids.		
UNIT I	**Dielectrics:** Dipole moment – Polarization – Local electric field, Clausius-Mosotti relation – Polarization field – Lorentz field – Dielectric constant – Polarizability: The Classical theory of electronic polarizability – Ionic polarizabilities - Orientational polarizabilities - Frequency and temperature effects on Polarization – Dielectric breakdown and dielectric loss.		
UNIT II	**Ferroelectrics and Piezoelectrics:** Ferroelectric Crystals – Classifications of Ferroelectric crystals - Ferroelectric Transition - Antiferroelectricity - Ferroelectric domains – Ferroelectric domain wall motion – Piezoelectricity - Phenomenological approach to Piezoelectric effects - Piezoelectric parameters and their measurements - Piezoelectric materials.		
UNIT III	**Magnetic Materials:** Classification of magnetic materials – Langevin's theory of paramagnetism – Quantum theory of paramagnetism – Ferromagnetism – Weiss molecular field theory –The physical origin of Weiss molecular field - Ferromagnetic domains - Domain theory - Antiferromagnetism – Neel's theory – Ferrimagnetism and ferrites – Spin waves – Hard and soft magnetic materials – NdFeB Hard magnets & applications – High power magnets – Magnetic recording – Spintronics.		
UNIT IV	**Superconductivity:** Introduction – Meissner effect – Isotope effect – Type I and Type II superconductors –London equations – Coherence length – BCS Theory – Cooper pair – Normal tunneling and Josephson effect – DC Josephson effect - AC Josephson effect - Macroscopic quantum interference – High temperature super conductors – Applications.		
UNIT V	**Physics of Nanosolids:** Definition of nanoscience and nanotechnology – Preparation of nanomaterials – Surface to volume ratio – Quantum confinement of nanostructures – Qualitative and Quantitative description – Density of states of nanostructures – Excitons in Nano semiconductors – Carbon in nanotechnology – Buckminsterfullerene – Carbon nanotubes – Nano diamond – BN nano tubes – Graphene – Nanoelectronics – Single electron transistor – Molecular machine – Nano biometrics.		

Reference and Textbooks:

Bain, A. K, & Chand, P. (2017). *Ferroelectrics*. Wiley.

Charles Kittel. (2012). *Introduction to Solid State Physics* (8th ed.). New Delhi: John Wiley & Sons. Pvt. Ltd.

Patterson, J. D, & Bailey B. C. (2012). *Solid-State Physics: Introduction to the Theory*. Springer Publications.

Pillai, S.O. (2006). *Solid State Physics*, New Age International.

Wahab, M. A. (2015). *Solid State Physics – Structure and properties of Materials* (2nd ed.). New Delhi: Narosa Publishers

Outcomes	On successful completion of the course, a student will be able to • Gain noteworthy knowledge in dielectric, magnetic, ferroelectrics, piezoelectrics and superconducting materials. • Develop analytical thinking to understand various properties of solids thereby equip students to pursue higher education.

Name of the Course Teachers
Dr. G. Ravi & Dr. R. Yuvakkumar

Course code: 521402	NUCLEAR AND PARTICLE PHYSICS	Credits: 4	Hours: 4
Objectives	➢ To introduce students to the fundamental principles and concepts governing nuclear and particle physics. ➢ To understand the concept of elementary particles.		
UNIT I	**Nuclear Forces** Characteristics of Nucleus forces – Exchange forces and tensor forces – charge independence-Spin dependence of Nucleus forces - Yukawa's Meson theory of nuclear forces- Ground state of deuteron, Normalization of deuteron wave functions - Nucleon-nucleon scattering singlet and triplet parameters – Nucleon-Nucleon scattering: Cross-section, Differential Cross-section, Scattering Cross-sections – Magnetic moment-Quadrupole moment –S and D state admixtures - Effective range theory of n-p scattering at low energies.		
UNIT II	**Nuclear Models** Binding energy & mass defect – Weizacker's formula – mass parabola, Liquid Drop model – Bohr Wheeler theory - Shell model – Single particle model, its validity and limitations – Rotational Spectra - Magic numbers – Spin – orbit coupling - Angular momentum of nucleus ground states – Magnetic Moments of the shell model – Schmidt lines – Magnetic dipole moment – Electric quadrupole moment – Collective Model of Bohr and Mottelson: Nuclear vibration – Nuclear rotation –Nelson model.		
UNIT III	**Reaction Cross Sections, Nuclear Reactions and Reactors** Nuclear Fission and Fusion - Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions - Nuclear reaction - Q-value – Nuclear reaction cross section – Direct Nuclear reactions: Knock out reaction, Pick-up reaction, Stripping reaction – Compound nucleus theory – Formation – Disintegration energy levels – Partial wave analysis of Nuclear reaction cross-section - Resonance Scattering and Reaction cross-section (Breit-Wigner dispersion formula) – Scattering matrix - Reciprocity theorem – Breit-Wigner one level formula – Resonance scattering – Absorption cross section at high energy - Interaction of neutron with matter – Thermal neutrons – Neutron cycle in a thermo nuclear reactor – Critical size – Types of nuclear reactors - cylindrical and spherical- sub-nuclear particles (elementary ideas only) – source of stellar energy – controlled thermo nuclear reactions.		
UNIT IV	**Nuclear Decay** Gamow's Theory of Alpha decay - Fermi's theory of Beta decay – Kurie plots –Selection rules, Fermi & G.T Selection rules – Electron capture – Parity violation in Beta decay - Neutrinos – Measurement of neutrino helicity – Gamma decay – Angular momentum and parity selection rules - Internal Conversion Nuclear Isomerism - Positron's -source of Positron emitters-Biological application of nuclear particles in cancer therapy.		
UNIT V	**Elementary Particle Physics** Classification of fundamental forces–Particle Directory and quantum numbers (Charge, spin, parity, iso-spin, strangeness etc) – Leptons, Baryons and quarks - Spin and parity assignments, isospin, strangeness; The fundamental interactions - Phenomenology of weak interaction hadrons and leptons - Universal Fermi interaction – Elementary concepts of weak interactions– Translations in space – Rotations in space – SU(2) and SU(3) groups – Charge conjugation – Parity – Gell-Mann-Nishijima formula- Gell-Mann - Okubo mass formula for octet and decuplet hadrons - Time reversal–CPT invariance- Applications of symmetry arguments to particle reactions, Parity non-conservation in weak interaction; Relativistic kinematics.		

Reference and Textbooks:

Brian Martin, R. (2009), *Nuclear and Particle Physics: An Introduction*, 2nd Edition, John Wiley & Sons, Inc.

Irving Kaplan. (2012) *Nuclear Physics*, Narosa Publishing House.

Kakani Shubhra (2018) *Nuclear and Particle Physics* (Second Edition), Viva Publisher and Co. Pandya, M.L, Yadav, P.R.S. (2016) *Elements of Nuclear Physics*, Kedar Nath Ram Nath publications, Meerut. Tayal, D.C. (2018). *Nuclear Physics*, Himalaya Publishing House Pvt. Ltd., Vth Ed.	
Outcomes	On successful completion of the course, a student will be able to ➢ Identify the fundamental models of nuclear structure that are used to describe various modes of nuclear excitation. ➢ Learn applications of Nuclear Particles in medical imaging's.

Name of the Course Teacher
Dr. N. Anandhan

Course Code: 521403	THERMODYNAMICS AND STATISTICAL MECHANICS	Credits: 4	Hours: 4
Objectives	➢ The main objective of this paper is to impart understanding on the knowledge about the Statistical mechanics to the students. ➢ To discuss in details about the basics of quantum statistics.		
UNIT I	**Thermodynamics – I:** Basic postulates of thermodynamics – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations of state – Euler relation, densities - Gibbs-Duhem relation for entropy - Thermodynamic potentials – Maxwell relations – Thermodynamic relations – Microstates and macrostates – Ideal gas and real gases – Microstate and macrostate in classical systems – Microstate and macrostate in quantum systems – Density of states and Volume occupied by a quantum state. Thermodynamic processes: reversible, irreversible, quasi-static, adiabatic, isothermal.		
UNIT II	**Thermodynamics – II:** Micro canonical distribution function – Two level system in micro canonical ensemble – Gibbs paradox and correct formula for entropy – The canonical distribution function – Contact with thermodynamics - Partition function and free energy of an ideal gas – Distribution of molecular velocities – Equipartition and Virial theorems – The grand partition function – Relation between grand canonical and canonical partition functions – One-orbital partition function-derivation of thermodynamics from statistical mechanics principles		
UNIT III	**Classical mechanics – III:** Bose-Einstein and Fermi-Dirac distributions – Thermodynamic quantities – Fluctuations in different ensembles – Bose and Fermi distributions in micro canonical ensemble - Maxwell-Boltzmann distribution law for microstates in a classical gas - Physical interpretation of the classical limit – Derivation of Boltzmann equation for change of states without and with collisions – Boltzmann equation for quantum statistics – Equilibrium distribution in Boltzmann equation-non-equilibrium process; Joule-Thompson process-Free expansion and mixing-Thermal conduction-The heat equation.		
UNIT IV	**Quantum statistics – I:** Non-interacting Bose gas and thermodynamic relations – Chemical potential of bosons –pressure and energy density of bosons – Black body radiations and Planck's distribution law – Number density of photons and Bose condensation - Thermodynamic relations for non-interacting Fermi gas – Fermi gas at zero temperature – Fermi energy and Fermi momentum – Pressure and energy density – Fermi gas at low temperature – Mass less Fermi gas at any temperature, Particles and antiparticles - random walk, Brownian motion-transport processes; one speed and one dimension-All speeds and all directions-conserved properties-Distribution of molecular velocities-Equipartion and virial theorems.		
UNIT V	**Quantum statistics – II:** Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas – Heat capacities of solids; Dulong and Petit law, Einstein temperature and Debye theory – Heat capcities of metals – Heat capacitiy of Bose gas – One-dimensional Ising model and its solution by variational method – Exact solution for one-dimensional Ising model - Phase transitions and criterion for phase transitions – Classification of phase transitions by order and by symmetry – Phase diagrams for pure systems-Clausius-Clapeyron equation-Gibbs phase rule.		

<table>
<tr><td colspan="2">Reference and Textbooks:-
Ansermet, P. Brechet S.D. (2019). Principles of Thermodynamics and Statistical Mechanics. Cambridge University Press.
Garg, S.C. Bansal, R.M. Ghosh, C.K. (2017). Thermal Physics: With Kinetic Theory, Thermodynamics and Statistical
Koks, D. (2018). An Introduction to Statistical Mechanics. Springer.
Mechanics. McGraw Hill Education.
Palash B. Pal. (2008). An Introductory Course of Statistical Mechanics. New Delhi: Narosa Publishing House.
Puglisi, A. Sarracino, A. Vulpiani, A. (2018). Thermodynamics and Statistical Mechanics of Small Systems. Basel: MDPI</td></tr>
<tr><td>Outcomes</td><td>On successful completion of the course, a student will be able to
➢ Understand a general background in thermodynamics.
➢ Understand the basic theories and concepts in statistical mechanics.</td></tr>
</table>

Name of the Course Teacher
Dr. M. Ramesh Prabhu

ELECTIVE COURSES
SEMESTER - I

Course Code: 521501	**DIGITAL ELECTRONICS PRINCIPLES**	**Credits: 4**	**Hours: 4**
Objectives	➢ The main objective of this paper is to impart fundamental aspects of digital electronics principles to the students ➢ To give advanced knowledge about the interactions of Number systems, Codes, Logic gates and their applications.		
UNIT I	**Number systems and binary codes: -** Decimal System – Binary System – Octal System – Hexadecimal System – Conversion of Number Systems – Conversion of Decimal to Binary - Binary to Decimal – Decimal to Octal – Octal to decimal – Octal to Binary – Binary to Octal – Decimal to Hexadecimal – Hexadecimal to Decimal – Hexadecimal to Binary – Binary to Hexadecimal – Codes: Binary Coded Decimal Numbers (BCD) – 8421 code – ASCII code – EBCDIC code - Alphanumeric Codes – Error detecting code - Parity – Even parity and odd parity method - Encoder and Decoder (1 of 16 Decoder, BCD Decoder and LED Decoder).		
UNIT II	**Boolean algebra – logic gates – Karnaugh map and minimization: -** Logic Gates - Inverter or NOT Gate – OR gate – AND gate – NOR Gate – NAND Gate – Construction of circuit using IC chips – Action – Truth Table – Logic Symbol - Boolean Algebra: Boolean Operators – Logic Expressions - De Morgan's Theorems – Laws and rules of Boolean Algebra – Truth Table – Reducing Boolean Expressions - Karnaugh Map – Logic diagrams of Boolean expressions – Converting logic circuits into expressions- Don't Care-Conditions-Looping-pairs.		
UNIT III	**Sequential circuits, flip-flops, registers and counters: -** Sequential Circuits – Flip-Flop – Definition - R-S Flip-Flops – Clocked R-S Flip-Flop – Data Latch or D-Flip-Flop – Clocked Data Latch – J K Flip-Flop – T Flip-Flop – Master – Slave J K Flip-Flop – Registers – Shift Registers – Shift-left Register – Shift-right Register –Counters – Ring Counter – Ripple Counter- Propagation delay in ripple counters – Mod Counters, IC asynchronous counters, Asynchronous down counter.		
UNIT IV	**Arithmetic and logic circuits: -** Arithmetic and logic Circuits – XOR gates - Half Adder – Full Adder – Half-subtractor – Full-subtractor - Parallel Binary Adders – Parallel Binary Subtractors – Construction – Action and Truth Table- Carry propagation, IC parallel adder, 2's-complement system.		
UNIT V	**Input output unit: -** Magnetic Tape – Magnetic Disc – Magnetic Memory –Logic – Coincident Current – Memory – Memory Addressing – Semiconductor Memory – MOS – Random Access Memory (RAM)–STT- MRAM-DRAM-SRAM- Programmable Read only Memory – Erasable Programmable Read only Memory-Programmable Logic Devices- Applications of a programmable Logic Device-Expansion of word size and capacity.		

Reference and Textbooks:-

Anil K. Maini. (2018). *Digital Electronics Principles, Devices and Applications*, India, John Wiley & Sons Ltd.

Chattopadhyay, D. (2018). *Electronics: Fundamentals and Applications*, New Age International Publishers; 14th edition.

Herbert, T. Donald, S. (2017). *Digital Integrated Electronics*, McGraw Hill, Indian Edition.

Millman & Halkias. (2017). Integrated Electronics, 2nd Edition.

Puri, V.K. (2006). *Digital Electronics–Circuits and Systems*, New Delhi, Tata Mc-Graw Hill Publishing Company Ltd.(Chapters 1,2,4,5 and 6).

Outcomes	On successful completion of the course, a student will be able to ➢ Understand basic principles of the techniques presented in the course, their advantages and limitations ➢ Understand the requirements for discrete components suitable for each different

Name of the Course Teacher
Dr. S. Sudhahar

Course code: 521502	MODERN OPTICS	Credits: 4	Hours: 4
Objectives	The main objective of this paper is to ➢ Motivate light as an electromagnetic field as it arises from first principles in Maxwell's equations. ➢ The student will study reflection and transmission of light at a dielectric surface, leading to the Fresnel equations.		
UNIT I	**Basic Concept of Optics and Optical Materials:** Classification of optical processes, optical coefficients, complex refractive index and dielectric constant - Optical materials : Crystalline insulators and semiconductor, glasses, metal, molecular materials, doped glass and insulator characteristics - Optical Physics in the Solid state, crystal symmetry, electronic bands, vibronic band, the density of state, delocalized states and collective excitation - Light propagation: Propagation of light in dense optical medium - Atomic oscillator - Vibration oscillator - Free electron oscillation - The Kramers–Kronig relationship - Dispersion - Optical anisotropy – Birefringence - Matrix representation of polarization, Jones vector, Jones matrices, Jones calculus, orthogonal polarization - Reflection and refraction at a plane boundary - Fresnel's equations.		
UNIT II	**Excitons:** Basic concept - Free excitons in external electric and magnetic fields - Free Excitions at light densities - Frenkel excitons - Luminescence: Light emission in solids - Interband luminescence - Direct and indirect gap materials - Photoluminescence: Excitation and relaxation, degeneracy - Photoluminescence spectroscopy - Electroluminescence: General Principles of electroluminescence - Light emitting diodes, Diode laser - Spectral scanning and Separation by optical property - Applications in bioimaging.		
UNIT III	**Electromagnetism of Light Propagation:** Electromagnetism in dielectrics - Electromagnetic fields and Maxwell equation - Electromagnetic waves - Quantum theory of radiative absorption and emission - Einstein coefficients - Quantum transition rates, selection rules - Basic concept of phonons - Polaritons and polarons.		
UNIT IV	**Nonlinear Optics:** Physical origin of optical nonlinearities - Non resonant and resonant nonlinearities - Second order nonlinearities - Non liner frequency mixing - Crystal symmetry - Phase matching - Third order non linear media - Harmonic generation, mixing and parametric effects - Multiphonon processes - Two-photon absorption - Saturated absorption - Spectroscopy Rayleigh, and Raman scattering - Stimulated Raman effect - Hyper Raman effect - Coherent Antistoke Raman scattering - Self-focusing and self-phase modulation - Self-induced transparency - Solitons (Elementary ideas).		
UNIT V	**Optical Design, Fourier Optics & Holography:** Revision of geometrical optics - Fourier transforms - Impulse response transfer function - Scalar diffraction, spatial and temporal coherence - Image forming systems - Coherent and incoherent imaging - Spatial filtering - Holography (Fresnel, Fraunhofer, Fourier) - Holographic techniques and applications - Fourier transforming property of thin lens - Optical communication sources (LED, Lasers etc.) and detectors and optical, electro- and magneto-optic effects - Laser-matter interaction.		

Reference and Textbooks: Christoph Gerhard (2017) *Optics Manufacturing: Components and Systems*, 1st Edition, Christoph Daniel Malacara Hernandez (2017) *Fundamentals and Basic Optical Instruments*, 1st Edition, CRC Press. Gerhard, CTC Press. Izuka, K. (2008) *Engineering Optics*, Springer Verlag. Roshan Aggarwal, L. (2018) *Introduction to Optical Components* 1st Edition, CRC Press. Yu Kulchin, N. (2018) *Modern Optics and Photonics of Nano- and Microsystems*, 1st Edition, CRC Press.	
Outcomes	On successful completion of the course, a student will be able to ➢ Understand the physical aspects of Polarization and diffraction ➢ Acquire an introductory knowledge of non-linear optics

Name of the Course Teacher
Dr. N. Anandhan

Course code: 521503	THIN FILM PHYSICS	Credits: 4	Hours: 4
Objectives	➢ To understand the basic concepts of thin films technology. ➢ To acquire the knowledge about thin film coating methods, its characterization methods and its applications.		
UNIT I	**Preparation of Thin Film:** Nature of Thin Film-Deposition Technology-Distribution of Deposit- Resistance Heating-Thermal Evaporation-Flash Evaporation.		
UNIT II	**Deposition Techniques:** Electron Beam Method- Cathodic Sputtering-Glow Discharge Sputtering- Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition.		
UNIT III	**Film Thickness & its Control:** Mass Methods-Optical Method-Photometry-Ellipsometry-Interferometry- Other Methods-Substrate Cleaning-Microscopic Defect and Dislocation- Edge Dislocation-Screw Dislocation-Boundary Defect-Stress Effect-Removal of Defect-Defect and Energy State.		
UNIT IV	**Thin Film Analysis:** Electron Diffraction Technique- High Energy Electron Diffraction-Low Energy Electron Diffraction-Electron Microscopy-Scanning Electron Microscopy - X-ray Photoelectron Spectroscopy-Mass Spectroscopy-Thermodynamics of Nucleation-Nucleation Theories- Film Growth-Incorporation of Defects, Impurities etc. in Film-Deposition Parameters and Grain Size.		
UNIT V	**Thin Film Growth Process:** Epitaxy -Thin Film Structure-Substrate Effect-Epitaxial Deposit-Twinning and Multi twinning-Phase Transition-Dissociations-Film Thickness Effect- Crystal Growth Process.		

Reference and Textbooks:

Donald Smith (1995). *Thin Film Deposition*, Tata Mc GrawHill

Freund, L.B, Suresh, S. (2009). *Thin Film Materials: Stress, Defect Formation and Surface Evolution*, 1st Edition,Cambridge University Press.

Goswami, A. (1996). *Thin Film Fundamentals-New Age International*-New Delhi.

Meissel, L.T, Glang, R. (2015). *Handbook of Thin Film Technology*, McGraw Hill.

Milton Ohring (1992). *Materials Science of Thin Films*, Academic Press.

Outcomes	On successful completion of the course, a student will be able to ➢ Understand the physical aspects of thin films and preparation techniques. ➢ Acquire an introductory knowledge of thin films and its recent applications.

Name of the Course Teachers
Dr. G. Ravi
Dr. N. Anandhan

SEMESTER - II

Course code: 521504	MICROPROCESSOR AND INSTRUMENTATION	Credits: 4	Hours: 4
Objectives	➢ To provide students with the necessary foundation for entry-level industrial applications in process monitoring and controlling, with an emphasis on analysis, problem solving, exposure to open-ended problems and design methods. ➢ To design an application based on microcontrollers or microprocessors.		
UNIT I	**Microprocessor Architecture (8085 and 8086):** Introduction, Intel 8085 : Architecture, Instruction Cycle, Timing Diagram: Op-code fetch, Memory read & Memory write – Instruction Set : Instruction and Data Format, Addressing Modes, Status Flags, Instructions Set, Data Transfer, Arithmetic, Branching, and Logical group operations - Interrupts - Architecture of 8086, Pin Configuration, Register organization, Minimum and Maximum mode operation – Addressing Modes – Interrupts – Hardware and Software.		
UNIT II	**Programming of Microprocessor:** Instructions for 8085 – Software development tools – Assembly language programs with data transfer, arithmetic, logical, bit level instructions and branch instructions -Interrupts and interrupt service routines-Subroutine – Flow charting – Loops – Pseudo instructions – Stack Operations- Programming and applications: Traffic control system.		
UNIT III	**Micro-Controller:** Introduction to 8 bit micro-controller, Architecture of 8051-Hardware features of 8051 - Signal description of 8051-General Purpose and Special Function Registers- Oscillator and clock circuit-I/O Port-Memory organization and I/O addressing by 8051, Interrupts of 8051-Instructions set of 8051-Programming of 8051 (Simple Arithmetic and Logical programs)		
UNIT IV	**Interfacing Devices:** Address space partition - Memory & I/O Interfacing – Data transfer schemes – Interrupts - I/O Ports – Programmable Peripheral Interface: 8255 – Programmable Interrupt Controller :8259– Programmable DMA Controllers:8257 – Programmable Communication Interface:8251 - A/D Sub systems- Applications – Temperature monitoring and Stepper motor control.		
UNIT V	**Electronic Instrumentation** Instrumentation amplifiers, Sample and hold circuits, Comparators, – D/A – Weighted resistor method – Resistor ladder net work method – A/D – Successive approximation method - Classification of transducers - Temperature transducers: thermo-resistive transducers, thermoelectric, p-n junction, chemical thermometry - Displacement transducers: potentiometer, resistive strain gauges, capacitive displacement transducer, LVDT transducers - Photoelectric transducers: photovoltaic cell, photoconductive cell- Piezoelectric transducers.		

Reference and Textbooks:

Daniel Tabak. (2012). *Advanced Microprocessors*. New Delhi: Tata Mc Graw Hill.

Nagoor Kani, A. (2012). *Microprocessors and Microcontrollers.* New Delhi: Tata Mc Graw Hill.

Ram, B. (2010). *Fundamentals of Microprocessors and Microcomputers* (8th Edition). New Delhi: Dhanpat Rai Publications (P) Ltd.

Ramesh Gaonkar. (2010). *Microprocessor Architecture, Programming and Application.* New Delhi: Pri-Penram International Publishing.

Ray, A. K. (2006). *Advanced Microprocessors and Peripherals*. New Delhi: Tata Mc Graw Hill.

Outcomes	On successful completion of the course, a student will be able to ➢ Develop the programming skills of microprocessor. ➢ Appreciate the applications of microcontroller programming.

Name of the Course Teacher
Dr. K. Sankaranarayanan

Course code: 521505	QUANTUM CHEMISTRY	Credits: 4	Hours: 4
Objectives	➢ To impart basic knowledge about quantum chemistry to the student. ➢ To study the basic data recognizing and accounting for uncertainties.		
UNIT I	**Ab-Initio Methods:** Accuracy and scaling- Classes of methods – Hartree-Fock (HF) - Post HF methods - Multi-configurational self-consistent field (MCSCF) - Density functional theory - Variational formulation- LDA		
UNIT II	**Operator Concepts:** Operators-second, third, fourth postulates of QM, derivative of an operator with respect to time - Eigen functions and position operator-Dirac Delta function- projection operator-density operator and density matrix.		
UNIT III	**Simple Spectroscopic Applications:** Quantum mechanical picture of chemical bonding – Symmetry aspects of molecular orbital – Valence bond – M-O bond theories – Comparison – Heitler – London theory for H_2 molecules.		
UNIT IV	**Molecular Orbital Theory:** LCAO approximation- The Huckle approximation – Hund's Rule and Exclusion principle-Bonding character of Orbitals- Hybridization – Molecular orbital of CH_4, C_2H_4, C_2H_2, Benzene, Water-Hydrogen bonding.		
UNIT V	**Symmetry:** Types of symmetry operations, point groups-Properties-Determination and representation-Character table-Symmetry properties and quantum mechanics.		
Reference and Textbooks: Albert Cotton, F. (2009). *Chemical applications of Group Theory* (3rd Edition). Wiley India (P.) Ltd. 3rd Edn. Reprint. Chandra, A. K. (2012). *Introductory Quantum Chemistry (*4th Edn). Tata McGraw Hill, 9th reprint. Donald A Mc Quarrie, (2016). *Quantum Chemistry.* Viva student edition. Ira N. Levine. (2014). *Quantum Chemistry*. Pearson. Prasad, R. K. (2007). *Quantum Chemistry* (3rd Edn). New Delhi: New Age International Publishers.			
Outcomes	On successful completion of the course, a student will be able to ➢ Design, set up and carry out experiments. ➢ To analyze data recognizing and accounting for uncertainties; and compare results with theoretical predictions.		

Name of the Course Teacher
Dr. M. Sivakumar

Course Code: 521506	COMMUNICATION ELECTRONICS	Credits: 4	Hours: 4
Objectives	➢ To understand the basic concepts of communication and optical communication system. ➢ To identify different types of modulation and multiplexing formats and to compute a simple optical power budget.		
UNIT I	**Antennas & wave propagation: -** Terms and Definition - Effect of Ground on Antennas-Grounded λ/4-Ungrounded Antenna λ Antenna- Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas- Sky Wave Propagation- Ionosphere- Eccles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation. Basic Antenna parameter, Antenna Measurements-Radiation pattern, Gain Impedance.		
UNIT II	**Microwaves: -** Microwave Generation-Multicavity Klystron-Reflex Klystron-Magnetron- Travelling Wave Tubes (TWT) and other Microwave Tubes-MASER-Gunn Diode, Microwave propagation: Line of sight propagation, Attenuation of Microwaves by Atmospheric gases water vapors and precipitates, RWH (Ridley-Watkins-Hit sum) Theory, Microwave cavities, Microwave circulators and isolators.		
UNIT III	**Radar and television: -** Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems- Radar Antennas-Duplexers-Radar Receivers and Indicators- Pulsed Systems-Other Radar Systems- Colour TV Transmission and Reception, Application & limitations of Radar, Radar waveforms, Radar block diagram.		
UNIT IV	**Communication electronics: -** Analog and Digital Signals - Modulation - Types of Modulation- Amplitude modulation theory - Frequency spectrum of the FM wave - Effects of noise on carrier, Amplitude- Modulation index, AM-receivers & FM Transmitters, FM- Broadcast receiver- Wireless telecommunication-Second generation-Third Generation-Fourth generation-Latest Generation.		
UNIT V	**Optical fibers: -** Propagation of Light in an Optical Fiber-Acceptance Angle-Numerical Aperture- Step and Graded Index Fibers-Optical Fiber as a Cylindrical Wave Guide-Fiber Losses and Dispersion-Applications - Single mode and Multimode Fibers, photonic crystal fibers, Preparation of optical fiber- Optical fibers cables and design-Laser based underwater communication systems.		

Reference and Textbooks:-

Khare, A, Tiwari, U.S. Sethi, I. Singh, N. (2019). *Recent Trends in communication*, computing, and Electronics. Springer Publication.

Kennedy, G. Prasanna, SRM. Davis, B. (2017). *Kennedy's Electronic Communication System*. Tata McGraw Hill.

Simon Haykin-John. (2018). *Communication Systems*. Wiley & Sons.

Stewart D. Personick. (2013). *Fiber Optics technology & Applications*. Delhi: Khanna Publishers.

Taub, H. Donald L. Schilling. Saha, G. (2017). *Principles of Communication Systems*. McGraw Hill Education

Outcomes	On successful completion of the course, a student will be able to ➢ Design, set up and carry out experiments; analyse data recognizing and accounting for uncertainties; and compare results with theoretical predictions. ➢ The basic components of an Electronic communication system include a

	transmitter, a communication medium or channel, a receiver and noise. Information is transmitted into the system in analog or digital form; it is then processed and decoded by the receiver.

Name of the Course Teachers
Dr. M. Ramesh Prabhu
Dr. S. Sudhahar

SEMESTER - III

Course code: 521507	PHYSICS OF NANOMATERIALS	Credits: 4	Hours: 4
Objectives	➢ To impart the basic knowledge on the exotic properties of nanostructured materials at their nanoscale lengths. ➢ Acquire the knowledge on various nanoparticles process methods and their skills and to study the reactive merits of various process techniques.		
UNIT I	**Introduction:** Introduction – Nanoscience and Nanotechnology - Classification of nanomaterials: Definition of Zero, one and two dimension nano structures – Examples - Classification of synthesis methods - Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization - Steric stabilization – DLVO theory.		
UNIT II	**Functional Nanomaterials:** Carbon Fullerenes and Nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes - Micro and Mesoporous Materials: Ordered mesoporous structures, Random mesoporous structures, crystalline microporous materials - Core-shell structures: Metal-oxide structures, Metal-polymer structures, Oxide-polymer structures - Organic- Inorganic Hybrids - Intercalation Compounds – Nanocomposites.		
UNIT III	**Properties:** Physical properties of nanomaterials: Melting points, Specific heat capacity and lattice constants – Mechanical properties – Optical properties - Surface Plasmon Resonance – Quantum size effects – Electrical property: Surface scattering, charge of electronic structure, Quantum transport, effect of microstructure - Ferroelectrics and dielectrics – Variation of magnetism with size-Super paramagnetism-Diluted magnetic semi conductor.		
UNIT IV	**Synthesis:** Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition plasma arching - Sol gel - Ball milling technique - Reverse miceller technique – Electrodeposition - Synthesis of Semiconductors: Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.		
UNIT V	**Characterization and Applications:** Structural Characterization: X-ray diffraction – Scanning tunneling Microscopy – Transmission Electron Microscopy – Chemical Characterization: Elemental Analysis - Optical Properties. Applications: Molecular electronics and Nano electronics, Nano electromechanical systems- Colorants and pigments –DNA chips – DNA array devices – Drug delivery systems – Nano Energy Systems.		

Reference and Textbooks:

Christof M. Niemeyer & Chad A. Mirkin. (2004). *Nanobiotechnology: Concepts, Applications and Perspectives*, Wiley-VCH Verlag GmbH & Co. KGaA.

Charles P. Poole & Frank J. Owens. (2003). *Introduction to Nanotechnology.* Wiley Interscience.

Mark A. Ratner & Daniel Ratner. (2002). *Nanotechnology: A gentle introduction to the next Big Idea (*1st ed). Prentice Hall P7R.

Pradeep, T. (2007). *The Essentials, Nano.* Tata MC Graw-Hill publishing company limited

Wilson, M, Kannangara, K, Smilt, G, Simmons, M & Raguse, B. (2005). *Nanotechnology Basic Science and Emerging Technologies*. Overseas Press.

Outcomes	On successful completion of the course, a student will be able to ➢ Gain noteworthy knowledge in CMOS technology to molecular electronics,

	spintronics, nanophotonics and quantum computations and understand the various process techniques available for the processing of nanostructured materials. ➢ To understand creation, manipulation and applications of materials at nanometer scale.

Name of the Course Teachers
Dr. G. Ravi
Dr. R. Yuvakkumar

Course code: 521508	SOLAR ENERGY UTILIZATION	Credits: 4	Hours: 4
Objectives	➢ To impart fundamental aspects of solar energy utilization to the students. ➢ To know the most important factors that determine the cost-efficiency of a PV system and be able to perform simple cost analysis		
UNIT I	**Heat Transfer & Radiation Analysis:** Conduction Convection and Radiation – Solar Radiation at the earth's surface - Determination of solar time – Solar energy measuring instruments.		
UNIT II	**Solar Collectors:** Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.		
UNIT III	**Solar Heaters:** Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.		
UNIT IV	**Solar Energy Conversion:** Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo-electric conversion - Process flow of silicon solar cells- Different approaches on the process- texturization, diffusion, antireflective coatings, metallization.		
UNIT V	**Nanomaterials in Energy Storage Devices** Batteries- Basic Battery Theory – Definitions of fundamental quantities - Classifications of Batteries- Advantages of Batteries for Bulk energy storage. Use of nanostructures and nanomaterials in fuel cell technology - High and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts - Use of nano technology in hydrogen production and storage.		

References and Textbooks:

Kothari, D.P. & Singal, K.C. (2011). *Renewable Energy Resources and Emerging Technologies.* PHI learning.

Leonid A. Kosyachenko. (2015). *Solar Cells New Approaches and Reviews*. Intech.

Rai, G.D. (2011). *Solar Energy Utilization*. Delhi: Khanna Publishers.

Rai, G.D. (2011). *Non-Conventional Energy Sources*, 5th Edn. Khanna Publishers.

Sukhatme, S.P. (2011). *Solar Energy – Principles of Thermal Collection & Storage.* Delhi: TMH,

Outcomes	On successful completion of the course, a student will be able to ➢ Have in-depth knowledge of the structure of a solar module and what determines the efficiency. ➢ Have knowledge about the components and design of on-grid PV systems, building integrated PV systems and off-gird PV systems.

Name of the Course Teachers
Dr. M. Sivakumar
Dr. R. Subadevi

Course Code: 521509	BASIC CONCEPTS OF INSTRUMENTATION	Credits: 4	Hours: 4
Objectives	➢ The main objective of this paper is to impart aspects of basic concepts of instrumentation to the students. ➢ To understand the basic operations in electronic circuits and go for its applications.		
UNIT I	**Static characteristics of instruments: -** Types of errors – Static Performance Parameters – Accuracy, Precision, Resolution – Linearity – Hysteresis – Dead Band – Backlash – Drift - Impedance loading and Matching. Mathematical description of data distribution function - functions - propagation error Analysis of data- systematic error.		
UNIT II	**Dynamic characteristics of instruments: -** Instrumentation and system design- Dynamic Response: Periodic Input Harmonic Signal - First order – Second order system - Response to step input and transient input – Compensation networks.		
UNIT III	**Analog and digital transducers: -** Analog transducers: Electrochemical – Potentiometric Resistive – Inductive – Capacitive linear variable differential transformer capacitive transducer -Piezo-Electric transducers – Digital transducers: Frequency Domain, Electromagnetic Frequency Domain – Opto-Electrical Frequency Domain – Vibrating String Transducers.		
UNIT IV	**Transducers – I: -** Moderate Pressure: Manometers, Elastic Transducers – High Pressure measurement – Temperature measurements: Non-Electrical Methods – Bimetallic Thermometer – Liquid in Glass Thermometer – Pressure Thermometers – Low temperature thermometer-Semiconductor thermometer - Magnetic thermometer - Electrical Methods: Electrical Resistance Thermometers- semiconductor temperature sensors.		
UNIT V	**Transducers – II: -** Transducer properties -Flow Measurement: primary or Quantity Meters – Positive Displacement Meters- Nutating Disc Meter – Sliding Vane Type – Lobed impeller meter – Acoustic Measurements – Sound Level Meter – Frequency Analysis of Noise Signal –Sound Intensity Measurements – Microphones – Capacitor Type – Electret Microphone – Photo conduction detector - Photo emission detector - Strain gauges -Piezo Electric Crystal Type and application of piezo Electric, Piezo Electric Transducers – Electrodynamic Type.		

Reference and Textbooks:-

Gooneratne, C. P. Li, B. Deffenbaugh, M. Mollendick, T. (2018). *Instruments, Measurement principles and communication Technologies for Downhole Drilling Environments*. Springer.

Ghosh Arun, K. (2014). *Introduction to Transducers*. PHI Learning Pvt. Ltd

Rajput, R. K. (2016). *Electrical and Electronics Measurements and Instrumentation*. S Chand & Company.

Nakra, B. C. Chaudhry, K. K. (2011). *Instrumentation Measurement and Analysis*. New Delhi: TMH.

Sawhney, A. K. (2015). *A Course in Electronics Measurements and Instrumentation*, Dhanpat Rai & Co. (P) Limited.

Outcomes	On successful completion of the course, a student will be able to ➢ Understand and describe the fundamental principles behind the methods of instrumentation which are included in the curriculum. ➢ Analyze, interpret and present observations from the different methods.

Name of the Course Teacher
Dr. M. Ramesh Prabhu

SEMESTER – IV

Course Code: 521510	ELEMENTARY NUMERICAL ANALYSIS	Credits: 4	Hours: 4
Objectives	➢ The main objective of this paper is to impart understanding on the basics of C program and its applications. ➢ To understand the concept of Elementary numerical analysis to the students.		
UNIT I	**C programming: -** Introduction – Basic structure of C Program – Operators and Expressions – Library functions – getchar Functions and putchar Functions – Control Statements – Arrays and strings – Pointers – Structures and Unions.		
UNIT II	**Error, computer arithmetic and root finding: -** Errors: Definition, sources, Propagation of error, summation, least squares data fitting, eigen value problem, nonlinear systems - Bisection method, Newton's method: Error analysis, error estimation - Secant method: Error analysis, comparison of Newton and Secant methods – Truncation error – Horner's method – Method of false positioning.		
UNIT III	**Interpolation: -** Polynomial interpolation: linear interpolation, Quadratic interpolation, higher-degree interpolation, divided differences, properties of divided differences, Newton's divided difference interpolation – Lagrange interpolation – Central difference interpolation – Inverse interpolation.		
UNIT IV	**Numerical integration and ordinary differential equations: -** Newton-cote's quadrature formula - The Trapezoidal and Simpson rules - Error formulae: An error formula for Trapezoidal and Simpson's rule - Richardson Extrapolation, periodic interpolation - Ordinary differential equations: theory of differential equations - Euler's methods - Taylor and Runge-Kutta methods second order and third order (no derivation).		
UNIT V	**Solution of systems of linear equations: -** Systems of linear equations - Gaussian elimination: Partial Pivoting, calculation of inverse matrices, operations count - The LU Factorization: Compact Variants of Gaussian Elimination - Tri-diagonal systems - Iteration methods: Jacobi method and Gauss-Seidel method.		
Reference and Textbooks:- Atkinson, K. Han, W. (2011). *Elementary Numerical Analysis*, Wiley-India, 3rd Edition Balagurusamy, E. (2017). *Numerical Methods*, McGraw Hill Education. Burden, R.L. Faires, J.D. Burden, A.M. (2016). *Numerical Analysis* (10th Edition), Cengage Learning. Grewal, B.S. Grewal, J.S. (2013). *Numerical Methods in Engineering and Science*, Delhi, Khanna Publishers, 11th Edn. Miller James E. et.al. (2011). *Elementary Theory and Application of Numerical Analysis*, McGraw-Hill Ltd.			
Outcomes	On successful completion of the course, a student will be able to ➢ Create and solve mathematical models of physical phenomena using numerical methods ➢ Understand basic principles, structure and function of C programming.		

Name of the Course Teacher
Dr. S. Sudhahar

Course code: 521511	SOLID STATE IONICS	Credits: 4	Hours: 4
Objectives	➢ To impart in-depth knowledge on the basic and advanced technologies of solid state ionics to the students. ➢ To consider the understanding of the complex mechanism in Lithium batteries.		
UNIT I	**Superionic Materials:** Basics of ionic and covalent materials- Superionic Materials- Crystalline anionic and cationic conductors- Mixed ionic and electronic conductors- Structural factors responsible for high ionic conductivity.		
UNIT II	**Battery Materials – Electrodes:** *Anode Materials*: An Overview: Introduction Lithium metal and carbon based materials –Compounds and composites Sn, Sb and Al-Metal Oxides. *Cathode Materials:* Trends in cathode materials -Methods of synthesis-Effect of particle size and morphology on cathode behavior- Cathode Materials: $LiNiO_2$, $LiCoO_2$, Manganese spinals, Layered Li_XMnO_2 and similar cathodes-3V cathodes, a special case: $LiFePO_4$.		
UNIT III	**Battery Materials- Electrolytes and Interfaces:** Electrolytes: Liquid Electrolytes- Polymeric electrolytes: molten salt –Lithium transport in lithium batteries-Polymer electrolytes in lithium batteries. *SEI Formation*: Introduction -SEI formation: Principles and routes of the SEI formation- Structure of the SEI.		
UNIT IV	**Analytical Techniques:** X-ray and Neutron scattering - Transport properties- Ion dynamics (Microscopic properties)-Spectroscopic techniques - Surface morphology, FT-IR, Raman analyses of super ionic materials - Impedance spectroscopy of super ionic materials.		
UNIT V	**Solid State Batteries and Conversion Devices:** Solid State Batteries- Thermodynamics and Mass transport in solid state batteries -Battery performance and electrode kinetics- Double layer and other polarization effects at solid/solid interface. Fuel Cells: Introduction, operation- Types of fuel cells and applications- Electrochromic devices - Super capacitors.		

References and Textbooks:

Balbuena, P. B & Wang, Y. (2004). *Lithium-ion-Batteries Solid Electrolyte Interphase*. University of South Carolina, Imperial College Press.

Helena Berg. (2015). *Batteries for Electric Vehicles.* Cambridge University Press.

Minami, T., Tatsumisago, M., Wakihara, M., Iwakura, C., Kohjiya, S & Tanaka, I. (2005). *Solid State Ionics for Batteries*. Springer.

Nazri, G.A & Pistoia, G. (2004). *Lithium Batteries Science And Technology.* Kluwer Academic Publishers.

Zanello, P. (2003). *Inorganic Electrochemistry, Theory, Practice and Application*. The Royal Society of Chemistry.

Outcomes	On successful completion of the course, a student will be able to ➢ Describe the components and processes in batteries: separators, binder, electrolyte, additives, ion insertion/de-insertion, solid electrolyte interphase (SEI) formation, degradation (cycle life, calendar life, overcharging) ➢ Analyze the Li-ion battery development and safety issues (thermal runaway, short-circuiting, fire/explosion hazard) and to familiarize with the characterization methods of batteries.

Name of the Course Teachers
Dr. M. Sivakumar
Dr. R. Subadevi &Dr. M. Ramesh Prabhu

Course Code: 521512	CRYSTAL GROWTH AND THIN FILM PHYSICS	Credits: 4	Hours: 4
Objectives	➢ The objective of the course is to impart knowledge about Crystal structures, various crystal growth methods, Thin Film deposition and some of the essential characterization techniques. ➢ The theoretical knowledge gained in the class room can be experimented in the crystal growth and thin film laboratories at our department. This may pave way for further studies in this field.		
UNIT I	**Basic concepts, nucleation and growth kinetics: -** Ambient phase equilibrium – Supersaturation – Equilibrium of finite phases - Thomson-Gibbs Equation – Gibbs free energy – Types of nucleation – Formation of critical nucleus – Classical theory of nucleation – Homo and heterogeneous formation of 3D nuclei – Rate of nucleation – Growth from solutions, melts and vapor phases – Epitaxial growth – Growth mechanism and classification – Growth Kinetics of epitaxial films – Mechanism and control for nanostructures in 0 and 1 dimensions.		
UNIT II	**Crystallization principles and growth techniques: -** Crystalline and noncrystalline materials - Crystal systems – Crystal symmetry – Space lattice - Bravais lattice - Reciprocal lattice - Crystal planes - Bragg's law - Solvents and solutions – Solubility diagram – Super solubility – Expression for supersaturation – Metastable zone and induction period – Miers TC diagram – Solution growth – Slow cooling, slow evaporation and temperature gradient methods – Constant temperature bath as a crystallizer – High temperature solution growth – Choice of flux – Top seeded solution growth.		
UNIT III	**Gel, melt and vapor growth techniques: -** Principle of gel technique – Various types of gel - Structure and importance of gel – Methods of gel growth and advantages - Melt technique – Czochralski growth – Floating zone – Bridgeman method – Horizontal gradient freeze –Hydrothermal growth – Vapor-phase growth – Physical vapor deposition – Chemical vapor deposition – Stoichiometry – Phase diagram.		
UNIT IV	**Thin film deposition techniques: -** Vacuum evaporation - Hertz-Knudsen equation - Evaporation from a source - Film thickness - E-beam, pulsed laser and ion beam evaporations - Glow discharge and plasmas - Mechanisms and yield of sputtering processes – DC, rf, magnetron sputtering, reactive sputtering – Spray pyrolysis – Electro deposition – Sol-gel technique – Spin coating – Dip coating.		
UNIT V	**Characterization techniques: -** X–ray diffraction – Fourier transform infrared analysis – Elemental dispersive X-ray analysis – Transmission and scanning electron microscopy – UV-Vis-NIR spectrometer – Chemical etching – Vickers micro hardness – Basic principles and operations of AFM and STM - X-ray photoelectron spectroscopy for chemical analysis – Ultraviolet photoemission spectroscopy analysis for work function of the material - Photoluminescence – Thermoluminescence – Thickness measurement.		

Reference and Textbooks:-

Kaufmann, E.N. (2012). *Characterization of Materials*, Volume-I (John Wiley, New Jersey).

Goswami, A. (2008). *Thin Film Fundamentals,* New Delhi, New Age.

Muller, G. Jacques Metois, J. Rudolph, P. (2004). *Crystal growth-from fundamentals to technology*, Elsevier publication.

Markov, I.V. (2003). *Crystal Growth for Beginners*, Second Edition, World Scientific Publishing Co.

Pvt. Ltd. Santhanaragavan, P. Ramasamy, P. (2001). *Crystal Growth Process and Methods,* Kumbakonam KRU Publications.	
Outcomes	On successful completion of the course, a student will be able to • Give an introduction to elementary crystal growth principles, various crystal growth and thin film techniques that allows them to prepare for a master or Ph.D. project in this field. • Understanding the basic concept of structural, optical and surface textural analyses.

Name of the Course Teachers
Dr. G. Ravi
Dr. K. Sankaranarayanan
Dr. S. Sudhahar

SPECIAL COURSE

Course Code: 521106	SKILL DEVELOPMENT	Credits: 3	Hours: 3
Objectives	➢ To provide fundamental principles and concepts in basic skills to the learners. ➢ To felicitate the learners to understand the technical skills.		
UNIT I	**Communicative English:** Phonetics and Grammar- Listening, Conversation, Reading , Writing and Presentation - Group Discussion - Concept of Achievement- Resume Writing – Writing Formal Letters - Media Studies and Business Communication.		
UNIT II	**Personality Skill:** Inter- personal relations - Deal with complex feelings - Confidence building- Body language- Conflict - types and resolutions - Emotional intelligence –Dressing- Do's and Don'ts -Ethics and Social Responsiveness-Attitude- Nature, Formation and Change- Decision Making - Team Work- Concept of Achievement.		
UNIT III	**Technical Skill – I (Electrical):** Concepts of Electricity – Wiring, Earthing, Transformers and Motors- Wiring Diagram – Wiring for Household – Working of Electrical Appliances – Maintenance.		
UNIT IV	**Technical Skill – II (Sensors & Automation):** Transducers – Transistors – Photodiodes – Colour Codes – Colour Sensor – IR sensor – Digital Circuits – Hydraulic – Pneumatic – Valves and actuators –Scheme for Automation.		
UNIT V	**Technical Skill – III (Scientific Instruments):** Resistivity Set-up - Hall Sensor – Lock-in Amplifier – Oscilloscope – Microscope – Spectrometer – X-Y-Z stage – Variable Power Source.		
Reference and Textbooks: Edward Russo & Paul, J. H. Schoemaker. (2002). *Winning Decisions*. Doubleday agency of Random House Inc. Indrajit Bhattacharya. (2008). *An Approach to Communication Skills*. New Delhi: Dhanpat Rai & Co. Ravi Aggarwal. (2008). *Communication Today & Tomorrow*. Jaipur: Sublime Publications.			
Outcomes	On successful completion of the course, a student will be able to ➢ Use a set of fundamental physics ideas in a day to day life activities ➢ Learn to use physics ideas for variety of society applications		

Name of the Course Teacher
Dr. M. Ramesh Prabhu

INTER-DEPARTMENTAL COURSES

Course Code: 521222	PHYSICS FOR EVERYONE	Credits: 2	Hours: 3
Objectives	➢ To provide the fundamental principles and concepts in basic physics. ➢ To felicitate the learners to understand the physics around them.		
UNIT I	**Matter:** Structure of the atom – Bohr Atom Model – Somerfield's Relativistic Atom Model – The Vector Atom Model – Quantum Numbers Associated with Vector Atom Model – Coupling Schemes – Pauli Exclusion Principle - Bonding in Crystals – Ionic Bond – Covalent Bond – Metallic Bond- Molecular Bond – Hydrogen Bond – Some Simple Crystal Structures.		
UNIT II	**Light:** Electromagnetic Waves - Revision of Maxwell's equations - Light as an electromagnetic wave – Light velocity in various media - index of refraction, - Fermat's Principle - Polarization – Wave Characteristics – Wavelength, Amplitude, Phase, Period, Frequency – Sources of Light – Wave Front – Huygens' Principle – Interference, Reflection, Refraction, Absorption, Transmission, Diffraction, Scattering –Applications of Light – Lenses – Concave, Convex – Microscope - LED – LASER.		
UNIT III	**Sound:** Simple Harmonic Motion (SHM) - Superposition of two SHM at right angle to each other- Lissajous figures-Beats- Determination of frequency using beats- Intensity-Loudness of Sound – Decibel - Free, damped and forced vibrations – Resonance - Reverberation- Reverberation time-Sabine's formula- Absorption coefficient – Damping and Damping Materials - Piezo-electric effect - Ultrasonic waves - Transducer, Production and Detection of ultrasonic waves - Applications of ultrasonic wave.		
UNIT IV	**Heat:** Modes of heat transfer – Conduction, Convection, Radiation - Effect of temperature on thermal conductivity of different solids, liquids and gases – One dimensional and Two dimensional Equation in Cartesian, cylindrical and spherical coordinates - General laws of heat transfer- Convection – Dimension less number – Natural and Forced Convection – Radiation - Absorptivity, reflectivity and transmissivity - Black and White body -Emissive power and emissivity, laws of radiation – Planck's Constant.		
UNIT V	**Energy:** Energy Resources – Conventional and Renewable Energy – Energy Conversion – Solar Energy – Solar radiation at the earth's surface – Solar thermal flat plate collectors-Concentrating collectors–Solar thermal applications-heating, cooling, desalination, drying, cooking, etc–Photovoltaic conversion of solar energy, types of solar cells - BioEnergy- Biomass resources and their classification-Biomass conversion processes-Thermo chemical conversion-Direct combustion–Biomass gasification-pyrolysis and liquefaction- Types of biogas Plants-applications–bio diesel production–Urban waste to energy conversion.		

Reference and Textbooks:

Murugesan, R. (2018). *Modern Physics*. New Delhi: S. Chand & Company Ltd.

Brij Lal & Subrahmanyam, N. (2003). *Properties of Matter and Sound*. S. Chand and Co.

Brij Lal & Subrahmanyam, N. (2003). *Heat and Thermodynamics*, S. Chand and Co.

Avadhanalu, M. N, Brij Lal & Subrahmanyam, N. (2003). *A Text Book on Optics.* S. Chand and Co.

Garg, H. & Prakash, J. (2000). *Solar Energy Fundamentals and Applications*. McGraw Hill Education (India) Private Ld.	
Outcomes	On successful completion of the course, a student will be able to ➢ Use a set of fundamental physics ideas in day to day life activities. ➢ Learn to use physics ideas for variety of society applications.

Name of the Course Teacher
Dr. R. Yuvakkumar

Course Code: 521333	ANALYTICAL INSTRUMENTATION	Credits: 2	Hours: 3
Objectives	➢ To impart fundamental aspects of analytical instrumentation to the students. ➢ To show insight into the fundamental properties of the instrumental analysis both the experimental and theoretical parts of the characterization techniques.		
UNIT I	**Structural Characterization:** Instrumentation of X-ray spectrometer – Detectors – X-ray fluorescence spectrometer – X-ray diffractometer – X-ray absorption – Application, strengths and limitation of X-ray diffraction.		
UNIT II	**Spectral Characterization:** Laser Raman spectrometer – Laser sources – Detectors – Sample handling. Infrared spectrophotometry – Instrumentation – Radiation sources – Detectors – Fourier Transform Interferometer - NMR basic principles – Continuous wave NMR spectrometer – ESR basic principles – ESR spectrometer.		
UNIT III	**Optical Characterization:** Ultraviolet absorption spectrophotometry – Instrumentation – Detectors – Filters – Monochromators – Instruments for absorption photometry - Photoluminescence principles - Instrumentation and applications.		
UNIT IV	**Thermal and Mechanical Characterization:** Introduction to thermal methods – Thermogravimetric analysis - Differential thermal analysis - Differential scanning calorimetry – Mechanical principles - Methods of hardness testing and its applications.		
UNIT V	**Morphological Characterization:** Basic Principles – Instrumentation: AFM – Contact and Non-Contact Mode – Scanning Electron Microscope (SEM) - Transmission Electron Microscopy.		

References and Textbooks:

Banwell (2008). *Fundamentals of Molecular & Spectroscopy*. New Delhi: TMH.

Chatwal, G. & Anand S. (1996). *Instrumental Methods of Chemical Analysis*. New Delhi: Himalaya Publications House.

Douglas A. Skoog, F. James Holler, Stanley R. Crouch. (2016) *Principles of Instrumental Analysis*. USA: Cengage Learning.

Sindu, P.S. (2006). *Molecular Spectroscopy*. New Delhi: TMH.

Willard, H.H. & Merritretal. (1986). *Instrumental methods of Analysis.* New Delhi: CBS Pub & Co.

Outcomes	On successful completion of the course, a student will be able to ➢ Understand the different processes of structural and topographical characterization. ➢ Sample characterization techniques.

Name of the Course Teacher
Dr. R. Yuvakkumar

COURSE TEACHER CURRICULUM VITAE

Name: **Dr. G. RAVI**
Designation: Professor and Head
Address: Department of Physics, Alagappa University, Karaikudi.
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Fax: +91 4565- 225202
Email: raviganesa@rediffmail.com, ravig@alagappauniversity.ac.in

Educational qualification:

Degree	University/Institution	Year of Passing	Subject	Class/ Grade
B.Sc.	Bharathidasan University	1986	Physics	First
M.Sc.	Bharathidasan University	1989	Physics	First
M.Phil.	Anna University, Chennai	1990	Physics	First
Ph.D.	Anna University, Chennai	1995	Physics	Highly commended
D.Sc.,	Alagappa University,Karaikudi	November2018	Physics	Highly commended
PDF	JSPS, NIMS, Japan	Apr.2002- Mar.2004	Physics	
Visiting Professor	Shizuoka University, Japan	Aug. – Nov.2012	Physics	
Honorable Guest Professor	Shizuoka University, Japan	April 2014, April 2016, 2018, 2019	Physics	

Professional experience:

Institution	Position	Period	
		From	To
Alagappa University	Lecturer, Crystal Research Centre	Feb.1995	Nov.2004
Alagappa University	Reader, Dept. of Physics	Dec.2004	Nov.2007
Alagappa University	Associate Professor, Dept. of Physics	Dec.2007	Nov. 2010
Alagappa University	Professor, Dept. of Physics	Dec. 2010	Till date

Teaching Experience: 25 Years **Research Experience: 30 Years**
Additional Responsibilities: Head, Department of Physics : Dean, Industry- Consultancy, Chairperson, School of Physical Sciences; Co-ordinator, SPARC-MHRD

Honours and Awards:

Senior Research Fellow (SRF)- CSIR, Govt. of India, 1993 Young Researcher Award- (IUMRS-ICA), IISc., Bangalore, India, 1998 Young Scientist Award- ICCG-13, Kyoto, Japan, 2001 Young Invited Researcher Award, Cheju, Korea (ICPOP), 2001 Invited Special Researcher, NIMS, Japan, Nov. 2001-March 2002 JSPS Award, Japan Society for Promotion of Science, Japan, April 2002-March 2004 Invited Special Researcher, NIMS, Japan, June-Nov. 2004	Visiting Professor, Shizuoka University, Japan, Aug-Nov. 2012 Honorable Guest Professor, Shizuoka University, Japan, April 2014 Alagappa Excellence Award for Research (2015-2016), Alagappa University, 2016 Honorable Guest Professor, Shizuoka University, Japan, April 2016 JSPS Invitation Fellowship, Japan, Nov.-Dec. 2016 Appreciation Award, Alagappa University, Karaikudi, Feb. 2017 Honorable Guest Professor, Shizuoka University, Japan, April 2018, April 2019.

Selective 10 publications in Last Five Years:

1. Efficient and stable planar perovskite solar cells using co-doped tin oxide as the electron transport layer, P. Sakthivel, Shini Foo, M. Thambidurai, P.C. Harikesh, Nripan Mathews, R. Yuvakkumar, **G. Ravi**, Cuong Dang, Journal of Power Source, 471 (2020) 228443 **[IF : 8.247].**

2. Improved optoelectronic properties of Gd doped cadmium oxide thin films through optimized film thickness for alternative TCO applications, P. Sakthivel, S. Asaithambi, M. Karuppaiah, R. Yuvakkumar, Y. Hayakawa, **G. Ravi**, Journal of Alloys and Compounds, 820 (2020) 153188 **[IF : 4.650]**.

3. Investigation of electrochemical properties of various transition metals doped SnO_2 spherical nanostructures for supercapacitor applications, S. Asaithambi, P. Sakthivel, M. Karuppaiah, G. Udhaya Sankar, K. Balamurugan, R. Yuvakkumar, M. Thambidurai, **G. Ravi**, Journal of Energy Storage, 31 (2020) 101530 **[IF : 3.762]**.

4. Solvent dependent morphological modification of micro-nano assembled Mn_2O_3/NiO composites for high performance supercapacitor applications, M. Karuppaiah, P. Sakthivel, S. Asaithambi, R. Murugan, G.Anandha babu, R. Yuvakkumar, **G. Ravi**, Ceramic International 45 (2019) 4298-4307 **[IF : 3.830].**

5. Sn doped α-Fe_2O_3(Sn=0,10,20,30 wt%) photoanodes for photoelectrochemical water splitting applications, B.Jansi Rani, **G. Ravi**, R. Yuvakkumar, S. Ravichandran, Fuad ameen,. Alnadhary, Renewable Energy, 133 (2019) 566-574 **[IF: 6.120]**.

6. In vitro antibacterial activity of ZnO and Nd doped ZnO nanoparticles against ESBL producing Escherichia coli and Klebsiella pneumonia, Abdulrahman Syedahamed Haja Hameed, Chandrasekaran Karthikeyan, Abdulazees Parveez Ahamed, Nooruddin Thajuddin, Naiyf S Alharbi, Sulaiman Ali Alharbi**, Ganasan Ravi,** Scientific Reports, 6 (2016) 24312. **[IF: 4.120].**

7. Enhancement of room temperature ferromagnetic behavior of RF sputtered Ni-CeO_2 thin films, R. Murugan, G.Vijayaprasath, T.Mahalingam, **G. Ravi**, Applied Surface Science 390 (2016) 583–590 **[IF:6.182]**

8. Photoelectrochemical study of MoO_3 assorted morphology films formed by thermal evaporation, R. Senthilkumar, G. Anandhababu, T. Mahalingam, **G. Ravi**, Journal of Energy Chemistry, 25 (2016) 798-804 **[IF : 7.216]**.

9. Influence of Microwave Power on preparation of NiO Nanoflakes for enhanced Magnetic and Super capacitor Applications, G.Anandha babu, T.Mahalingam, M. Kumaresavanji, Y.Hayakawa, **G.Ravi,** Dalton Transaction, 44, (2015), 4485. **[IF:4.060]**

10. Effect of Cobalt Doping on Structural, Optical, and Magnetic Properties of ZnO Nanoparticles Synthesized by Coprecipitation Method, Vijayaprasath Gandhi, Haja Hameed Abdulrahman Syedahamed, Mahalingam Thaiyan, Ravi Ganesan, J. Physical Chemistry C, 118, (2014), 9715−9725.**[IF: 4.270]**

Countries visited: USA, UK, GERMANY, FRANCE, JAPAN, KOREA, AUSTRALIA, MEXICO, BRAZIL, S.AFRICA, NETHERLANDS, ITALY, CHINA, SWISS, SINGAPORE, MALASIA, TAIWAN, BELGIUM, SRILANKA, BANGLADESH, SPAIN, PORTUGAL

Cumulative Impact factor: 566.247
Total Citation: 3721
h- index: 31
i10- index: 98

COURSE TEACHER CURRICULUM VITAE

Name: **Dr. K. SANKARANARAYANAN**
Designation: Professor
Address: Department of Physics, Alagappa University, Karaikudi.
Phone: +91 4565- 223303
Fax: +91 4565- 225202
Email: sankaranarayanank@alagappauniversity.ac.in, hhrsankar@yahoo.com

Educational qualification:

Degree	University	Subject	Year	Class
Ph.D	Alagappa University, Karaikudi	Physics-Crystal Growth	2006	---
M.Phil.,	Madurai Kamaraj University, Madurai	Physics	1990	I
M.Sc.,	Madurai Kamaraj University, Madurai	Physics	1989	I

Professional experience:

Teaching Experience: 25 Years Research Experience: 30 Years
Additional Responsibilities: Member Syndicate [6.1.2019-Till Date], Director, University Scientific Instrumentation Centre **[1/2017-Till Date], Dean,** Faculty of Science **[27.12.2018-14.2.2020], Co-ordinator**, Intellectual Property Rights Cell [6/2016-5/2017]

Honours and Awards:

1. **Indo-China Bilateral Students Exchange Fellowship *(1992-93)*** by MHRD, Govt. of India, New Delhi.
2. **Young Scientist Fellowship*(1995-96)*** by TNSCST, Govt. of Tamil Nadu, Chennai, India.
3. **Prof.P.Ramasamy National Award for Crystal Growth *(2005)*** by Indian Association for Crystal Growth, Chennai.
4. **Best Researcher Cash Award *(2005-2006)***, Alagappa University, Karaikudi
5. **Visiting Professor (*April, 2010-July, 2010)* –**Shizuoka University, Hamamatsu, Japan.
6. **Visiting Scientist (2005, 2008, 2014, 2018**) – Hebei Semiconductor Research Institute, Shijiazhuang, China.
7. A Ph.D thesis entitled "Unidirectional growth of organic scintillators", was awarded with "**National Award for Best Thesis in Crystal Growth**" by Indian Association of Crystal Growth, 2019
8. Introduced 2 novel crystal growth methods namely 1.**Microtube-Czochralski Technique** and **2. Sankaranarayanan-Ramasamy Method of Crystal Growth.**

Selective 10 publications in Last Five Years:

1. Physicochemical and DFT studies on new organic Bis-(2-amino-6-methylpyridinium) succinate monohydrate good quality single crystal for nonlinear optical applications
   Journal of Molecular Structure Volume 121215 July 2020 Article 128069
   R. Kaliammal, S. Sudhahar, G. Parvathy, K. Velsankar, **K. Sankaranarayanan**

2. Growth, experimental and theoretical investigations on 4-hydroxy-3-methoxybenzaldehyde 5-chloro-2-hydroxybenzoic acid: A new high second order nonlinear optical material
   Journal of Molecular Structure Volume 12175 October 2020 Article 128406
   G. Parvathy, R. Kaliammal, **K. Sankaranarayanan**, M. Arivanandhan, S. Sudhahar

3. Estimation of neutron energy distributions from measured prompt gamma intensities: Experimental validation Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment Volume 96921 July 2020 Article 164101
   Priyada Panikkath, Ashwini Udupi, P. K. Sarkar, **Sankaranarayanan K.**

4. Unidirectional growth of pure and composite t-stilbene single crystals for scintillator applications Journal of Crystal Growth Volume 5311 February 2020 Article 125344
   Govindan, D. Joseph Daniel, Phan Quoc Vuong, **K. Sankaranarayanan**, H. J. Kim

5. Electrochemical, structural, compositional and optical properties of Cuprous Selenide thin films Chinese Journal of Physics Volume 63 February 2020 Pages 138-148
   S. Thanikaikarasan, D. Dhanasekaran, **K. Sankaranarayanan**

6. Sol–gel mediated microwave synthesis of pure, La and Zr doped SnS2 nanoflowers an efficient photocatalyst for the degradation of methylene blue, Journal of Materials Science: Materials in Electronics 30 (8), 7963-7973, (2019)
   V.Govindan, L Kashinath, DJ Daniel, **K Sankaranarayanan,**

7. Electrochemical synthesis, single-crystal growth, physicochemical and dielectric studies of tetrabromobisphenol A, Indian Journal of Physics 93 (3), 349-359, 2019.
   V Govindan, K Kulangiappar, S Selvanayagam, B Sridhar, **K Sankaranarayanan**

8. Crystal growth and characterization of 1, 3, 5-triphenylbenzene organic scintillator crystal, Materials Chemistry and Physics 223, 183-189 2019.
   V Govindan, DJ Daniel, HJ Kim, **K Sankaranarayanan.**

9. Unidirectional crystal growth, luminescence and scintillation characteristics of t-stilbene single crystals, Dyes and Pigments 160, 848-852, 2019.
   V Govindan, DJ Daniel, HJ Kim, **K Sankaranarayanan.**

10. Impact of Cerium Doping on Dielectric Properties of Palmierite [K2Pb(SO4)2]
    Journal of Electronic Materials, 48(4), 2577–2586, (2019)
    Sarala. N, Dhatchayani. S, Govindan. V, **Sankaranarayanan.K**

Cumulative Impact factor: 417.04
Total Citation: 1217
h- index: 19
i10- index: 33

COURSE TEACHER CURRICULUM VITAE

Name: **Dr. M. SIVAKUMAR**
Designation: Assistant Professor
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Educational qualification: M.Sc., M.Phil., Ph.D., BLIS.

Professional experience: Teaching - 21 Years Research - 23 Years

Honours and Awards:

- **Post-Doctoral Fellowship –** 15.11.2004 to 31.07.2006 –National Science Committee, Taiwan ROC.
- **Principal Indian Scientist** of DST-NSC supported India – Taiwan Collaborative Research Project from 2011-14.
- **Outstanding Reviewing Contribution in Electrochimica Acta, Elsevier Publications.**

Selective 10 publications in Last Five Years:

1. Enhanced rate performance of multiwalled carbon nanotube encrusted olivine type composite cathode material using simple polyol technique **R.Muruganantham, R.Subadevi, M.Sivakumar**
   Journal of Power Sources, 300 (2015) 496-506. **IF:8.247 DOI**:10.1016/j.jpowsour.2015.09.103

2. Synthesis of surface modified $LiFePO_4$ cathode material via polyol technique for high rate Lithium secondary battery **M.Sivakumar, R.Muruganantham, R.Subadevi**
   Applied Surface Science, 337 (2015) 234-240. ***IF:6.182*** **DOI:**10.1016/j.apsusc.2015.02.100

3. Cobalt doped layered Lithium nickel oxide as a 3 in 1 electrode for Lithium-ion, Sodium-ion and supercapacitor applications **K.Diwakar, P.Rajkumar, P.Arjunan, R.Subadevi*, M.Sivakumar***
   International Journal of Energy Research, 44 (2020) 7591-7602. ***IF:3.741*** **DOI:**10.1002/er.5492

4. Kombuchascoby based carbon and Graphene oxide wrapped sulfur/ Poly (acrylonitrile) as a high-capacity cathode in lithium–sulfur batteries **K.Krishnaveni, R.Subadevi, M.Sivakumar*, M.Raja, T.Premkumar**
   Frontiers of Chemical Science and Engineering, (2020). ***IF:3.552*****DOI:**10.1007/s11705-019-1897-x

5. Carbon Loaded Nano-Designed Spherically High Symmetric Lithium IronOrthosilicate Cathode Materials for Lithium Secondary Batteries **K.Diwakar, P.Rajkumar, R.Subadevi*, Wei-Ren Liu, Chia-Hung Huang, M.Sivakumar***
   Polymers 11(2019) 1703.***IF:*****3.426 DOI**:10.3390/polym11101703

6. High Capacity Prismatic Type Layered Electrode with Anionic Redox Activity as an Efficient Cathode Material and PVdF/SiO_2 Composite Membrane for a Sodium Ion Battery
   ArjunanPonnaiah, SubadeviRengapillai*, DiwakarKaruppiah, SivakumarMarimuthu*, Wei-Ren Liu, Chia-Hung Huang
   *Polymers,12 (2020) 662.***IF:3.426 DOI:**10.3390/polym12030662

7. Physicochemical Exfoliation of Graphene Sheet using Graphitic Carbon Nitride
V.Priyanka, G.Savithiri, R.Subadevi*, V.Suryanarayanan, M.Sivakumar*
New Journal of Chemistry 6(43) (2019) 16200-16206 ***IF:3.288*****DOI:**10.1039/c9nj02149c

8. Titanium based Layered O3-$NaTi_{7/10}Ni_{3/20}Mg_{3/20}O_2$ anode material for Sodium ion batteries
K.Kannan, M.Kouthaman, P.Arjunan, R.Subadevi*, M.Sivakumar*
*Materials Letters, 273 (2020) 127950.****IF:3.204*** **DOI:**10.1016/j.matlet.2020.127950

9. Novel Layered O3-$NaFe_{0.45}Co_{0.45}Ti_{0.1}O_2$ cathode material for Sodium Batteries
M.Kouthaman, K.Kannan, P.Arjunan, T.Meenatchi, R.Subadevi*, M.Sivakumar*
*Materials Letters, 276 (2020) 128181.***IF:3.204 DOI:** 10.1016/j.matlet.2020.128181

10. Micro-/Mesoporous Nature of Carbon Nanofiber/Silica Matrix as an Effective Sulfur Host for Rechargeable Lithium-Sulfur Batteries **P.Rajkumar, K.Diwakar, R.Subadevi*, RM.Gnanamuthu, Fu-Ming Wang, M.Sivakumar***
*Journal of Physics D: Applied Physics,53 (2020) 265501.****IF: 3.169*** **DOI:10**.1088/1361-6463/ab8137

Cumulative Impact factor: 167.275
Total Citation: 1097
h- index: 14
i10- index: 18

COURSE TEACHER CURRICULUM VITAE

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Phone: 04565-223305, Fax: 04565-225202/225525.
Email: anandhan_kn@rediffmail.com, anandhann@alagappauniversity.ac.in.

Educational qualification:

- M.Sc.,(Physics) Bharathidasan University, Tiruchirapalli, India, Apr-2000.
- M. Phil.,(Physics: Specialization: Materials Science), Annamalai University, Chidambaram, India, Apr-2002.
- Ph.D.,(Physics: Specialization: Materials Science), Annamalai University, Chidambaram, India, Dec-2007.

Professional experience: Teaching- 13 Yrs & Research – 20 Yrs.

- **Assistant Professor (From 12.03.2010 to till date)** Department of Physics, Advanced Materials and Thin film Laboratory, Science Campus, Alagappa University, Karaikudi-630 003, Sivaganga Dist. Tamilnadu, India.
- **Assistant Professor (From 28.07.2007 to 11.03.2010)** Department of Physics, Faculty of Engineering and Technology, SRM University, SRM Nagar, Kattankulathur, Chennai-603 203, Tamilnadu, India.

Honours and Awards:

- Best paper presentation award from National Conference on Materials for Energy and Environment (NCMEE-2012)organised by Department of Science and Humanities, Chendu College of Engineering and Technology, Zamin Endathur, Maduranthagam, Kanchipuram Dist. 6th April-2012.

Selective 10 publications: (Last Five Years):

1. R. Panneerselvam, **N. Anandhan**, G. Gopu, A.Amali Roselin, K.P.Ganesan, T.Marimuthu, Impact of different transition metal ions in the structural, mechanical, optical, chemico-physical and biological properties of nanohydroxyapatite, Appl. Surf. Sci., 506, 14480215 , 2020 **(I.F.: 6.182).**

2. A.AmaliRoselin, N. Anandhan, G. Gopu, I. Joseph Panneer Doss, K.P. Ganesan, R. Paneer Selvam, T. Marimuthu, G. Sivakumar, Electrochemical Sensor for the Detection of Lead ions of B-site Doped Bismuth Titanate Perovskite Thin Film, Applied Physics A, Accepted for Publication. DOI: 10.1007/s00339-019-2963-4. (**IF: 1.870).**

3. K.P. Ganesan, **N. Anandhan** , A. Amaliroselin, R. Thangamuthu, T. Marimuthu, R. Panneerselvam, Tuning the magnetic properties of electrochemically deposited Cu2O thin films by Fe incorporation, Journal of Materials Science: Materials in Electronics (Accepted For Publications), DOI: 10.1007/s10854-019-01925-6.(**IF.: 2.220).**

4. R.Panneerselvama, **N.Anandhan**, G.Sivakumar, K.P.Ganesana, T. Marimuthu, V. Sugumar, Role of Annealing Temperatures on Mechanical, Optical, Electrical, Magnetic Properties of Nanohydroxyapatite Biomaterial, Journal of Nanoscience and nanotechnology 19 (8), 4366-4376 **(IF: 1. 354).**

5. K.P.Ganesan,G.Sivakumar,**N.Anandhan**,T.Marimuthu,R.Paneerselvam,A.AmaliRoselin, Influence of bath temperatures on physical and electrical properties of potentiostatically deposited Cu_2O thin films for heterojunction solar cell applications, Optical and Quantum Electronics 51 37 **(2019),** (**I.F-1.842).**

6. T. Marimuthu1, **N. Anandhan**, R. Thangamuthu, S. Surya, R. Panneerselvam, and K. P. Ganesan, Effect of Deposition Potential and Bath Temperature on One-Step Electrochemical Synthesis of One and Two Dimensional Nanostructured ZnO Thin Films on Fluorine Doped Tin Oxide Substrates, J of Nanosci and Nano Technol., 19 (11), 7014-7025, (2019**) (IF: 1.354).**
7. K.P.Ganesan, **N. Anandhan**, T.Marimuthu,R.Paneerselvam,A.Amali Roselin, Effect of Deposition potential on Synthesis, Structural, Morphological and Photoconductiviy Response of Cu_2O thin films by Electrodeposition technique, Acta Metallurgica Sinica(English Letters) **(2019)** (**I.F-2.090**).

8. Govindhasamy Murugadoss, Rangasamy Thangamuthu, Sakkarapalayam Murugesan Senthil Kumar, **Anandhan Narayanasamy**, Manavalan Rajesh Kumar, Arumugam Rathishkumar, Synthesis of lignad free,large scale with high quality all-inorganic $CsPbI_3$ and $CsPb_2Br_5$ nanocrystals and fabrication of all-inorganic perovskite solar cells, Journal of Alloys and Compounds **(2019) (I.F-4.650**)

9. G. Muthusankar, M. Sethupathi, S.-M. Chen, R. Keerthika Devi, R. Vinoth, G. Gopu, **N. Anandhan**, N. Sengottuvelan N-doped carbon quantum dots @ hexagonal porous copper oxide decorated multiwall carbon nanotubes: A hybrid composite material for an efficient ultra-sensitive determination of Caffeic acid, , Composites Part B: Engineering, in press – Accepted Manuscript **(IF: 7.635).**

10. T.Marimuthu, **N.Anandhan**, R.Thangamuthu, Electrochemical synthesis of one-dimensional ZnO nanostructures on ZnO seed layer for DSSC applications, Appl. Surf. Sci., 428, 385-394, 2018 **(I.F.: 6.182).**

Cumulative Impact factor: 92.186.
Total Citation: 288.
h- index: 10.
i10- index: 12.

COURSE TEACHER CURRICULUM VITAE

Name: **Dr. R. SUBADEVI**
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---

Educational qualification: M.Sc., M.Phil., Ph.D.

Professional experience: Teaching - 11 Years Research - 21 Years

Honours and Awards:

- ✓ **Obtained *Dr.Mohan's* Best Teacher Award from The Foundation of Dr.Mohan, at TamilNadu College of Education, Nainarpuram, Karaikudi on 18.8.2011.**

Selective 10 publications: (Last Five Years):

1. Enhanced rate performance of multiwalled carbon nanotube encrusted olivine type composite cathode material using simple polyol technique **R.Muruganantham, R.Subadevi, M.Sivakumar**
   Journal of Power Sources, 300 (2015) 496-506. **IF:8.247 DOI**:10.1016/j.jpowsour.2015.09.103

2. Synthesis of surface modified $LiFePO_4$ cathode material via polyol technique for high rate Lithium secondary battery **M.Sivakumar, R.Muruganantham, R.Subadevi**
   Applied Surface Science, 337 (2015) 234-240. ***IF:6.182*** **DOI:**10.1016/j.apsusc.2015.02.100

3. Cobalt doped layered Lithium nickel oxide as a 3 in 1 electrode for Lithium-ion, Sodium-ion and supercapacitor applications **K.Diwakar, P.Rajkumar, P.Arjunan, R.Subadevi*, M.Sivakumar***
   International Journal of Energy Research, 44 (2020) 7591-7602. ***IF:3.741*** **DOI:**10.1002/er.5492
4. Kombuchascoby based carbon and Graphene oxide wrapped sulfur/ Poly (acrylonitrile) as a high-capacity cathode in lithium–sulfur batteries **K.Krishnaveni, R.Subadevi, M.Sivakumar*, M.Raja, T.Premkumar**
   Frontiers of Chemical Science and Engineering, (2020). ***IF:3.552*****DOI:**10.1007/s11705-019-1897-x

5. Carbon Loaded Nano-Designed Spherically High Symmetric Lithium IronOrthosilicate Cathode Materials for Lithium Secondary Batteries **K.Diwakar, P.Rajkumar, R.Subadevi*, Wei-Ren Liu, Chia-Hung Huang, M.Sivakumar***
   Polymers 11(2019) 1703.***IF:*****3.426 DOI**:10.3390/polym11101703

6. High Capacity Prismatic Type Layered Electrode with Anionic Redox Activity as an Efficient Cathode Material and PVdF/SiO_2 Composite Membrane for a Sodium Ion Battery
   ArjunanPonnaiah, SubadeviRengapillai*, DiwakarKaruppiah, SivakumarMarimuthu*, Wei-Ren Liu, Chia-Hung Huang
   *Polymers,12 (2020) 662.***IF:3.426 DOI:**10.3390/polym12030662

7. Physicochemical Exfoliation of Graphene Sheet using Graphitic Carbon Nitride
   V.Priyanka, G.Savithiri, R.Subadevi*, V.Suryanarayanan, M.Sivakumar*
   New Journal of Chemistry 6(43) (2019) 16200-16206 ***IF:3.288*****DOI:**10.1039/c9nj02149c

8. Titanium based Layered O3-$NaTi_{7/10}Ni_{3/20}Mg_{3/20}O_2$ anode material for Sodium ion batteries **K.Kannan, M.Kouthaman, P.Arjunan, R.Subadevi*, M.Sivakumar*** *Materials Letters, 273 (2020) 127950.**IF:3.204*** **DOI:**10.1016/j.matlet.2020.127950

9. Novel Layered O3-$NaFe_{0.45}Co_{0.45}Ti_{0.1}O_2$ cathode material for Sodium Batteries **M.Kouthaman, K.Kannan, P.Arjunan, T.Meenatchi, R.Subadevi*, M.Sivakumar*** *Materials Letters, 276 (2020) 128181.***IF:3.204 DOI:** 10.1016/j.matlet.2020.128181

10. Micro-/Mesoporous Nature of Carbon Nanofiber/Silica Matrix as an Effective Sulfur Host for Rechargeable Lithium-Sulfur Batteries **P.Rajkumar, K.Diwakar, R.Subadevi*, RM.Gnanamuthu, Fu-Ming Wang, M.Sivakumar*** *Journal of Physics D: Applied Physics,53 (2020) 265501.**IF: 3.169*** **DOI:10**.1088/1361-6463/ab8137

Cumulative Impact factor: 164.17
Total Citation: 1069
h- index: 13
i10- index: 17

COURSE TEACHER CURRICULUM VITAE

Name :**Dr. M. RAMESH PRABHU**
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Educational Qualification:

Degree	University/ Board	Year of passing	Thesis topic/ Subjects studied	Percentage of marks or CGPA
B.Sc	Madurai Kamaraj University	2004	Physics	6.295
M.Sc	Alagappa University	2006	Physics	7.0
Ph.D	Alagappa University	2010	Synthesis and Characterisation of solid polymer blend electrolytes based on PEMA.	Highly Commended

Professional Experience:

- 7 years 10 months

Honors and Awards:

- RFSMS Fellow during 2008 to 2010

Selective 10 publications: (Last Five Years):

1. R. Gayathri, **M. Ramesh Prabhu***, Protonated state and synergistic role of Nd^{3+} doped barium cerate perovskite for the enhancement of ionic pathways in novel sulfonatedpolyethersulfone for H_2/O_2 fuel cells, (2020), Soft Matter (RSC), DOI: 10.1039/d0sm00427h (I.F 3.399)

2. Raja PugalenthiMariappan, Chaofeng Liu, Guozhong Cao, **Ramesh PrabhuManimuthu*,** Tailoring SPEEK/SPVdF-co-HFP/$La_2Zr_2O_7$ Ternary Composite Membrane for Cation Exchange Membrane Fuel Cells, (2020), Industrial & Engineering Chemistry Research (ACS), DOI:10.1021/acs.iecr.9b06922 (I.F 3.375)

3. P. Martina, R. Gayathri, M. Raja Pugalenthi, Guozhong Cao, Chaofeng Liu, **M. Ramesh Prabhu***, Nano-sulfonated silica incorporated SPEEK / S-PVdF-HFP polymer blend membrane for PEM fuel cell application, (2020), Ionics(Springer), DOI: 10.1007/s11581-020-03478-9 (I.F 2.289)

4. Raja K, Raja Pugalenthi M and **Ramesh Prabhu M***, The Effect of incorporation of ferrous titanate nanoparticles in sulfonated poly(ether ether ketone)/poly (amide imide) acid-base polymer for cations exchange membrane fuel cells, (2019), Journal of Solid State Electrochemistry(Springer),DOI: 10.1007/s10008-019-04453-9 (I.F 2.531)

5. S. Ponmani, J. Kalaiselvimary, **M.RameshPrabhu***, Structural, electrical, and electrochemical properties of poly(vinylidenefluoride-co-hexaflouropropylene)/poly(vinyl acetate)-based polymer blend electrolytes for rechargeable magnesium ion batteries, (2018), Journal of Solid State Electrochemistry(Springer), DOI: 10.1007/s10008-018-3971-6 (I.F 2.531)

6. K. Selvakumar S. Rajendran, **M. Ramesh Prabhu***, A Study of influence on sulfonated TiO_2-Poly (Vinylidene fluoride-co-hexafluoropropylene) nano composite membranes for PEM Fuel cell application, (2017), Applied Surface Science(Elsevier), Doi:10.1016/j.apsusc.2016.11.139 (I.F 5.155).

7. P.Pradeepa , **M. Ramesh Prabhu***, G.Sowmya, S. Edwinraj, Plasticized polymer electrolyte membranes based on PEO/PVdF-HFP for use as an effective electrolyte in Lithium-ion batteries, (2017),Chinese journal of polymer science, DOI: 10.1007/s10118-017-1906-9(I.F 2.804)

8. P.Pradeepa, G.Sowmya, **M. Ramesh Prabhu***, Influence of barium titanatenanofiller on PEO/PVdF-HFP blend-based polymer electrolyte membrane for Li-battery applications, (2016), Journal of Solid State Electrochemistry(Springer), DOI: 10.1007/s10008-016-3477-z (I.F 2.531).

9. P.Pradeepa, S.Edwinraj,G.Sowmya,J.Kalaiselvimary, **M. Ramesh Prabhu***, Optimization of hybrid polymer electrolytes with the effect of lithium salt concentration in PEO/PVdF-HFP blends (2016), Materials Science and Engineering B(Elsevier), DOI:10.1016/j.mseb.2015.11.009(I.F 3.507).

10. P. Pradeepa, S. Edwin Raj, **M. Ramesh Prabhu*,** Effects of ceramic filler in Poly vinyl alcohol / Poly ethyl methacrylate based polymer blend electrolytes **(**2015), Chinese Chemical Letters(Elsevier), DOI:10.1016/j.cclet.2015.05.007 (I.F 3.839).

Cumulative Impact Factor: 111.6
Total Citations: 525
h-index: 13
i-10 index: 15

COURSE TEACHER CURRICULUM VITAE

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Educational Qualification:
M.A./M.Sc./ M.Ed./M.Phil./ Ph.D./

Professional Experience:
- 8 years

Honors and Awards:

Name of the Award / Fellowships, Medals and Patents	Name of the Awarding Agency	International / National / State	Year
Brain Pool Korea Fellowship	NRF	International	2013
Senior Research Scientist	KRISS	International	2014

Selective 10 publications: (Last Five Years):

1. Electrochemical and photoelectrochemical water oxidation of solvothermally synthesized Zr-doped α-Fe_2O_3 nanostructures, B. jansi Rani, M. Praveen kumar, G. ravi, S. Ravichandran, Ramesh K. Gurudu, **R. Yuvakkumar**, Applied surface science, 471, (2019), 733-744 **[IF: 6.182]**

2. Sn doped α-Fe 2 O 3 (Sn=0,10,20,30 wt%) photoanodes for photoelectrochemical water splitting applications, B. Jansi rani, G. Ravi, **R. Yuvakkumar**, S. Ravichandran, Fuad ameen, Alnadhary, Renewable Energy,133 (2019) 566-574 **[IF:6.274]**

3. Ni doped Bi_2WO_6 for electrochemical OER activity, SP Keerthana, B. Jansi Rani, G. Ravi, **R. Yuvakkumar**, S.I Hong, Dhayalan Velauthapillai, B Saravanakumar, M Thambidurai, Cuong Dang, International Journal of Hydrogen energy **[IF: 4.939]**

4. Neutral and alkaline chemical environment dependent synthesis of Mn_3O_4 for oxygen evolution reaction (OER), B. Jansi Rani, G. Ravi, Dhayalan Velauthapillai, **R. Yuvakkumar**, S.I Hong, B Saravanakumar, M Thambidurai, Cuong Dang, Materials Chemistry and Physics 247, (2020), 122864 **[IF: 4.175]**

5. Urchin like $NiCo_2O_4$/rGO nanocomposite for high energy asymmetric storage applications, M. Isacfranklin, G. Ravi, **R. Yuvakkumar**, P. Kumar Dhayalan Velauthapillai, , B Saravanakumar, M Thambidurai, Cuong Dang, Ceramics International, 46, (2020), 16291-16297 **[IF:3.83]**

6. Ultrafine M-doped TiO_2 (M = Fe, Ce, La) nanosphere photoanodes for photoelectrochemical water-splitting applications, B. Jansi Rani, M. Praveen kumar, S. Ravichandran, V. Ganesh, Ramesh K. Gurudu, G. Ravi, **R. Yuvakkumar**, Materials Characterization ,152,(2019), 188–203 **[IF:3.562]**

7. Supercapacitor and OER activity of transition metal (Mo, Co, Cu) sulphides, B. Jansi Rani, S.S. Pradeepa, Zinab M. Hasan, G. Ravi, **R. Yuvakkumar**, S.I. Hong, Journal of Physics and Chemistry of Solids,138, (2020), 109240 **[IF:3.442]**

8. WO_3 nanocubes for photoelectrochemical water-splitting applications, B.Jansi Rani, .Praveen Kumar, S. Ravichandran, G. Ravi, V. Ganesh,Ramesh K.Guduru, **R. Yuvakkumar**, S.I. Hong, Journal of Physics and Chemistry of Solids, 134, (2019), 149-156 **[IF: 3.442]**

9. Binder free, robust and scalable CuO@GCE modified electrodes for efficient electrochemical water oxidation, B. Jansi Rani, G. Ravi, **R. Yuvakkumar**, Zinab M. Hasan, S. Ravichandran, S.I.Hong, Materials Chemistry and Physics,239,(2020)122321 **[IF: 3.408]**

10. Functional reduced graphene oxide/cobalt hydroxide composite for energy storage applications, M sangeetha Vidhya, G. Ravi, Dayalan Velauthapillai, M Thambidurai, Cuong dang, B Saravanakumar, A Syed, T MS Dawoud, **R. Yuvakkumar**, Materials Letter, 276, (2020), 128193 **[IF: 3.019]**

Cumulative Impact Factor: 200
Total Citations: 2172
h-index: 23
i-10 index: 53

COURSE TEACHER CURRICULUM VITAE

Name : **Dr. S. SUDHAHAR**
Designation : **Assistant Professor**
Address : **Department of Physics, Alagappa University, Karaikudi**
Phone : **+91 9944183251, +91 4565 223309**
Email : **sudhaharmed@gmail.com, sudhahars@alagappauniversity.ac.in**

Educational Qualification:

Degree	University/ Board	Year of passing	Thesis topic/ Subjects studied	Percentage of marks or CGPA
Ph.D	University of Madras	2014	Physics	Highly Commended
M.Ed	University of Madras	2010	Education	61.21
B.Ed	Tamilnadu Teachers Education University	2009	Physical Sciences (Physics)	79.81
M. Sc	Bharathidasan University	2008	Physics	68.87
B. Sc	Bharathidasan University	2006	Physics	76.64

Professional Experience:

- 5 years 9 months

Honors and Awards:

- Best Poster Presentation Award-2019, National conference on advanced materials for sustainable energy and sensors (NCAMSES) at Alagappa University, Karaikudi on 20-22nd March, 2019.

Selective 10 publications: (Last Five Years):

1. K. Velsankar, V. Vinothini, **S. Sudhahar***, M. Krishna Kumar, S. Mohandoss, Green Synthesis of CuO nanoparticles via Plectranthus amboinicus leaves extract with its characterization on structural, morphological, and biological properties, (2020), *Applied Nanoscience*, **DOI**: 10.1007/s13204-020-01504-w (**I.F: 2.88**).

2. G. Maheshwaran, A. Nivedhitha Bharathi, M. Malai Selvi, M. Krishna Kumar, R. Mohan Kumar, **S. Sudhahar*,** Green synthesis of Silver oxide nanoparticles using Zephyranthes Rosea flower extract and evaluation of biological activities, (2020), *Journal of Environmental Chemical Engineering*, **Doi**:10.1016/j.jece.2020.104137 (**I.F: 4.3**).

3. K. Velsankar, R.M. Aswin Kumar, R. Preethi, V. Muthulakshmi, **S. Sudhahar*,** Green synthesis of CuO nanoparticles via Allium sativum extract and its characterizations on antimicrobial, antioxidant, antilarvicidal activities, (2020), *Journal of Environmental Chemical Engineering*, **Doi**:10.1016/j.jece.2020.104123 **(I.F: 4.3)**.

4. K. Velsankar, R. Preethi, P.S. Jeevan Ram, M. Ramesh, **S. Sudhahar*,** Evaluations of biosynthesized Ag nanoparticles via Allium Sativum flower extract in biological applications, (2020), *Applied Nanoscience*, **DOI**:10.1007/s13204-020-01463-2 **(I.F: 2.88)**.

5. G. Parvathy, R. Kaliammal, K. Sankaranarayanan, M. Arivananthan, M. Krishna Kumar, **S. Sudhahar*,** Growth, experimental and theoretical investigations on 4-hydroxy-3-methoxybenzaldehyde 5-chloro-2-hydroxybenzoic acid: A new high second order nonlinear

optical material, (2020), *Journal of Molecular Structure*, **DOI**:10.1016/j.molstruc.2020.128406 **(I.F: 2.463)**

6. R. Kaliammal, **S. Sudhahar***, G. Parvathy, K. Velsankar, K. Sankaranarayanan, Physicochemical and DFT studies on new organic Bis-(2-amino-6-methylpyridinium) succinate monohydrate good quality single crystal for nonlinear optical applications, (2020), *Journal of Molecular Structure*, **DOI**:10.1016/j.molstruc.2020.128069 **(I.F: 2.463)**

7. G. Maheshwaran, K. Velsankar, G. Parvathy, R. Kaliammal, M. Krishna Kumar, **S. Sudhahar*,** Effective growth and characterization of piperazinium orthophthalate single crystal yielding high second harmonic generation efficiency, (2020), *Chinese Journal of Physics*, **DOI**:10.1016/j.cjph.2020.01.005 (**I.F: 2.638)**

8. K. Velsankar, **S. Sudhahar***, G. Parvathy, R. Kaliammal, Effect of cytotoxicity and antibacterial activity of biosynthesis of ZnO hexagonal shaped nanoparticles by Echinochloa frumentacea grains extract as a reducing agent, (2020), *Materials Chemistry and Physics,* DOI: org/10.1016/j.matchemphys.2019.121976 (**I.F 3.408**).

9. B. Valarmathi, C. Amirthakumar, **S. Sudhahar***, G. Vinitha, R. Mohan Kumar, Synthesis, crystal growth, and characterization of piperazinediium bis (4-aminobenzoate) dihydrate - An efficient third-order nonlinear optical single crystal for opto-electronic applications, (2019) *Chinese Journal of Physics*, **DOI**:10.1016/j.cjph.2019.09.028 (**I.F: 2.638).**

10. K. Velsankar, **S. Sudhahar***, G. Maheshwaran, M. Krishna Kumar, Effect of biosynthesis of ZnO nanoparticles via Cucurbita seed extract on Culex tritaeniorhynchus mosquito larvae with its biological applications, (2020), *Journal of Photochemistry & Photobiology, B: Biology*, **DOI**:10.1016/j.jphotobiol.2019.111650 (**I.F: 4.383).**

Cumulative Impact Factor: 83.112
Total Citations: 275
h-index: 10
i-10 index: 11

COURSE TEACHER CURRICULUM VITAE

Name: **Dr. R. SIVAKUMAR**
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---

Educational qualification:

- Ph.D. Physics (April 2006), Alagappa University, Karaikudi.
- M.Phil. Physics (May 2002), Alagappa University, Karaikudi.
- M.Sc. Physics (April 2001), Bharathidasan University, Tiruchirappalli.
- B.Sc. Physics (April 1999), Bharathidasan University, Tiruchirappalli.

Professional / Research experience:

- Assistant Professor in Physics, Alagappa University, Karaikudi, from February 2009 onwards.
- Post-Doctoral Researcher, Nagaoka University of Technology, Japan (Dec. 2007 - Feb. 2009)
- Post-Doctoral Fellow, National Taiwan University, Taiwan (November 2006 - October 2007)
- Post-Doctoral Fellow, Institute of Physics, India (December 2005 - October 2006)

Honours and Awards:

- Young Scientist Award for the Year 2018 in Physical Sciences, from The Academy of Sciences, Chennai.
- Alagappa Excellence Award for Research for the Year 2015-2016, from Alagappa University, Karaikudi
- Young Scientist Award for the Year 2010-2011 in Physical Sciences, from Tamilnadu State Council for Science and Technology, Chennai.
- I have been ranked in *12th place* and *13th place* (*out of 183 Faculty Members*) in the Alagappa University Publication Statistics of Faculty Members in *Scopus database* and *Web of Science database*, respectively, as on 10.07.2019 (as per the data of NIRF cell of Alagappa University).

Selective 10 publications: (Last Five Years):

- Growth angle-dependent tunable work function and optoelectronic properties of MoO_x thin films
  Ranveer Singh, **R. Sivakumar**, S.K. Srivastava, Tapobrata Som
  Appl. Surf. Sci. 507 (2020) 144958. (Impact Factor: 6.182)

- Brown coloration and electrochromic properties of nickel doped TiO_2 thin films deposited by nebulized spray pyrolysis technique
  T. Dhandayuthapani, **R. Sivakumar**, R. Ilangovan, C. Sanjeeviraja, K. Jeyadheepan, C. Gopalakrishnan, P. Sivaprakash, S. Arumugam
  Thin Solid Films 694 (2020) 137754. (Impact Factor: 2.030)

- Facile fabrication of spinel structured n-type $CuAl_2O_4$ thin film with nano-grass like morphology by sputtering technique
  S. Ponmudi, **R. Sivakumar**, C. Sanjeeviraja, C. Gopalakrishnan, K. Jeyadheepan
  Appl. Surf. Sci. 483 (2019) 601. (Impact Factor: 6.182)

- Eco-friendly nebulized spray deposition of bifunctional anatase TiO_2 thin films exhibiting multicolor switching and efficient NH_3 gas sensing at room temperature
  T. Dhandayuthapani, **R. Sivakumar**, R. Ilangovan, C. Gopalakrishnan, C. Sanjeeviraja, K. Jeyadheepan
  Mater. Res. Exp. 6 (2019) 065053. (Impact Factor: 1.929)

- γ-MnS films with 3D microarchitectures: comprehensive study of the synthesis, micro structural, optical and magnetic properties
  T. Dhandayuthapani, M. Girish, **R. Sivakumar**, C. Sanjeeviraja, C. Gopalakrishnan, R.S. Nagarajan, S. Mathew, Ding Jun, T. Venkatesan, G. Kalai Selvan, K. Manikandan, S. Arumugam
  Cryst. Eng. Comm. 20 (2018) 578. (Impact Factor: 3.117)

- Structural, optical and electrochromic properties of Nb_2O_5:MoO_3 (95:5, 90:10, and 85:15) thin films prepared by RF magnetron sputtering technique
  N. Usha, **R. Sivakumar**, C. Sanjeeviraja
  Mater. Lett. 229 (2018) 189. (Impact Factor: 3.204)

- High coloration efficiency, high reversibility and fast switching response of nebulized spray deposited anatase TiO_2 thin films for electrochromic applications
  T. Dhandayuthapani, **R. Sivakumar**, R. Ilangovan, C. Gopalakrishnan, C. Sanjeeviraja, and A. Sivanantharaja
  Electrochemica Acta 255 (2017) 358. (Impact Factor: 6.215)

- A simple and distinguished nebulizer approach to prepare CdS thin films
  M. Girish, **R. Sivakumar**, C. Sanjeeviraja, R. Gopalakrishnan
  J. Energy Chem. 26 (2017) 398. (Impact Factor: 7.216)

- Improved electrochromic performance of a radio frequency magnetron sputtered NiO thin film with high optical switching speed
  K.S. Usha, **R. Sivakumar**, C. Sanjeeviraja, Vasant Sathe, V. Ganesan, T.Y. Wang
  RSC Adv. 6 (2016) 79668. (Impact Factor: 3.119)

- Mixed Nb_2O_5:MoO_3 (95:5 and 85:15) thin films and their properties for electrochromic device applications
  N. Usha, **R. Sivakumar**, C. Sanjeeviraja, R. Balasubramaniam, Y. Kuroki
  J. Mater. Sci.: Mater. Electron. 27 (2016) 7809. (Impact Factor: 2.220)

Cumulative Impact factor: 195
Total Citation: 1599
h- index: 22
i10- index: 38

FOREIGN SUBJECT EXPERT

CURRICULUM VITAE

Name: **Dr. S.N. PIRAMANAYAGAM Ph.D.**
Designation: Associate Professor
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Phone: **T** 65-6592-3148 **M** 65-9856-6712
Fax: +91-4565-225202
Email: prem@ntu.edu.sg www.ntu.edu.sg

Professional / Research experience:

- Associate Professor, NTU (January 2015 ~)
- Senior Scientist, Data Storage Institute (June 1999~January 2015)
- Adjunct Associate Professor, NUS (2003-2010)
- Post-PhD Research, Shinshu University, Japan (October 1995-June 1999)

Honours and Awards:

Editorial role

Editor, IEEE Transactions on Magnetics
Editorial Board, Scientific Reports (Nature Publishing Group)
Editorial Board, Physica Status Solidi-Rapid Research Letters
Editorial Board, Nanoscience and Nanotechnology Letters

Committees

Chair, IEEE Magnetics Society Technical Committee (2013-2016)
Voting Member of Adcom, IEEE Magnetics Society (2013-2016)
Co-Chair, IEEE Magnetics Singapore Chapter (2015-2016)
Chair, IEEE Magnetics Society Singapore Chapter (2013-2014)
Chair, IEEE Magnetics Society Singapore Chapter (2010-2011)

Recent publications:

Synaptic Element for Neuromorphic Computing Using a Magnetic Domain Wall Device with Synthetic Pinning Sites, T Jin, W Gan, F Tan, NR Sernicola, WS Lew, SN Piramanayagam, Journal of Physics D: Applied Physics	2019
Tilted magnetisation for domain wall pinning in racetrack memory, T Jin, F Tan, CAC Ian, W Gan, J Cao, WS Lew, SN Piramanayagam, Journal of Magnetism and Magnetic Materials, 165410	2019
Realization of Energy Harvesting Based on Stress-Induced Modification of Magnetic Domain Structures in Microwires, S Bhatti, C Ma, X Liu, SN Piramanayagam, IEEE Transactions on Magnetics	2019
Nanoscale modification of magnetic properties for effective domain wall pinning, T Jin, F Tan, WC Law, W Gan, I Soldatov, R Schäfer, C Ma, X Liu, WS Lew, SN Piramanayagam, Journal of Magnetism and Magnetic Materials 475, 70-75	2019
Nd-Fe-B films with perpendicular magnetic anisotropy and extremely large room temperature coercivity, C Ma, J Xia, X Zhang, Y Zhou, A Morisako, SN Piramanayagam, X Liu, Journal of Magnetism and Magnetic Materials 474, 406-410	2019
Magnetoresistive Sensor Development Roadmap (Non-Recording Applications), C Zheng, K Zhu, SC De Freitas, JY Chang, JE Davies, P Eames, . SN Piramanayagam, IEEE Transactions on Magnetics 55 (4), 1-30	2019

High amplitude microwave generation using domain wall motion in a nanowire, S Bhatti, SN Piramanayagam physica status solidi (RRL)–Rapid Research Letters 13 (3), 1800479	2019
Staggered magnetic nanowire devices for effective domain-wall pinning in racetrack memory, M Al Bahri, B Borie, TL Jin, R Sbiaa, M Kläui, SN Piramanayagam, Physical Review Applied 11 (2), 024023	2019
Stress-Induced Domain Wall Motion in FeCo-Based Magnetic Microwires for Realization of Energy Harvesting S Bhatti, C Ma, X Liu, SN Piramanayagam, Advanced Electronic Materials 5 (1), 1800467	2019

Cumulative Impact factor: ~600 (for 288 publications)
Total Citation: 4867 (as per Scopus database)
h- index: 29 (as per Scopus database)
i10- index: 82 (as per Google Scholar database)

FOREIGN SPECIAL INVITEE

CURRICULUM VITAE

Name: **Dr. R. PAULMURUGAN**
Designation: Associate Professor
Address: Department of Radiology
Stanford University, Stanford, USA
Phone: Phone: 650-725-6097, Fax: 650-721-6921
Email: paulmur8@stanford.edu

Educational qualification: 1986-1989 B.Sc. Madurai Kamaraj University, Madurai, India
1989-1991 M.Sc. University of Madras, Madras, India
1991-1997 Ph.D. University of Madras, Madras, India

Professional / Research experience:

1996-1999 Scientist B, Environmental Biotechnology Division, Rajiv Gandhi Centre for Biotechnology, Trivandrum, Kerala, India	**1999-2003 Scientist C,** Environmental Biotechnology Division, Rajiv Gandhi Centre for Biotechnology, Trivandrum, Kerala, India	**2001-2003 Visiting Scientist,** Crump Institute for Molecular Imaging, Department of Molecular and Medical Pharmacology, University of
2003-2009 Senior Research Scientist, Molecular Imaging Program at Stanford, Department of Radiology Stanford University, Stanford, USA	**2009-2016 Assistant Professor,** Department of Radiology, Stanford University, Stanford, USA	**2016-present Associate Professor,** Department of Radiology, Stanford University, Stanford, USA

Honours and Awards:

- 1991 Best Research Fellow, NEERI, CSIR, Nagpur, India
- 1999 Young Scientist Award, Government of Kerala, India
- 2003 Travel Award, Academy of Molecular Imaging for Best Paper Presentation, San Diego, California, USA
- 2005 Travel Award, Academy of Molecular Imaging for Best Paper Presentation, Orlando, Florida, USA
- 2005 Travel Award, Society of Molecular Imaging for Best Paper Presentation, Cologne, Germany
- 2006 Travel Award, Academy of Molecular Imaging for Best Paper Presentation, Orlando, Florida, USA
- 2018 Distinguished Investigator, The Academy for Radiology & Biomedical Imaging Research, RSNA, 2018

Recent publications:

Intranasal delivery of targeted polyfunctional gold–iron oxide nanoparticles loaded with therapeutic microRNAs for combined theranostic multimodality imaging, UK Sukumar, RJC Bose, M Malhotra, HA Babikir, R Afjei, E, R Paulmurugan Robinson, Biomaterials 218, 119342 2019

Ultrasound/microbubble-mediated targeted delivery of anticancer microRNA-loaded nanoparticles to deep tissues in pigs, T Di Ianni, RJC Bose, UK Sukumar, S Bachawal, H Wang, A Telichko, R Paulmurugan, Journal of Controlled Release 309, 1-10 2019

Cell-based biosensors: Recent trends, challenges and future perspectives, N Gupta, V Renugopalakrishnan, D Liepmann, R Paulmurugan, Biosensors and Bioelectronics, 111435	2019
The protean world of non-coding RNAs in glioblastoma, R Paulmurugan, M Malhotra, TF Massoud, Journal of Molecular Medicine, 1-17	2019
Molecular Imaging of Retinoic Acids in Live Cells Using Single-Chain Bioluminescence Probes, SB Kim, R Fujii, R Nishihara, RJC Bose, D Citterio, K Suzuki, TF Massoud, R Paulmurugan, ACS combinatorial science	2019
Biodegradable polymers for modern vaccine development, RJC Bose, M Kim, JH Chang, R Paulmurugan, JJ Moon, WG Koh, SH Lee, R Paulmurugan, Journal of Industrial and Engineering Chemistry	2019
Near Infrared bioluminescence imaging with Through-Bond Energy Transfer Cassette, M Abe, R Nishihara, Y Ikeda, T Nakajima, M Sato, N Iwasawa, R Paulmurugan, ChemBioChem	2019

Cumulative Impact factor: ~600 (for 202 publications)
Total Citation: 5761 (as per Scopus database)
h- index: 40 (as per Scopus database)
i10- index: 96 (as per Google Scholar database)

SUBJECT EXPERT

CURRICULUM VITAE

Name: **Dr. R. JAYAVEL**
Designation: Professor & Director
Address: Centre for Nanoscience & Tech. Anna University, Chennai-600 025
Phone: Tel : +91-44-22357355, Fax: +91-44-22301656.
Email: rjvel@annauniv.edu

Educational qualification:

Ph.D. Anna University April 1990 -Feb. 1995
M.Phil. Anna University Sep.1988 -March 1990
M.Sc. University of Madras June 1986-April 1988
B.Sc. University of Madras June 1982-April 1985

Professional / Research experience:

Director 3rd June 2015-Till Date Centre for Research, Anna University	Visiting Professor 23rd Aug.-22nd Oct. 2010 University of Goettingen, Germany.
Visiting Professor 15-30th June 2016. University of South Australia,	Professor 1st Jan. 2009 –Till Date Crystal Growth Centre, Anna University.
Director 21st Oct.2005 -2nd June 2015 Centre for Nanoscience & Technology, Anna University	Visiting Professor 1st Dec.06-31st March 07 Research Inst. of Electronics, Shizuoka University, Japan
Visiting Professor 15th Oct.-26th Oct.2012 University of Queensland, Australia.	Associate Professor 1st Jan.06 -31st Dec. 08 Crystal Growth Centre, Anna University

Honours and Awards:

Fellow of Academy of Sciences, Chennai.	Visiting Researcher, National Institute for Materials Science, Japan (June-2005)
MRSI Prize for Best Paper Presentation in the MRSI-Meeting-2013.	Best paper Award, "International Conference on Spectrophysics", Chennai (2005).
Visiting Professor, University of South Australia, Adelaide (June 2016).	Japanese Government Award for Foreign Expert (May-June 2004)
Visiting Professor, Queensland University, Australia (Oct. 2012).	Special Researcher, National Institute for Materials Science, Japan (2001-2003)
Active Researcher Award, Anna University (2012).	DAAD Sandwich Model Fellowship to visit Germany (2000)
Media Guild Award of Recognition 2012-2013.	Science & Technology Agency (STA) Fellowship, Japan (1999-2001)
Visiting Researcher, National Institute for Materials Science, Japan (June –2010)	Best paper Award, "Seminar on Materials and Characterization",CECRI (1998)
Visiting Professor, University of Goettingen, Germany under the European UnionAcademic Exchange Programme (Aug.-Oct. 2010).	Certificate of Achievement by Leica Cambridge Ltd, UK for SEM Training (1995)
Visiting Researcher, National Institute for Materials Science, Japan (Sep.-2009)	Selected for Young Physicists Colloquium by the Indian Physical Society (1993)
Honorary Guest Professor, Shizuoka University, Japan (2009-2012).	CSIR-Visiting Research Associate for research at NPL, New Delhi (1993).
Visiting Professor, Shizuoka University, Japan (December 2006-March 2007).	

Recent publications:

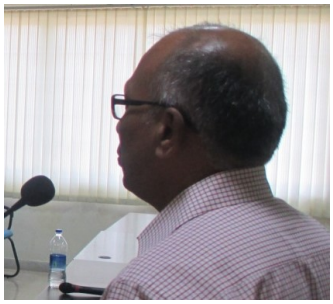
TiO2 nanostructures with controlled morphology for improved electrical properties of photoanodes and quantum dot sensitized solar cell characteristics, T Archana, K Vijayakumar, M Arivanandhan, R Jayavel, Surfaces and Interfaces 17, 100350 2019

A facile preparation, performance and emission analysis of pongamia oil based novel biodiesel in diesel engine with CeO2: Gd nanoparticles, K Dhanasekar, M Sridaran, M Arivanandhan, R Jayavel, Fuel 255, 115756	2019
Preparation and thermal characteristics of caprylic acid based composite as phase change material for thermal energy storage, P Sivasamy, S Harikrishnan, R Jayavel, SI Hussain, S Kalaiselvam, L Lu, Materials Research Express	2019

Cumulative Impact factor: ~1000 (for 502 publications)
Total Citation: 8116 (as per Scopus database)
h- index: 46 (as per Scopus database)
i10- index: 220 (as per Google Scholar database)

SUBJECT EXPERT

CURRICULUM VITAE



Name: **Dr. V. NATARAJAN, Scientist 'G'**
Designation: Director,
Address: Research & Innovation Centre
IITM Research Park, Taramani
Chennai - 600 113
Phone: 044 2254 8200
Fax: 044 2254 8215
Email: natarajan@ric.drdo.in

Educational qualification:
Graduation: Coimbatore Institute of Technology
Post Graduation: College of Engineering, Guindy
PhD: Crystal Growth Centre, Anna University

Professional / Research experience:
Joined DRDO, Solid State Physics Laboratory in 1988to 1993, Scientist 'B' and at NPOL, Naval Physical & Oceanographic Laboratory, since 1994.

Honours and Awards:

a) Solid State Physics Laboratory
Actively involved in the material development programme for Infrared Detectors for thermal imager.

b) Naval Physical & Oceanographic Laboratory

1. Underwater Acoustics -
   - Worked in the area of underwater acoustics in characterising and evaluation of transducers and materials from 1994 - June 2004. Established Materials & Transducers - Simulated Test Centre.
   - Designed and developed Near-Field array for under water acoustic evaluation of Transducers under simulated conditions.
   - Head, Acoustics Measurement Division from July 1997 - June 2004.

Post Doctoral Fellow at Centre for Engineering of Electronic and Acoustic Materials and Devices at Pennsylvania State University, USA during 2002.

2. MEMS devices
   - Established Clean room Class 100 & 1000 with all facilities and utilities
   - Developed CTD sensor, MOSFET Hydrophone, Acoustic Imaging Sensor, Polymer FET, Wide bandwidth capacitive accelerometer & Acoustic Vector Sensor.

3. Smart Materials & Devices
   - Associated in the development of MagnetoRheological fluid based devices â€“ smart brakes, dampers and MagnetoRheological elastomer based low frequency Transducer.
   - Designed and fabricated Magnetostrictive low frequency transducers using Giant Magnetostrictive Material.

Patent:

- Design & Development of Low Frequency Projector using MRElastomer. (Indian Patent).

Recent publications:

- Published more than 60 papers in Journals and conferences.
- A chapter entitled MEMS Sensors for Underwater Applications in a book Micro and Smart Devices and System, Springer, July 2014.
- DRDO AWARD "Laboratory Scientist of the Year 2009".
- DRDO Science Day Oration Award 2009
- Member: Indian Defence Delegation to Singapore
- Member: Naval Research Board

CO-OPTED MEMBER FROM INDUSTRY

Name: **Dr. K. DEVAKUMARAN**
Designation: Manager
Address: Welding Research Institute
Bharat Heavy Electricals Limited
Tiruchirappalli- 620014
Tamil Nadu, India
Phone: +91-9443689943
Fax: +91-431-2520773
Email: devakumaran@bhel.in

Educational Qualification :

Degree	Discipline	University / Institution	Month & Year of Passing
Ph.D.	Welding Engineering	Indian Institute of Technology Roorkee	Dec- 2008
M.E.	Production	Annamalai University	December- 2002
B.E.	Mechanical	University of Madras	April-1998

Work Experience : Around 13 Years

Organisation	Position	Period
Advanced Technology Products, BHEL, Trichy	Manager	July – 2019 onwards
Welding Research Institute, BHEL, Trichy	Deputy Manager	June 2015 – July -2019
Welding Research Institute, BHEL, Trichy	Senior Engineer	Oct. 2010- June 2015
VIT University	Associate Professor	Jan. 2010 to Oct. 2010
IIT Roorkee	Project Scientist Research Associate Senior Research Fellow	March 2009 to Dec. 2009 April 2007 to March 2009 March 2003 to July 2003
Super Machine Works Pvt. Ltd., Coimbatore	Production Engineer	June 1998 - October 2000

Awards

- **Technical Committee Convener, 8th International symposium on joining of materials (SOJOM) - 2018,** organized by WRI/BHEL, IWS and IIM.
- **Won the first price** in the metallography contest under the category of **electron microscope** in the **55th National Metallurgical Day (NMD), 2017.** The micrograph poster Captioned as**Oxides's Spinning Wheel.**
- **Won the first price** in the metallography contest under the category of light microscope in the **55th National Metallurgical Day (NMD), 2017.** The micrograph poster Captioned as **Appearance does not Matter. We are all Same.**
- **Won the second prize** for Poster Presentation entitled" Hot Corrosion Behaviour of T22 & SS347H Material and Their Weldments in Different Media", NCCI- **Eighteenth National Congress on Corrosion Control**, **2016**.
- **Won the first price** in the metallography contest under the category of light microscopein the **53rd National Metallurgical Day (NMD), 2015**. The micrograph poster Captioned as **Unity in Diversity.**
- **Republic Day Gold Medal Award** under the category of **Impress Project, 2014** by Bharat Heavy Electricals Limited **(BHEL)**.
- **First Time in India,** Successfully established and implemented "**Hot Wire GTAW Technology**" for various boiler components**. 2012-2013**.
- **Research Associate (RA)**, Council of Social and Industrial Research (CSIR). 2007-2009.

Publications	: More than 50
Project completed	: Around 25 (Total project cost is around 70 crores)
Patents	: 4 filed
Guided	: Ph.D – 3 completed and 2 in progress M.Tech. / MS – 14 completed and 2 in progress
Professional Membership	: Life member of IIM, IWS and IIW

STUDENT ALUMNI

CURRICULUM VITAE

Name: **Dr. K. KARTHIK, Ph.D.,**
Designation: DST INSPIRE Faculty, Assitant Professor in AcSIR,
Address: CMP Division, CSIR-CECRI, Karaikudi - 630 003
Phone: +91 4565 241562
Email: karthikk@cecri.res.in,

Professional / Research experience:

- DST INSPIRE Faculty at CSIR- Central Electrochemical Research Institute (CECRI), Karaikudi, India (14th Dec. 2016- till date)
- NIMS Researcher, National Institute for Materials Science (NIMS), Tsukuba, Japan (1st Dec. 2014- 30th Nov 2016)
- Post-Doctoral Researcher, Japan Advanced Institute of Science and Technology (JAIST), Nomi, Japan (11th Mar. 2013- 28th Nov 2014)
- Post-Doctoral Researcher, Research Core for Interdisciplinary Sciences (RCIS), Okayama University, Okayama, Japan. (1st Apr. 2012- 8th Mar. 2013)

Educational qualification:

- Ph.D. Physics-Materials Science (Jan. 2012), Anna University, Chennai, India
- M.Sc. Physics (April 2006), Alagappa University, Karaikudi. India
- B.Sc. Physics (April 2004), Alagappa Govt. Arts College, Karaikudi, Affiliated with Madurai Kamaraj University, India

Honours and Awards:

- Early Career Research (ECR) Award by SERB-India on Oct. 2018 (Rs. 48,00,168/-)
- Selected Journal article as 'Hot Article' in Analytical Sciences, 2017.
- DST INSPIRE Faculty award by DST, Govt. of India on Aug. 2016 (Rs. 86,27,426/-)
- Best Presentation Award on MANA International Symposium on Mar. 2016, Japan.

Selected Publications:

- **Karthik Krishnan**, Masakazu Aono, Kazuya Terabe, and Tohru Tsuruoka, **J. Phys. D. Applied Physics,** 2019, (doi.org/10.1088/1361-6463/ab35bf), **Impact Factor- 2.82**
- **Karthik Krishnan*** Premkumar Jayaraman, Subramanian Balasubramanian, and Ulaganathan Mani, J. Mat. Chem. A. 2018, 6, 23650-23658, **Impact Factor- 10.73**
- **Karthik Krishnan,*** Manoharan Muruganathan, Tohru Tsuruoka, Hiroshi Mizuta, and Masakazu Aono **Adv. Funct. Mater**. 2017, 27, *1605104*, Impact Factor- **15.62**
- **Karthik Krishnan,*** Tohru Tsuruoka, Cedric Mannequin, and Masakazu Aono, **Adv. Mater**., Vol. 28, 2016, 640-648. **Impact Factor- 25.80.**

Cumulative Impact factor: 124.63; Average Impact factor: 5.94; Total Citation: 445 (as per Google Scholar) h- index: 11 (as per Google Scholar); i10- index: 11 (as per Google Scholar)

Total of presentation/invited talks in Conferences/Symposiums/Workshops- 32