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 NANOSCIENCE AND TECHNOLOGY

M.Sc., NANOSCIENCE AND TECHNOLOGY

[Choice Based Credit System (CBCS)]

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

CONTENTS

I. General objectives of the Programme

(a) Nanotechnology is one of the key technologies of the 21st century.
(b) One academic course is necessary to create awareness to students in the emerging field and also it should teach basics, concepts and developments of nanoscience to students to make them as scientist or technologists in this filed.
(c) The current and future fields of application of nanotechnology are electronics, mechanical engineering, biomedical, satellite, automobile and pharmaceutical industries, the field of new materials and environmetal technology.
(d) Rigorous and comprehensive in approach, this syllabus presents essential contents in a detailed, clear and direct way.
(e) The programme is structured in such a way to impart more knowledge in science, in particular in Chemistry, Physics and Biology.

Programme specific objectives

(a) This course help learn advances in nanotechnology
(b) Foster the transfer of new technologies into products for commercial and public benefit
(c) Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment
(d) Apply their learned knowledge to develop Nanomaterials.

Programme outcome

On successful completion of the programme
(a) The students will be able to engage in noteworthy, self-govering, and creative research in Nanoscience& Technology.
(b) The skill-based courses support the student to develop entrepreneurship in the current field of Nanoscience & Technology.
(c) The student acquired significant knowledge and update the mankind currenttechnology.

II. Eligibility for Admission

A candidate who has passed B.Sc., Degree Examination with Mathematics, Physics, Chemistry and Biology as main subject of study of any university or any of the B.Sc., degree examination with specialization such as Mathematics, Applied Mathematics, Applied Physics, Electronics, Nuclear Physics, Biophysics, Industrial chemistry, Polymer Chemistry, Applied Chemistry, Pharmaceutical Chemistry, Biotechnology, Nanoscience, Nanobiotechnology, Biochemistry and Micro-biology or any other specialization in Mathematics, Physics, Chemistry and Biology and B.E/B.Tech in ECE,EEE, Chemical Engg., Petrochemical Engg., Mater.Sci. & Engg.,Nanotechnology, Biotechnology and Bioinformatics 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 Nanoscience and Technology of this University after a course of study of two academic years.

III. Duration of the Course

The course for the degree of Master of Science in Nanoscience and Technology shall consist of two academic years divided in to four semesters. Each Semester consist of 90 working days.

IV. Course of Study

M.Sc. Nanoscience and Technology (CBCS - Structure of the Course)

S.No	Paper Code	Title of the Paper	Credit	Hrs/ Week	CIA Marks	ESE Marks	Total Marks
Core Courses							
I -Semester							
1.	533101	Basics of Mathematics and Quantum Mechanics	5	5	25	75	100
2.	533102	Basics of Materials Science	5	5	25	75	100
3.	533103	Basic Biotechnology	5	5	25	75	100
4.	533104	Introduction to Nanoscience	5	5	25	75	100
5.	533501	Major Elective -I	4	4	25	75	100
6.	533107	Nano Science and Technology Lab-I (Nanophysics Experiments)	3	6	25	75	100
		Total	**27**	**30**			
		II -Semester					
7.	533201	Synthesis of Nanomaterials	5	5	25	75	100
8.	533202	Characterization of Nanomaterials	5	5	25	75	100
9.	533203	Applications of Nanomaterials	5	6	25	75	100
10.		Non-major Elective(NME) – I	2	3	25	75	100
11.	533207	Nano Science and Technology Lab – II (Nano-chemistry Experiments)	4	8	25	75	100
	SLC	MOOCs-Swayam	Extra credit				
		MOOCs-Swayam /Library /Yoga/ Career Guidance		3			
			21	**30**			
		III -Semester					
12.	533301	Nano Biotechnology and Nano Medicine	5	5	25	75	100
13.	533302	Nanoelectronics and Nanodevice	5	5	25	75	100
14.	533303	Nanoengineering	5	5	25	75	100
15.	533503	Major Elective – II (Microsystem Technology)	4	4	25	75	100
16.		Non-major Elective –II	2	3	25	75	100
17.	533307	Nano Science and Technology Lab – III (Nano-biotechnology Experiments)	4	8	25	75	100
		MOOCs-Swayam	Extra credit				
			25	30			
		IV-Semester					
18.	533508	Elective Course – IV - Nanotoxicology	4	4	25	75	100
19.	533999	Project - Report & Viva voce	13	26	25	75	100
			17	**30**			1900
Total Credits: 27+21+25 +17 = 90 Credit							

Elective Course							
1.	533501	Thin FilmTechnologies and Characteristics	4	4	25	75	100
2.	533502	Condensed Matter Physics	4	4	25	75	100
3.	533503	Microsystem Technology	4	4	25	75	100
4.	533504	Information Storage Materials and Devices	4	4	25	75	100
5.	533505	Computer Simulation and Modelling	4	4	25	75	100
6.	533506	Polymer nanocomposites	4	4	25	75	100
7.	533507	Nanobiomaterials and nanobiotechnology for tissue engineering	4	4	25	75	100
8.	533508	Nanotoxicology	4	4	25	75	100
*** NME/Supportive Courses for other Departments**							
1.	533703	Introduction to Nano Scale in Science and Technology	2	3	25	75	100
2.	533704	Nanotechnology and Advanced drug delivery System	2	3	25	75	100

Note: C – Core Courses, E – Elective Courses & S – Supportive Courses; L – Lecture,

Tutorial, P – Practical, C-cerdit.

V. Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would 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 would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

VI. Examinations

The examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

Practical examinations for M.Sc. course in Nanoscience and Technology should be conducted at first, second and third semester.

At the end of fourth semester viva-voce will be conducted on the basis of the Dissertation report submitted by the student. One internal and one external examiner will conduct the viva-voce jointly.

VIII. Question Paper Pattern

(For all theory courses)

Max. Marks: 75 **Time: 3 Hours**

PART-A: 10x2=20

(Answer all questions)

(Two questions from each unit)

Q.No. 1 – 10

PART-B: 5x5=25

(Answer all questions)

(One question from each unit with internal choice)

11. a) or b)
12. a) or b)
13. a) or b)
14. a) or b)
15. a) or b)

PART-C: 3x10=30

(Answer any three questions)

(One question from each unit)

Q.No. 16 – 20

Nano-Physics Practical	**Marks**
Formula	10
Experiment	40
Viva-voce in practical	10
Record	10
Accuracy of result	5
Total	75

Nano-chemistry Practical	**Marks**
Procedure	10
Preparation	40
Viva – Voce in practical	10
Record	10
Better result	5
Total	75

Nano-biotechnology Practical	**Marks**
Procedure	10
Experiment	40
Viva-voce in practical	10
Record	10
Better result	5
Total	75

X. Dissertation / Project Work

Dissertation / Project Work: 100 marks

Periodic Presentation of Learning	25 marks
Concise Dissertation	50 marks
Viva-Voce	25 marks
Total	100 marks

(a) Plan of Work:

The student should prepare plan of work for the dissertation, 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 acknowledge the alien facilities utilized by them.The duration of the dissertation research shall be a minimum of three months in the fourth semester.

(b) Dissertation Work outside the Department:

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

(c) No. of copies/distribution of dissertation:

The students should prepare four copies of dissertation and submit the same for the evaluation by Examiners. After evaluation one copy is to be retained in the Department library and one copy is to be submitted to the University (Registrar) and one copy for guide and one copy can be held by the student.

(d)Format to be followed:

The format/certificate for dissertation to be submitted by the students are given below:

Format for the preparation of project work:

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

CONTENTS

Format of the Title Page:

TITLE OF THE DISSERTATION

Dissertation Submitted in part fulfillment of the requirement for the Degree of Master of Science in Nanoscience and Technology to the Alagappa University, Karaikudi

By

Students Name:

Register Number:

Department of Nanoscience and Technology Year:

Format of the Certificate:

CERTIFICATE

This is to certify that the dissertation entitled submitted in partial fulfillment of the requirement of the degree of Master of Science in Nanoscience and Technology 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 dissertation 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 of full in any scientific or popular journals or magazines.

Date:

Place:

Signature of Guide

Approved by

Head of the Department External Examiner

Guidelines for approval of M.Sc. Nanoscience and Technology guides for guiding students in their research for submitting dissertation:

1. M.Sc. Nanoscience and Technology (Partial fulfillment) Guide:
   a) The person seeking for recognition as guide should have:
   A Ph.D. Degree in Science discipline
   (or)
   b) M.Phill / M.Sc. degree in Science with first class/second class
   Should have 3 years of active teaching/research experience
   They should have published at least one research paper in a National Journal authored solely or jointly.

2. Procedure for submitting application for approval as guides:
   (i) The University will 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 Principal.

XI. Village Extension Programe (VEP)

The Sivaganga and Ramnad districts are very 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 Programe (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. A minimum of two faculty members can accompany the students and guide them.

1. Environmental awareness
2. Hygiene and health

This course is a compulsory for all the M.Sc Nanoscience and Technology students of the Centre for Nanoscience and Technology, Alagappa University. Students will be awarded TWO credits apart from the minimum credits 90 to be earned for the M.Sc. programme.

XII. Passing Minimum

The candidate shall be declared to have passed the examination if the candidate secures a minimum of 50 % (50 marks out of 100 marks) in the University external examination. Then half of the total marks secured by the candidate will be taken and add with his/her internal marks (Maximum marks 50).

For a pass in the Practical paper, a candidate has to secure a minimum of 50%(25 marks) marks in the University (external) (50 marks) examination. He/she should get a minimum of 50 marks out of 100, an aggregate of internal (50 marks) and external marks (50 marks) and the record notebook taken together. There is no passing minimum for the record notebook. However submission of a record notebook is a must.

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 paper.

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

XIII. 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 course in the first instance and within a period of two academic years from the year of admission to the course only are eligible for University Ranking.

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

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

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

XIV. Maximum Duration for the Completion of the Course

The maximum duration for completion of M.Sc. Degree in Nanoscience and Technology Programme shall not exceed eight semesters from their first semester.

XV. Commencement of this Regulation

These regulations shall take effect from the academic year 2019-20.i.e., for students who are to be admitted to the first year of the course during the academic year 2019-20 and thereafter.

XVI. Transitory Provision

Candidates who were admitted to the M.Sc. Nanoscience and Technology course 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 2021. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

XVII. Code and Grading.

1. Legend

5	3	3	X	Y	Z

533 NANOSCIENCE – M.Sc.

X Semester No : 1 – core
Y Course : 4/1– elective/interdisciplinary

Z Course number in the semester

2. Each student should take 90 credits including core course, elective courses and interdisciplinary courses and 4 credits in computer applications/communication skill and 2 credits in village extension programme, totalling at least 90 + 2 credits to complete M.Sc., NANOSCIENCE AND TECHNOLOGY degree course.
3. Students may be allowed to take more than 3 or 4 credits in elective/ interdisciplinary courses in a semester from the courses offered by the department in inter-disciplinary subjects as suggested by the course advisor.
   The extra credits (above 12) secured in elective/ interdisciplinary courses will be entered in the mark list separately.
4. Each paper carries 4 or 3 or 2 credits with 50 marks in the university examination and 50 marks in C.I.A. The university examination will be of three hours duration.
5. For a pass in each paper, the candidate is required to secure at least 50% in the university examinations and 50% in the aggregate. (Including ,C.I.A).
6. If the total aggregate marks obtained by the candidate is X%, put together for all papers comprising the 84 credits, then,

Raw ScoreGrade	Description		Grade Points
90 and above	O	Out standing	9.0 – 10.0
80 to 89	A	Very Good	8.0 – 8.9
70 to 79	B	Good	7.0 – 7.9
60 to 69	C	Very poor	6.0 – 6.9
50 to 59	D	Satisfactory	5.0 – 5.9
Less than 50 F	Failures		
	V	Inadequate Attendance’	
	W	Withdrawal from the course	

Semester – I			
Course code:533101	**Basics of Mathematics and Quantum Mechanics**	**Credits: 5**	**Hours : 5**
Objectives	➢ To achieve an understanding of the theory of quantum mechanics, and an ability to apply the quantum theory to important physical systems. ➢ To become aware of the necessity for quantum methods in the analysis of physical systems of atomic and solid state physics		
Unit - I	**Vector & Special Function** Vector space, linear transformation - Inverse transformation, - Determination of Eigen values and Eigen vectors. Beta and Gamma functions, Legender's, Hermite and Laguerre polynomials and Bessel functions- Generating function, Rodirgues formula, Orthogonal properties and recurrence relations.		
Unit - II	**The Physical Basis of Quantum Mechanics: -** Limitation of classical physics – Plank's Quantum hypothesis- Einstein's Photoelectric effect- wave nature of particle Wave-particle duality, Schrödinger time dependedindependent wave equations andexpectation values, Uncertainty principle.		
Unit - III	**Bound States & Quantum Tunneling: -** Free particle - Momentum eigen functions, Energy levels of a particle – Infinite square well in one(1D), two (2D), and three dimensions(3D) - Density of states – Confined carriers - Electron wave propagation in devices - Quantum confinement - Penetration of a barrier – Tunnel effect - Basic principles of a few effective devices – Resonant tunnel diode, Superlattice , Quantum wire and Dot- Oscillatory dynamics.		
Unit - IV	**Optical properties and interactions of nanoscale materials: -** Size-dependent optical properties: Absorption and emission, Basic quantum mechanics of linearoptical transitions, General concept of excitons, Wannie rexcitons, Size effects in high-dielectric-constant materials, Size effects in Π-conjugated systems, Strongly interacting Π -conjugated systems:A molecular dimer, Size-dependent electromagnetic interactions: Particle–particle Forster resonant energy transfer (FRET).Photo-induced electron transfer.		
Unit - V	**Semiconductor Band-Gap Engineering : -** Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells.		

Reference and Textbooks:-

Aruldhass. G(2004), Quantum Mechanics**,** Printice hall of India Pvt Ltd. New Delhi.

Bhattacharya, P. (2009). *Semiconductor optoelectronic devices*. New Delhi: Prentice Hall India.

Dass, H. K., & Bhārmā, R. (2015). *Mathematical Physics:*. Rama Nagar, New Delhi: S. Chand & Company Pvt.

Griffiths, D. J. (2017). *Introduction to quantum mechanics*. Cambridge: Cambridge University Press.

Singh, J. (1995). *Semiconductor optoelectronics: Physics and technology*. New York: McGraw-Hill.

Tsurumi, T. (2010). *Nanoscale physics for materials science*. Boca Raton, FL: CRC Press.

Vaughn, M. T. (2008). *Introduction to mathematical physics*. Weinheim: Wiley-VCH.

Vaughn, M. T. (2008). *Introduction to mathematical physics*. Weinheim: Wiley-VCH.

Website-References

1. https://epgp.inflibnet.ac.in/view_search.php?&category=19026&ft=et
2. https://epgp.inflibnet.ac.in/view_f.php?category=1852

3. http://simons.hec.utah.edu/NewUndergradBook/Chapter1.pdf	
Outcomes	➢ The students should be able to understand the basic and advanced concepts to analyze the Quantum Mechanics and mathematical physics. ➢ Scientifically improvement of new applications of quantum physics in computation. ➢ To become aware of the necessity for quantum methods in the analysis of physical systems of atomic and solid state physics. ➢ To appreciate the applications of quantum mechanics in physics, engineering, and related fields.

Name of the Course Teacher

Dr.G.Ramalingam, Assistant Professor.

Semester – I			
Course code: 533102	**Basics of Materials Science**	**Credits: 5**	**Hours : 5**

Objectives	➢ To acquire basic understanding of advanced materials, their functions and properties for technological applications. ➢ To understand the principal classes of Metals, Semiconductors and their functionalities in modern engineering science.
Unit - I	**Crystal Symmetry and Structure Determination: -** The Growth and form of crystal - Crystal system - Space lattices and Unit cell - Crystal Symmetry-planes and Miller indices – Statistical thermodynamic of crystals - symmetry distribution of crystals – Scherrer's equation-crystalline size determination -Imperfections in Crystal-Schottky and Frenkel defects.
Unit - II	**Structure of Solids: -** The crystalline - Noncrystalline states – Classification of Solids – Amorphous Solids, Crystalline Solids – Properties of Solids - Mechanical properties, Electrical properties, Optical Properties, Magnetic properties, Fermi-Diarc- Electronic distribution in solids, Energy Bonding Structures in solid, low energy excitations: phonons, plasmons, Magnons, Polarons, Polaritons- Dielectric Response - Connection to Transport Properties –Density of states- Light Emission and Absorption-Inorganic solids-Covalent solids, Metal and alloys, Ionic solids, Molecular solids, Structure of silica and silicates.
Unit - III	**Metals, Semiconductors and Dielectric materials: -** Metals - Atomic Structure - physical and electronic properties, thermal conductivity - Electrical conductivity, non-metals - Semiconductors - energy gap in solids – band structures-excitons, types of Semiconductors, Semiconductor devices.
Unit - IV	**Polymeric materials: -** Polymeric Materials - Electrical Properties of Polymers - Classification of polymers – Polymer Crystallinity - Mechanical-Dynamic-Tensile – Flexural properties, Heat-thermal – Gas barrier – ionic conductivity - optical transparency - Biodegradability behavior, structure of long chain polymers, Crystallinity of long chain polymers. Stress strain behavior – macroscopic deformation - viscoelastic deformation – deformation of semi crystalline polymers – Advanced polymeric materials.
Unit - V	**Crystals and defects: -** Defects in solid structures – point defects – extended defects – Planar Defects – dislocations – grain boundaries – role of the defects on the properties of solids – grain boundary volume in microscopic and nanocrystals – defects in microscopic and nanocrystals – surface effects on the properties - defects due to severe plastic deformation – stacking faults – Hall Petch behavior – deformation in FEE and HCP nanostructures.

Reference and Textbooks:-

Atkins, P. W., Paula, J. D., & Keeler, J. (2019). *Atkins physical chemistry*. Oxford: Oxford University Press.

Barnham, K., & Vvedensky, D. D. (2001). *Low-dimensional semiconductor structures: fundamentals and device applications*. New York: Cambridge University Press.

Byrappa, K., & Ohachi, T. (2003). *Crystal growth technology*. Norwich, NY: William Andrew Pub.(2003). *Materials science and technology*. Washington, D.C.: National Academies Press.

CallisterW, D. (2006). *Materials science and engineering an introduction*. La Habana: Editorial Félix Varela.

Chung, Y.-wah. (2007). *Introduction to materials science and engineering*. Boca Raton: CRC/Taylor & Francis.

Fischer, T. E. (2009). *Materials science for engineering students*. Amsterdam: Elsevier/Academic Press.

Goddard, W. A. (2002). *Handbook of nanoscience, engineering, and technology*. Boca Raton, FL: CRC.

Karas, G. V. (2005). *New developments in crystal growth research*. New York: Nova Science Publishers.

Lu, G. Q., & Zhao, X. S. (2006). *Nanoporous materials: science and engineering*. London: Imperial College Press.

Markov, I. V. (2017). *Crystal growth for beginners: fundamentals of nucleation, crystal growth, and epitaxy*. New Jersey: World Scientific.

Narayan, R. (1983). *An introduction to metallic corrosion and its prevention*. New Delhi: Oxford & IBH.

Pillai, S. O. (2018). *Solid state physics*. London, UK: New Academic Science, an imprint of New Age International (UK) Ltd.

Raghavan, V. (2015). *Materials science and engineering: a first course*. Delhi: PHI Learning Private Limited.

Raghavan, Y. S. (2010). *Nanostructures and nanomaterials: synthesis, properties and applications*. New Delhi: Arise Publishers & Distributors.

Shackelford, J. F. (2016). *Introduction to materials science for engineers*. Pearson Education: Harlow.

Wasa, K., Kitabatake, M., & Adachi, H. (2011). *Thin films material technology: sputtering of compound materials*. Berlin: Springer.

Website References

1. https://epgp.inflibnet.ac.in/view_f.php?category=1640
2. https://epgp.inflibnet.ac.in/view_f.php?category=1673

Outcomes	➢ To emphasize the significance of materials selection in the design process ➢ To get familiarize with the new concepts of Nano Science and Technology ➢ To educate the students in the basics of instrumentation, measurement, dataacquisition, interpretation and analysis ➢ To appreciate the applications of materials science in engineering and related fields.

Name of the Course Teacher

Dr. P. Shakkthivel, Professor.

Semester – I			
Course code: 533103	**Basic Biotechnology**	**Credits: 5**	**Hours : 5**

Objectives	➢ Learn about the structure and function of biomolecules in living system. ➢ To strengthen the knowledge on various cloning and expression vectors. ➢ To impart the importance genetic engineering. ➢ To make the students understand the concepts and application of transgenic animals and plants and its application. ➢ To familiarize and expose the students to fundamentals of biological database and its application in genomics and proteomics.
Unit - I	**Biotechnology: -** Basic concepts of Biotechnology-- Structure of atom and molecules,Bonding in biological system, Structure and properties of water, Buffers in biological system;Structure and function of cells – prokaryotes and eukaryotes, Structure and organization of membrane, membrane transport; Structure, classification and biological importance of carbohydrates, amino acids, Protein, nucleic acid and lipids; Enzymes – classification, kinetics and application.
Unit - II	**Genetic Engineering: -** Scope andMilestones in Genetic Engineering– Gene Expression and Gene Regulation; Molecular tools used in Genetic Engineering - DNA modifying enzymes, vectors and host system; Gene cloning-ethical issues, Merits and Demerits of cloning; - Gene Therapy;. Biotechnological applications of rDNA technology.
Unit - III	**Plant Biotechnology: -** Plant cell and Tissue culture – In vitro culture methodologies -Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis; Applications of Plant Genetic Engineering in crop improvement-green house technology, plants as bioreactors, transgenic plants and its application.
Unit - IV	**Animal Biotechnology: -** Scope of animal biotechnology - Techniques of animal cell and tissue culture- Culture media, growth factors, laboratory facilities, characteristics of cells in culture - Primary culture, immortal cells, cell lines, Maintenance of cell lines in the laboratory; application of animal cell culture; stem cell culture; Transgenic animal production – Methods of gene transfer, Transgenic animals model for human disorders .
Unit - V	**Microbial Biotechnology: -** Environmental pollution – Types, Causes, Effects and Control measures; Bio remediation -concepts, bioremediation of toxic metal ions, phytoremediation, Microbial leaching mechanism; Bioactive metabolites - Primary metabolites, Secondary metabolites, Enzyme Technology, Single cell protein, Biomass and Bio-energy, Bio-gas production.

Reference and Textbooks:-

Al-Rubeai, (2014). *Animal Cell culture*. Springer International Publishing. Zahoorullah, S. (2015). *A Text book of Biotechnology*. SM online LLC.

Brown, T. (2006). *Gene cloning and DNA analysis* (Fiftgh edition ed.). Blackwell.

Freshney, R. I. (2015). *Culture of Animal cells: A Manual of Basic technique and Specialised Application* (Seventh Edition ed.). Wiley Blackwell.

Gayatri, (2015). *Plant Tissue Culture: Protocols in Plant Biotechnology*. Alpha Science International.

Godbey, W. (2014). *An Introduction to Biotechnology: The Science technology and medical applications*. Academic Press, Elseiver.

Nelson, D. (2013). *Lehninger Principles of Biochemistry* (6th edition ed.). Macmillan worth.

Primrose, S. (2014). *Principles of Gene manipulation and genomics* (Seventh Edition ed.). Blackwell.

Sambrook, J. (2007). *A Laboratory Manual, Cold spring harbour laboratory press*. Cold spring harbour laboratory press.

Smith, R. (2013). *Plant tissue culture experiment and techniques* (Third edition ed.). Academic Press, Elseiver.

Stewart, C. N. (2016). *Plant Biotechnology and genetics: Principles, Techniques and Applications* (Second Edition ed.). John Wiley and Sons.

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2. https://epgp.inflibnet.ac.in/view_f.php?category=1038
3. https://epgp.inflibnet.ac.in/loaddata.php?action=loadpaperlist1&maincat=3
4. https://epgp.inflibnet.ac.in/ahl.php?csrno=2
5. https://nptel.ac.in/courses/102105034/
6. https://nptel.ac.in/courses/102103016/

Outcomes	➢ Understand the basic concepts of biotechnology and apply their knowledge in advanced area of nanoscience for the betterment and advancement of their professional career ➢ Understand the animal and plant cell culture techniques, which will help the students in micro and macro level manipulations of plants and animals for applications in environmental monitoring and health care. ➢ Gain expertise in the existing bioinformatics tools and resources for computational analysis of biological data. Understanding the problems related to genomics and proteomics, will be useful for the students in the modeling & analysis of living system.

Name of the Course Teacher

Dr. N. Suganthy,Assistant Professor.

Semester – I			
Course code: 533104	**Introduction to Nanoscience**	**Credits: 5**	**Hours : 5**
Objectives	➢ Demonstrate a working knowledge of nanotechnology principles and industry applications. ➢ Explain the nanoscale paradigm in terms of properties at the nanoscale dimension. ➢ Apply key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology. ➢ Identify current nanotechnology solutions in design, engineering and manufacturing. ➢ Search, read and present current nanotechnology literature applied to a particular problem domain. ➢ Explain the history of nanotechnology and where the field may evolve over the next 10 to 15 years. ➢ Identify societal and technology issues that may impede the adoption of nanotechnology. Identify career paths and requisite knowledge and skills for career change toward nanotechnology.		
Unit - I	**Introduction and History channel: -** Significance of Nanoscale: Surface area, quantum confinement effect, penetration of a barrier-Tunnel effect, Different types of Nanomaterials metals, semiconductors, composite materials, Ceramics, Alloys, Polymers.		
Unit - II	**Evolution and growth: -** Thermodynamics of Phase Transitions – triggering the Phase Transition – fundamentals of nucleation growth – Controlling Nucleation & Growth – Size Control of the Nanometric State –Aggregation – Stability of Colloidal Dispersions – Spontaneous Condensation of Nanoparticles: Homogeneous Nucleation – Spinodal decomposition – Other undesirable Post-Condensation Effects – Nanoparticles' morphology.		
Unit - III	**Nanomaterials: -** Types of Nanocrystals – zero dimensional – one dimensional – two dimensional – three dimensional nano structured materials – metals – semiconductors – ceramics and composites – size dependent properties – mechanical, physical and chemical - uniqueness in these properties compared to bulk and microscopic solids. Biological nanomaterials – Enzymes, DNA and RNA- Advanced nanomaterials- CNTs, Fullerenes.		
Unit - IV	**Laws governing Nanomaterials: -** Forces between atoms and molecules, particles and grain boundaries, surfaces – strong intermolecular forces - Van der Waals and electrostatic forces between surfaces – similarities and differences between intermolecular and interparticle forces – covalent and coulomb interactions – interactions involving polar molecules and polarization – weak intermolecular forces and total intermolecular pair potentials – Forces between solvation, hydration; polymers at surfaces; adhesion – thermodynamics of self-assembly; micelles, bilayers, vesicles – bio-nanomachines – biological membranes**.**		
Unit-V	**Colloids and Interfacial systems: -** Classification-structural-properties of colloidal systems -preparation - structural characteristics-Solid-liquid-gas phases- Nanoscale-Mesoscale - surface thermodynamics- Nanofluidics- Adsorption Absorption- Micells and self-associating systems -thermodynamic and electrostatic properties of colloids- Brownian movement -Surface thermodynamics-surface tension- Air-solid and liquid-solid interfaces-Surface tension measurements		

Reference and Textbooks:-

Malhotra, B. D., & Ali, M. A. (2018). *Nanomaterials for biosensors: Fundamentals and applications*. Amsterdam: Elsevier.

Klabunde, K. J. (2001). *Nanoscale materials in chemistry*. New York: Wiley Interscience.

Kontogeorgis, G. M., & Kiil, S. (2016). *Introduction to applied colloid and surface chemistry*. Chichester, West Sussex: Wiley.

R., K. C. (2007). *Nanofabrication towards biomedical applications: Techniques, tools, applications, and impact*. Weinheim: Wiley-VCH.

Liz-Marzán, L. M., & Kamat, P. V. (2004). *Nanoscale Materials*. Boston, MA: Springer US.

emeyer, C. M., & Mirkin, C. A. (2007). Nanobiotechnology: Concepts, applications and perspectives. Weinheim: Wiley-VCH.

Poole, C. P., & Owens, F. J. (2003). *Introduction to nanotechnology*. Hoboken: J. Wiley.

Cheetham, A. K., Müller, A., & R., R. C. (2008). *Nanomaterials chemistry: Recent developments and new directions*. Weinheim: Wiley-VCH.

Ramachandra, R. C., Müller, A., & Cheetham, A. K. (2006). *The chemistry of nanomaterials: Synthesis, properties and applications in 2 volumes*. Weinheim: Wiley-VCH Verlag.

Ratner, M. A., & Ratner, D. (2008). *Nanotechnology: A gentle introduction to the next big idea*. Upper Saddle River, NJ: Prentice Hall Professional Technical Reference.

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3. https://nptel.ac.in/courses/118102003/

4.https://nptel.ac.in/courses/103103033/module9/lecture1.pdf

Outcomes	➢ Knowledge on historical perspective of Nanoscience and technology. ➢ Basic knowledge on different structures of nanomaterials. ➢ Different dimensional structures of nanoparticles and nanomaterials. Ideas to synthesis and characterize nanoparticles.

Name of the Course Teacher

Dr. K. Gurunathan/ Dr. C. Balalakshmi

Semester – I			
Course code: 533107	**Nano science and Technology lab-I (Nano-Physics Experiments)**	**Credits:3**	**Hours : 6**

1. Measurement of resistivity of a given Silicon nano material by Four probe method.
2. Measurement of resistivity of a given Alumina nanomaterial by Four probe method.
3. Measurement of Magnetoresistance of a given semiconducting nano material.
4. Study of Hall Effect.
5. Study of the dependence of Hall coefficient on temperature.
6. Study of P-N junction characteristics.
7. Thin film spray and spin nanocoating
8. Study of solar cell I-V Characteristics.
9. Hysteresis loop measurements for the ferroelectric materials
10. **Electrical measurement techniques:**
    1. ResistivityPolarization,DielectricpropertiesElectrochemical 2.Techniques(CyclicVoltammetry)
11. To determine the lattice constant and lattice angles for atomically resolved STM image of HOPG (Highly Oriented Pyrolytic Graphite using offline Scanning Probe Imaging Processor (SPIP) Software.
12. To determine the surface roughness of raw and processed AFM images of glass, silicon and films made by different methods using offline SPIP software.
13. Simulation of I-V Characteristics for a single Junction circuit with a single quantum Dot using MOSES 1.2 Simulator.

Name of the Course Teacher
Dr.G. Ramalinagam, Asst. Professor.

Semester – II			
Course code: 533201	**Synthesis of Nanomaterials**	**Credits: 5**	**Hours : 5**

Objectives	➢ To provide students an overview of nanomaterials and nanostructures. ➢ To impart knowledge to the students on fundamental principles pointing out the unique properties of nanomaterials. ➢ To develop theoretical and practical knowledge on the synthesis and characterization of nanomaterials and nanostructures. ➢ To make the students understand the various concepts involved in fabrication of device architectures.
Unit - I	**Physical methods: -** Inert gas condensation, Arc discharge, RF- plasma, Plasma arc technique, Ion sputtering - RF/DC magnetron sputtering, Laser ablation, Laser pyrolysis,microwave plasma evaporation , Thermal evaporation Electron beam evapo ration, Transferred Arc Plasma Reactor.
Unit - II	**Chemical Methods: -** Solvothermal synthesis- Photochemical synthesis-Electrochemical synthesis, Sol-gel technique – control of grain size – co-precipitation hydrolysis – sonochemical method combustion technique – colloidal precipitation – template process – Micellar route-growth of nanorods – solid-state sintering – grain growth.
Unit - III	**Hydrothermal methods: -** Principle, 3D nanostructures – carbon nanotube – Inorganic nanotubes and nanorods – Nanoflowers- nanocrystals,Nano-rings – chemical routes for 1D nanotubes and nanorods –Schlenk synthesisof Quantum dots.
Unit - IV	**Mechanical methods:** Grinding – high energy ball milling, types of balls, WC and ZrO_2, material-ball ratio, medium for grinding, limitations in getting required grain size for low melting point materials, typical systems, severe plastic deformation, melt quenching and annealing.
Unit - V	**Biological Methods: -** Biologically synthesized nanoparticles - Phytosynthesis, phycosynthesis andmycosynthesis,bioproduct mediated synthesis of nanoparticles, Protein Based Nanostructure Formation, DNA Templated Nanostructure Formation.

Reference and Textbooks:-

Abdullaeva, Z. (n.d.). *Synthesis of Nanoparticles and Nanomaterials: Biological Approaches*. Springer Nature.

Basiuk, V. (2015). *Green Processes for Nanotechnology: From inorganic to bioinspriednanomaterials*. Springer.

Grumezescu, A. (2015). *Fabrication and self assembly of nanobiomaterials: Application of Nanobiomaterials*(Vol. 1). William Andrew, Elseiver.

Grumezescu, A. (2016). *Nanomaterials in Antimicrobial therapy: Application of Nanobiomaterials*. William Andrew, Elseiver.

Horikoshi,S.(2013). *Microwaves in Nanoparticle Synthesis: Fundamentals and Application*. Wiley-VCH.

Kulkarni, S. (2014). *Nanotechnology: Principles and Practices*(Third edition ed.). Springer International Publishing.

Rao, (n.d.). *The Chemistry of Nanomaterials*(Second Edition ed.). John Wiley and Sons.

Sengupta, A. (2015). *Introduction to Nano: Basics to nanoscience and nanotechnology*. Springer.

Singh, (2015). *Bio-Nanoparticles: Biosynthesis and Sustainable Biotechnological implication*. Wiley Blackwell.

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https://nptel.ac.in/courses/102107058/3 https://nptel.ac.in/courses/103103033/module9/lecture2.pdf https://nptel.ac.in/courses/118102003/ https://www.slideshare.net/RamalingamGopal/sol-gel-synthesis-of-nanoparticles	
Outcomes	➢ Understand the basic and advanced concepts of nanomaterial preparations. ➢ Understand the importance of synthesis method addressed in the material properties and investigate the various factors influencing the properties of nanomaterials. ➢ Gain expertise in optimizing the synthesis methodology and will be able to fabricate nov device architectures and new nanomaterials with novel biological activity.

Name of the Course Teacher

Dr. N. Suganthy/Dr. K. Gurunathan

Semester – II			
Course code: 533202	**Characterization of Nanomaterials**	**Credits: 5**	**Hours : 5**
Objectives	➢ To explore different strategies for synthesizing low dimensional nanomaterials (e.g.,nanocrystals, nanotubes, nanowires) and common techniques for nanoscale materials characterization. ➢ To gain knowledge of the various process techniques to synthesis Nanostructured materials.		
Unit - I	**Mechanical Characterization: -**Hardness and elastic modulus of NPs-Micro hardness – nanoindensation – fatigue – failure stress and strain toughness – abrasion and wear resistance – fracture toughness – elasticity of nanomaterials – superplasticity – plastic nature of nanoceramics – nanomembranes – inter connected pores – plastic deformation of nanomaterials- Adhesion and friction of NPs		
Unit - II	**Electrical Characterization: -**DC electrical conductivity as a function of temperature - Hall effect – types of charge carriers – charge carrier density – impedance spectroscopy – dc electrical resistivity – activation energy – bulk and grain boundary capacitances – relaxation times of dipoles.		
Unit - III	**Spectroscopic and Microscopic characterization** **Optical spectroscopy: -**Optical absorption spectroscopy (OAS) - UV-Vis spectroscopy- photoluminescence (PL) - Fourier Transform Infrared Spectroscopy (FTIR) - Raman spectroscopy - X-ray diffraction (XRD) - *Electron Spectroscopy:* X-ray Photoelectron Spectroscopy (XPS) - Electron microscopy: - Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)/ High Resolution (HR)TEM with Selected Area Electron Diffraction (SAED) Atomic Force Microscopy (AFM).		
Unit - IV	**Magnetic Characterization: -** Concepts of dia-para-ferro and ferri magnetism – exchange correlation - exchange interaction – Hysteresis loop – coercivity – change of coercivity – grain size – soft magnets – hard magnets – spring exchange magnets – magnetic measurements using VSM – function of temperature - ferromagnetic resonance – magnetic force microscopy – Mossbauer spectroscopy for Fe and Sn containing nanomaterials – NMR – Introduction – Experimental Techniques – Chemical shift, dipolar interaction, spin - spin interaction – Applications – ESR – Principles and Applications of ESR Spectroscopy.		
Unit - V	**Electrochemical Characterization: -** **Fundamental Principle*:*** Electrochemical cell - ion/ion interaction and Stokes-Einstein equation - electrode/electrolyte interface - kinetics of electrode reactions - Butler-Volmer equation - Electroanalytical techniques: Cyclic Voltametric techniques - irrversible - quasi-reversible voltammetry - linear scan and cyclic voltammetry - Electrochemical impedance spectroscopy - Galvanostatic charge-discharge - chronopotentiometry chronoamperometry.		

Reference and Textbooks:-

Barsoukov, E., & Macdonald, J. R. (2005). *Impedance spectroscopy theory, experiment, and applications.* Hoboken, NJ: Wiley-Interscience.

Bashir, R., &Wereley, S. (2006). *Biomolecular sensing, processing and analysis*. New York: Springer.

Bhagyaraj, S. M., Oluwafemi, O. S., Kalarikkal, N., & Thomas, S. (2018*). Characterization of nanomaterials: advances and key technologies*. Duxford: Woodhead Publishing, an imprint of Elsevier.

Desai, T., & Bhatia, S. (2006). *Therapeutic micro/nanotechnology*. Berlin: Springer.

Fujita, H. (2012*). Micromachines as tools for nanotechnology.* Springer-verlag Berlin And Hei.

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Kaupp, G. (2011). *Atomic force microscopy, scanning nearfield optical microscopy and nanoscratching: application to rough and natural surfaces.* Berlin: Springer.

Micromachines as tools for nanotechnology. (2013). Place of publication not identified: Springer.

Parthasarathy, B. K. (2007). *Challenges and opportunities in nanotechnology.* New Delhi: Isha Books.

Pecharsky, V. K., &Zavalij, P. Y. (2009). *Fundamentals of powder diffraction and structural characterization of material.* New York, NY: Springer.

Ramesh, K. T. (2009). *Nanomaterials: Mechanics and mechanisms.* New York: Springer Science.

Thomas, S., Thomas, R., Zachariah, A. K., & Mishra, R. K. (2017). *Spectroscopic methods for nanomaterials characterization.* Amsterdam, Netherlands: Elsevier.

Tominaga, J., & Tsai, D. P. (2003). *Optical nanotechnologies: The manipulation of surface and local plasmons.* Berlin: Springer.

Zhang, J. Z. (2009). *Optical properties and spectroscopy of nanomaterials.* New Jersey: World Scientific.

Outcomes	➢ To know the importance of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties and characterization. ➢ To investigations into the various factors influence the properties of nanomaterials, optimizing the procedures, and implementations to the new designs. ➢ To provide a sound understanding of the various concepts involved in fabrication of device architectures and able to evaluate them in advance. ➢ To be able to analyze structural and optical properties of nano structured materials.

Name of the Course Teacher

P. Shakkthivel, Professor.

Semester – II			
Course code: 533203	**Applications of Nanomaterials**	**Credits: 5**	**Hours : 5**

Objectives	➢ What nanotechnology is? The size and shape dependent properties at the nanometer scale Enhanced physical properties of nanomaterials ➢ What nano particles are and how it is used currently? Applications of nanotechnology in engineering, biomedical, energy, and environmental fields.
Unit - I	**Electronic Applications: -** Microelectronics – photolithography – Density of microcomponents –molecular electronics –Nanoelectronics – memories – LEDs – Nanotransistors-photonics — carbon nanotubes (CNT) in electronic applications – CNT based MOSFET – MEMS and NEMS – dye sensitized solar cells – CMOS technology-Large Electrochromic Display Devices-low cost Flat-Panel Displays.
Unit - II	**Magnetic Applications:** - Soft magnets for high speed memories – hard magnets – high density memories-High Energy Density Batteries-High-Power Magnets– biological applications – targeted drug delivery – hyperthermia.
Unit - III	**Applications of Nanoceramics and Nanocomposites: -** Near net shaped components – membranes for purification of water – blood and air, catalysis – tooth and bone substitutes – hydroxyappetites – inductive bone – replacements – ceramic valves. Aerospace Components with Enhanced Performance Characteristics.
Unit - IV	**Environmental applications: -** Nanotoxicology – organic dye degradation – textile and leather industries – removal of bacteria and microbes – water resistant composites for walls resistance to fungal attack – sensors for gases – pressure – temperature – DNA etc., - lightening arrestors – varistors. Detoxification of organic /inorganic pollutants.
Unit - V	**Biological applications: -** Dendrimers – Bio-functionalisation of CNT and biological applications – self assembly molecules and their applications – tissue culture – nanopharma. Cancer detection/diagnosis via nanotechnologies and nanosensors/nano biosensor - Biomimetic amplification of nanoparticle homing to tumors-Longer-Lasting Medical Implants.

Reference and Textbooks:-

AndrzejWieckowski & et.al, (2003) *Catalysis and Electrocatalysis at Nanoparticle*.

Challa, S., & Kumar, S. (2006). *Nanomaterials: Toxicity, health and environment issues*. Wiley- VCH.

Chellakumar, (2006) *Nanomaterials for Cancer Therapy,* Wiley –VCH press.

Gogotsi, Y, (2006) *CabonNanomaterials*. CRC.press

Gupta, R., & Francis (2016) *NanoparticleTechnology for Drug Delivery*.

Louis Theodore, Robert, & Kunz, G. (2006*.). Nanotechnology Environmental Application and Solutions*.

Neelina, H., & Malsch,. (2005). *Biomedical Nanotechnology*.

Nicholas, A. PeppasJ, ZaohHilt& Brock Thomas, J, (2006)*Nanotechnology in Therapeuties,current technology and applications ,* Horizon Scientific press.

Ralph, S. (2004). *Nanoscale Technology in Biological systems*.

Rashid,Bashir, & Steve Wereley (2006) *Biomolecular Sensing, Processing and Analysis,* Springer.

Sergey Lyshevski ,(2005) *2/e, Nano and Microelectromechanical systems: Fundamentals of Nano and Microengeneering.*

Tejal, & Desai, (2006) *Therapeutic Micro /NanoTechnology*, Springer.

Victor, I, Klimov & etal. (2004) *Emiconductor and Metal Nanocrystals:synthesis and electronic and optical properties ,* Marcel.

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Outcomes	➢ Understand the general physics and chemistry Microelectronics –photolithography. ➢ Understand processing techniques for nanomaterials Soft magnets for high speed memories and applications of Nanoceramics and Nanocomposites. ➢ DUnderstand the important applications and properties of nanomaterials in bio field.

Name of the Course Teacher

Dr. C. Balalakshmi, Assistant Professor.

Semester – II			
Course code: 533207	**Nanoscience and Technology Lab – II (Nanochemistry Experiments)**	**Credits: 4**	**Hours : 8**

1. Synthesis of Iron oxide nanoparticles by Co-precipitation method.
2. Synthesis of ZnO nanoparticles by chemical method.
3. Synthesis of SnO_2 nanoparticles by Chemical sol-gel method.
4. Synthesis of TiO_2 nanoparticles by Chemical sol-gel method.
5. Synthesis of colloidal nanocmaterials of Au and Ag nanoparticles
6. Preparation of polymer nanocomposites.
7. Studies on bulk and nanoparticles through UV-Vis spectroscopy.
8. Raman spectroscopy studies on nanomaterials.
9. Demo Thin film characterization through AFM.
10. Conductivity studies of polymer-nanocomposite material by Four probe method.
11. XRD demo studies for calculating the size of the nanoparticles and nanocomposites by Scherrer's formula and mass approximation method
12. SEM demo characterization of nanomaterials. for size and surface morphology

Name of the Course Teacher
P. Shakkthivel, Professor

Semester – III			
Course code: 533301	**Nanobiotechnology and Nanomedicine**	**Credits: 5**	**Hours : 5**

Objectives	➢ Understand the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology. ➢ To make the students understand the principles behind nanomedicine and its application. ➢ Employ bionanomaterials for analysis and sensing techniques. ➢ Impart knowledge about drug delivery systems. ➢ Apprehend and explain the biomedical applications of nanotechnology.
Unit - I	**Concept of Biology: -** Nanotechnology and Nanomedicine- Medical Nanomaterials- Tagged nanomaterials- Carbon nanotubes-Dendrimers- Smart Drugs – nanopore- Nanowires – Sensors- Nanorobotics- Nanotweezers- Nanomotors-Nanobodies- Nanocarriers-Nanomedical Diagnosis and Treatment- Biology inspired concepts- biological network- biological neurons - the function of neuronal cell - biological neuronal cells on silicon modeling of neuronal cells by VLSI circuits - bioelectronics- molecular processor - DNA analyzer as biochip.
Unit - II	**Nano Biometrics: -** Introduction - Lipids as nanobricks and mortar: Self assembled monolayers- proteins-3D structures using a 20 amino acids designed protein pores as biosensors-DNA as smart glue- DNA as wire template- DNA computer-self assembling electronic connections-nanostructures solar cells-DNA chip- DNA based Nanodevices.
Unit - III	**Nanocomposites and Bio-polymers: -** Classification and structure of Natural fibres- Regenerated cellulose- Natural fibre composites-Graft co-polymerization- Natural nano composites -biologically derived synthetic nano composites — protein based nanostructure formation – biologically inspired nano composites. Metal based nanocomposites -Nanotechnology in Agriculture (Fertilizers and pesticides)
Unit - IV	**Nanotechnology for Imaging and Detection:** - Fluorophores and Quantum dots - Labeling and functionalization, Image analysis, Imaging facilitating surgical approaches- Nanoparticles for bioanalytical applications – Biosensors - DNA and Protein based biosensors – Implantable materials and devices- BioMEMs- Use of nanoparticles for MRI, X Ray, Ultrasonography Drug Delivery- Nano devices- Diagnostic Tools – Genetic Testing – Imaging – Nanoparticles Probe – Case Analysis – 1) Respirocytes – Mechanical Artificial red Cells – 2) Using DNA as a construction medium.
Unit - V	**Prospects of Nano- Medicine: -** Nanobiotechnology for drug discovery - protein and peptide based compounds for cancer and diabetes - drug delivery - nanoparticle based drug delivery - lipid nanoparticles - vaccination - cell therapy -Gene therapy.

Books for study:

Bawa, R. (2016). *Handbook of Clinical Nanomedicine: Nanoparticles, Imaging, Therapy, and clinical application*. CRC Press.

Berezin, M. (2015). *Nanotechnology for Biomedical Imaging and Diagnostics: From Nanoparticle design to application*. John Wiley and Sons.

Chen, X. (2014). *Cancer Thernostics*. Academic press, Elseiver.

Ge, Y. (2014). *Nanomedicine: Principles and Perspectives*. Springer, Newyork.

Howard, 8. A. (2016). *Nanomedicine,*. Springer Nature.

Lourtioz, J. (2014). *Nanosciences and Nanotechnology: Evolution or Revolution*. Springer, New York.

Mirkin, C. (2015). *Nanotechnology-Based Precision Tools for the Detection and Treatment of Cancer*. Springer International.

Pathak, Y. (2016). *Drug Delivery Nanoparticles Formulation and Characterization*. Informa Healthcare, USA.

Rai, M. (2015). *Nanotechnology in Diagnosis, Treatment and Prophylaxis of Infectious Diseases*.

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Thakur, V. K. (2015). Ecofriendly polymer nanocmposites: Chemistry and Applications. Springer, India.
Thomas, S. (2015). Nanotechnology Applications for Tissue Engineering. Elsevier, USA.
Visakh, 1. (2016). Nanomaterials and nanocomposites: Zero to three dimensional materials and their composits. Wiley-VCH.
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https://nptel.ac.in/courses/118107015/
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</td></tr>
<tr><td>Outcomes</td><td>➢ Understand how nanotechnology can be tailored and used for biomedical purposes.
➢ Realize the need and obstacles in polymeric, lipidous and solid nanosized drug delivery systems.
➢ Understand how nano-relevant instruments such as focused ion beam scanning electron microscopes, atomic force microscopes and optical microscopes can be used in biomedicine.
➢ Perform simple micro fabrication procedure.</td></tr>
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Name of the Course Teacher

Dr. C. Balalakshmi, Assistant Professor.

Semester – III			
Course code: 533302	**Nanoelectronics and Nano Devices**	**Credits: 5**	**Hours : 5**
Objectives	➢ To understand the basic concepts involve in this technology for device architecture and interface engineering at atomic. ➢ To demonstrate how simulation can facilitate learning of fabrication process and device designing. ➢ To understand the limitations of silicon electronics and progress of nanoelectronics.		
Unit - I	**Basic of Nanoelectronics: -** Basics of nanoelectronics – capabilities of nano electronics – physical fundamentals of nano electronics – basics of information theory – the tools for micro and nano fabrication – basics of lithographic techniques for nanoelectronics.		
Unit - II	**Memory Devices and Sensors: -** Nano ferroelectrics – ferroelectrics random access memories – introduction – FeRAM circuit design – ferroelectric thin film properties and integration –Types of sensors- calorimetric sensors – electrochemical cells – surface and bulk acoustic devices – gas-sensitive FETs – resistive semiconductor gas sensors – Identification of hazardous solvents and gases – semiconductor sensor array.		
Unit - III	**Spintronics: -** Diffusive spin-dependent transport, spin-dependent scattering, GMR effect, spin-dependent tunneling, ballistic spin transport, Landau-Lifshitz Gilbert equation, micromagnetics (brief), spin transfer/torque.		
Unit - IV	**Semiconductor Nanodevices**: - Single –Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor – Single Electron Transistors; Single-Electron Dynamics ; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers - Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA – Based Nanodevices; Gas-Based Nanodevices; Micro and Nanomechanics.		
Unit - V	**Electronic and Photonic Molecular Materials: -** Preparation- Electroluminescent Organic materials- Laser Diodes – Quantum well lasers:- Quantum cascade lasers - Cascade surface – emitting photonic crystal laser – Quantum dots lasers – Quantum wire lasers:- White LEDs – LEDs based on nanowires, nanotubes and nanorods High Efficiency Materials for OLEDs –Quantum well infrared photo detectors-electronic properties of carbon based nanomaterials.		

Reference and Textbooks:-

Awschalom, D. (2004). *Spin electronics*. Dordrecht: Kluwer Academic.

Bloor, D., Bryce, M. R., & Petty, M. C. (1995). *Introduction to molecular electronics:*. London: Arnold.

Botti, S. (2007). *Physical Properties of Carbon Nanotubes*. Trivandrum.

Goser, K., Glö sekö tter, P., & Dienstuhl, J. (2004). *Nanoelectronics and nanosystems: From transistors to molecular and quantum devices*. Berlin: Springer.

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Shul, R. J. (2001). *Wide-bandgap electronic devices*. Warrendale, PA: Materials Research Society.

Waser, R. (2012). *Nanoelectronics and information technology: Advanced electronic materials and novel devices*. Weinheim: Wiley-VCH.

Wilson, M. A., Raguse, B., Kannangara, K., Smith, G., & Simmons, M. (2014). *Nanotechnology: Basic science and emerging technologies*. Strawberry Hills,

Web-Reference : http://www.circuitstoday.com/nanoelectronics https://link.springer.com/chapter/10.1007/978-94-015-9576-6_6 https://nptel.ac.in/courses/117108047/ https://nanohub.org/	
Outcomes	➢ To give different types of conventional and novel nanoelectronic devices for different applications ➢ To study the significance of tunneling effect in nanoelectronic devices ➢ To understand the concepts of coulomb blockade and electron transport ➢ To emphasize the importance of electronic property of materials in mesoscopic level ➢ To understand the underlying physical processes governing the operation of spintronic devices.

Name of the Course Teacher

Dr. G. Ramalingam, Assistant Professor.

Semester – III			
Course code: 533303	**Nano Engineering**	**Credits: 5**	**Hours : 5**
Objectives	➢ Educate a new generation of engineers who can participate in, and indeed seed, new high-technology companies that will be the key to maintaining jobs, wealth and educational infrastructures as nanotechnology results in a new industrial revolution. ➢ Enable students to develop a range of professional, scientific and computational skills that will enhance employment opportunities in a wide range of industrial and governmental institutions. ➢ Prepare students for the workplace through developing their ability to have effective communication skills, modern science and engineering skills, and contribute constructively to multidisciplinary teams. ➢ Form strong multidisciplinary educational links through joint team projects that cross the traditional areas of science and engineering.		
Unit - I	**Semiconductor Nanostructures: -** Overview- semiconductor physics, Fabrication techniques, Electronic structure and physical processes in semiconductor nanostructures, Optical Imaging -Lorentz Microscopy -Electron Holography of Magnetic Nanostructures - Magnetic Force Microscopy -Magnetic Data Storage -Introduction - Magnetic Media - Properties -Materials Used -Write Heads -Read Heads.		
Unit - II	**Molecular Electronics: -** Molecular scale electronics -Molecular materials for electronics – Carbon materials:Fullerene and CNTs, Graphene and RGO - Carbon Nanotubes, Structure and Unique Properties of Carbon Nanotubes – types of Carbon Nanotubes - Applications of Carbon Nanotubes–CNTs in field Emission, Shielding, Field-Effect Transistor and logic gates.		
Unit - III	**Micro and Nanoelectrical Systems: -** Overview- Micro and Nano-Electromechanical systems - Fundamental concepts - fabrication process- choice of materials, calculations - the performance of different structures - Nanoelectronic Devices - Approaches to Nanoelectronics - advantages and disadvantages of different approaches, thermal sensors, radiation sensors, magnetic sensors, chemical sensors, mechanical sensors, Micro actuators - Extension to the Nanoscale, Micro component assembly and packing.		
Unit - IV	**Nanoscale Materials and Devices: -** Electron Transport in Magnetic Multi-layers - Spintronics -Spin Polarized Electron Tunneling - The Datta-Das spin field effect transistor - Concept of the Datta–Das transistor - Spin injection in semiconductors - Interface tunnel barriers - Gate-induced spin rotation: The Rashba effect - Spin relaxation and spin dephasing - Interlayer Exchange Coupling -Spin Relaxation in Magnetic Metallic layers and Multi-layers -Non-Equilibrium Spin Dynamics in Laterally Defined Magnetic Structures.		
Unit - V	**Electronic and Photonic Molecular Materials and Devices: -** Definitions, examples, hybridisation, conjugation, excitations, Molecular crystals, conducting vs semi conducting polymers, Electroluminescence from an Electrochemical Cell - injection, transport, Exciton formation, light emission, Influence of supramolecular order: excimers, H- and J-aggregates, liquid crystallinity.		

Reference and Textbooks:-

Bloor, D., Bryce, M. R., & Petty, M. C. (1995). *Introduction to molecular electronics:*. London: Arnold.

Current opinion in solid state & materials science. (n.d.). London, UK: Current Science.

Diwan, P., & Bharadwaj, A. (2006). *Nanorobotics*. New Delhi: Pentagon Press.

Diwan, P., & Bharadwaj, A. (2006). *Nanorobotics*. New Delhi: Pentagon Press.

Duzer, T. V., & Turner, C. W. (1999). *Principles of superconductive devices and circuits*. Upper Saddle River, NJ: Prentice Hall PTR.

Feng, D., &Jin, G. (2005). *Introduction to condensed matter physics*. Singapore: World Scientific.

Goser, K., Glösekötter, P., &Dienstuhl, J. (2004). *Nanoelectronics and nanosystems: From transistors to molecular and quantum devices*. Berlin: Springer.

Hadziioannou, G., &Malliaras, G. G. (2007). *Semiconducting polymers: Chemistry, physics and engineering*. Weinheim: Wiley-VCH.

Heinzel, T. (2010). *Mesoscopic electronics in solid state nanostructures*. Weinheim: Wiley-VCH.

Lu, G. Q., & Zhao, X. S. (2006). *Nanoporous materials: Science and engineering*. London: Imperial College Press.

Marder, M. P. (2015). *Condensed matter physics*. New York: John Wiley and Sons.

OHandley, R. C. (2000). *Modern magnetic materials: Principles and applications*. New York: Wiley.

Verdeyen, J. T. (2003). *Laser electronics*. Taipei: Pearson Education Taiwan.

Wise, D. L., Wnek, G. E., &Trantolo, D. J. (1998). *Electrical and optical polymer systems: Fundamentals, methods and applications*. New York: Dekker.

Zhou, B., Hermans, S., &Somorjai, G. A. (2004). *Nanotechnology in catalysis*. New York: Springer.

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https://nptel.ac.in/downloads/115106076/

https://nptel.ac.in/syllabus/syllabus_pdf/115106076.pdf

nptel.ac.in/syllabus/syllabus_pdf/115104044.pdf

https://nptel.ac.in/courses/115106076/14

Outcomes	➢ Knowledge on Nanoengineering. ➢ Basic knowledge on historical perspectives of nanoengineering. ➢ One can specialize in electronics, materials chemistry, bioengineering, and photonics. ➢ Ideas on different type of nano technology.

Name of the Course Teacher

Dr. P. Shakkthivel, Professor.

Semester-III Major ElectiveCourse			
Course code: 533503	**Microsystem Technology**	**Credits:4**	**Hours : 4**

Objectives	➢ Introduction to MEMS and Microsystems technology. ➢ Microelectronic-fabrication processes. ➢ Lithography techniques. ➢ Nanomaterials for sensor application. ➢ Overview of Lab-on-chip technology/ biomedical and chemical sensors, specific cases.
Unit - I	**Process Method: -**Processing of substrate materials-Thin film deposition methods: Physical Vapour Deposition (Sputtering, evaporation, MBE, PLD etc), Chemical methods (CVD, MOCVD, CSD, Sol-gel), Fabrication-Patterning approaches-Thin film sensors, Pattern transfer-rapid prototyping and micro ECM and EDM.
Unit - II	**Fabrication Process: -** Silicon fabrication processes. Silicon micromachining (wet), Dr etching technologies for metals, semiconductors and insulators, Microsystems fabricatio techniques.
Unit - III	**Lithography: -** Silicon MEMS fabrication technology, Advanced lithography (e-beam lithography, radiation for imaging (UV,X-rays, synchrotron, masking issues), Lithographically induced self-construction (LISC), Nano imprint lithography.
Unit - IV	**Sensors: -** Packaging of MEMS devices by anodic/fusion bonding, Pressure sensors and packaging, MEMS performance and evaluation.Bionanosensor devices- communicable disease and biological threat detection.
Unit - V	**Industries Application : -** Non-silicon MEMS and related fabrication techniques- Si carbide MEMS- Biomedical MEMS Micro-stereolithography- Integration of microsystems with electronics including RF MEMS and the exploitation of Microsystems.

References:

Beeby, S. (2004). *MEMS mechanical sensors*. Boston: Artech House.

CERAMIC MATERIALS FOR ELECTRONICS. (2019). S.l.: CRC PRESS.

Implications of emerging micro- and nanotechnologies. (2002). Washington, D.C.: National Acad. Press.

Meisami, E., & Timiras, P. S. (1988). *Handbook of human growth and developmental biology*. Boca Raton, FL: CRC Press.

Pierson, H. O. (1999). *Handbook of chemical vapor deposition (CVD): Principles, technology, and applications*. Norwich, NY: Noyes Publ.

Pileni, M. P. (2005). *Nanocrystals forming mesoscopic structures*. Chichester: John Wiley distributor.

Tay, F. E. (2002). *Materials & process integration for MEMS:*. Boston: Kluwer Acad. Publ.

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https://epgp.inflibnet.ac.in/ahl.php?csrno=831
http://www.owlnet.rice.edu/~phys534/notes/week07_lectures.pdf
http://www.cense.iisc.ac.in/research/mems-and-nems-sensors
http://faculty.uml.edu/zgu/Teaching/documents/Lecture04-24-13.pdf

Outcomes	➢ Know about an Idea in NEMS and MEMS. ➢ Methods for the fabrication through lithography techniques. ➢ Principles of Sensors functionalisation and assembling. ➢ Bio nanomachines.

Name of the Course Teacher
Dr. K. Gurunathan, Professor & Head

Semester -III			
Course code: 533307	**Nanoscience and Technology- lab III (Nano-biotechnology Experiments)**	**Credits: 4**	**Hours : 8**
Objectives	➢ Teach students safe and good laboratory practice to be followed in microbiology, biochemistry and nanotechnology lab. ➢ Demonstrate proficiency and use of the following in the laboratory: microbial isolation from environmental samples, proper culture handling, handling microscopes, bacterial staining techniques, preservation of microbial cultures. ➢ Develop the skills in green synthesis of nanoparticles and assessing its antimicrobial activity ➢ Provide a solid training in the area of nanotechnology that is at the interface of biology, chemistry, pharmaceutical sciences and medicine ➢ Understand the fundamentals of nano-bioconjugation techniques.		

1. Preparation of buffers and pH measurement
2. Techniques for isolation of pure bacterial culture. Preservation and maintenance of microbial cultures.
3. Bacterial characterization by staining techniques and biochemical tests. Measurement of growth - Growth curve
4. Isolation and quantification of DNA and Protein from microbial source
5. Microbial synthesis of nanoparticles from bacteria and fungi – Metal (Ag, Pd), metal oxide (CuO, TiO_2, FeO_2)
6. Synthesis of nanoparticles using herbal plants – ZnO, MgO.
7. Techniques for nanoparticle separation – Centrifugation, Sedimentation
8. Assessment of antimicrobial activity of synthesized nanoparticles.
9. Immobilization of synthesised nanoparticles
10. Evaluating the bioremediation activity of immobilized nanoparticles
11. Assessment of toxic effect of nanomaterials under *in vitro* conditions.

Reference and Textbooks:- (APA format

Cappuccino, J. (n.d.). *Microbiology A Laboratory Manual*(Eleventh ed.). Benjamin Cummings.

Green, (2012). *Molecular Cloning - A laboratory manual*. , Cold Spring Harbor laboratory press.

Holt, J. (2000). *Bergey's Manual of Determinative Bacteriology*. Lippincott Williams & Wilkin.

Kannan, N. (2002). *Laboratory Manual in General Microbiology*. Panima.

Katoch, P. (2016). *Analytical techniques in Biochemistry and Molecular Biology*. Springer New York.

Katoch, R. (2011). *Analytical techniques in Biochemistry and Molecular Biology*. Springer New York.

Poinern, G. (2014). *A Laboratory Course in Nanoscience and Nanotechnology*. CRC Press

Singh, O. V. (2015). *Bio-Nanoparticles: Biosynthesis and Sustainable Biotechnological Implications,*. Wiley-Blackwell.

Web links reference

1. https://vlab.amrita.edu/?sub=3&brch=73

Outcomes	➢ Acquire basic knowledge on practical techniques and approaches commonly used in biotechnology linked to nanotechnology. ➢ Understand the biogenic route for the synthesis of nanoparticles and apply it in the field of biological research. ➢ Gain knowledge on basic molecular biology techniques.

Name of the Course Teacher

Semester – IV Major Elective Course			
Course code: 533508	**Nanotoxicology**	**Credits: 4**	**Hours : 4**

Objectives	➢ To impart knowledge on diverse dimensions of nanomaterials and its interaction with environment. ➢ To develop understating of unique properties of nanomaterials which helps to study the interaction of engineered nanomaterials with biological system. ➢ To create awareness regarding the toxic effect of nanomaterials to human health. ➢ To emphasize the ethical agenda to be followed in nanotechnology. ➢ To afford knowledge on the preventive and remedial measures to overcome nanotoxicology.
Unit - I	**Introduction: -** Nanopollution – Natural source, anthropogenic source, Environmental and occupational exposure, Aerosol- Physicochemical characteristics of nanomaterials.
Unit - II	**Mechanism of cellular interaction: -** Interactions of Nanoparticles with Cells and their Cellular Nanotoxicology – Cellular uptake, Reactive oxygen species mediated toxicity - Oxidative stress, inflammation,genotoxicity and Immunotoxicity.
Unit - III	**Human exposure to Nanosized Materials: -** Nanoparticles interaction with biological membrane-Entry routes into the human body, Disposition of NSPs in the respiratory tract, Studies of neuronal translocation of UFPs from respiratory tract, Neuronal uptake and translocation,Translocation to the circulatory and lymphatic system, Translocation of NSPs in the liver, spleen and kidney, Exposure via GI Tract and Skin, toxicity of nanoparticles in the eye.
Unit - IV	**Assessment of nanotoxicity: -** Toxicity assessment- Laboratory rodent studies,Ecotoxicologic studies, Methodology for Nanotoxicology - *in vitro* and *in vivo*toxicity testing**.**
Unit - V	**Risk Assessment and Execution: -** Portals of entry and target tissue, Risk assessment – Ethical, Legal and Social Implications, Development of Test Protocols for Nanomaterials – Regulation of Engineered Nanomaterials in Europe and USA.

Books for Study

Duran, N. (2014). *Nanotoxicology: Materials, Methodologies, and Assessments*. Springer, Newyork.

Gatti, (2015). *Case Studies in Nanotoxicology and Particle Toxicology*. Academic Press.

Kumar, V. (2018). *Nanotoxicology: Toxicity Evaluation, Risk Assessment and Management*. CRC press.

Monteiro-Riviere, 6. (2014). *Nanotoxicology: Progress towards Nanomedicine*. CRC Press, Taylor and Franscis.

Njuguna, J. (2014). *Health and Environmental Safety of Nanomaterials: Polymer Nancomposites and other material containing nanoparticles,*. Woodhead Publishing, Elsevier, UK.

Otsuki,, T. (2016). *Biological Effects of Fibrous and Particulate Substances*. Springer, Japan.

Ramachandran, G. (2011). *Assessing Nanoparticle Risks to Human Health*. Elsevier, USA.

Salem, (2015). *Inhalation Toxicology*. , CRC Press, London.

Sutariya, V. (2014). *Biointeractions of Nanomaterials*. CRC press.

Weblink references

http://textofvideo.nptel.ac.in/102107058/lec20.pdf

https://www.slideshare.net/rijuchandran/nanotoxicology

Outcomes	➢ Analyze in depth about the toxic effect of nanoparticles and its adverse effect to the environment ➢ Comprehend the challenges and risk involved in nanotechnology ➢ Relate properties of nanomaterials with their transport, uptake, reactivity and toxicity in human system and environment ➢ Gain knowledge about various prevention methods and remedial measure to overcome the toxicity induced by the nanoparticles

Name of the Course Teacher

Dr. N. Suganthy, Assistant Professor

Semester – I			
Course code: 533501	**Thin Film Technologies and Characteristics**	**Credits: 4**	**Hours : 4**

Objectives	➢ To understand thin film fabrication techniques including PVD and CVD and to apply the knowledge to film formation ➢ To demonstrate how simulation can facilitate learning of fabrication process and device designing. ➢ To teach scientific principles behind thin film technology.
Unit - I	**Thin Film Technology: -** Role of Thin films and Nanostructures in Technology and Devices; Vacuum evaporation-Hertz- Knudsen equation, evaporation from a source and film thickness uniformity. Glow discharge and plasmas-Plasma structure, DC, RF and microwave excitation; Sputtering processes-Mechanism and sputtering yield, Sputtering of alloys; Reactive sputtering.
Unit - II	**Nucleation and Growth**: - Nucleation and Growth: Adsorption, Surface diffusion, models for 3D and 2D nucleation, coalescence and depletion, grain structure and microstructure and its dependence on deposition parameters. Role of energy enhancement in nucleation; Self-assembly: mechanisms and controls for nanostructures of 0 and 1 dimension.
Unit - III	**Deposition Technology: -** Adsorption, Surface diffusion, Nucleation, Surface energy, Texturing, Structure Development, Interfaces, Stress, Adhesion, Temperature Control, agglomeration, aggregation, Semiconductor devices , Growth Monitoring , Composition Control, Lattice Mismatch Surface Morphology.
Unit - IV	**Epitaxial Technology : -**Epitaxy: Structural aspects of epitaxy, homo- and hetero-epitaxy, lattice misfit and imperfections; epitaxy of compound semiconductor, theories of epitaxy, Role of interfacial layer, Artificial semiconductors, Band-gap engineering, Superlattice structures; Strained layer epitaxy, Gas Supply, Safety, Flow control, Contamination, Convection, Reaction, and Diffusion-PVD-CVD-LPE-VPE-MPE-MOCVD-ALD (Fundamentals).
Unit - V	**Characteristics of Thin Films: -** Mechanical, Electrical, Magnetic and Optical Properties of Thin Film, Analysis of thin films –Interface phenomena- Multilayer films.

Reference and Textbooks:-

Bunshah, R. F. (2001). *Handbook of hard coatings: Deposition technologies properties and applications*. Estados Unidos: Noyes Publications.

Callister, W. D., & Rethwisch, D. G. (2018). *Materials science and engineering: An introduction*. Hoboken, NJ: Wiley.

Chopra, K. L. (1985). *Thin film phenomena*. Malabar, FL: R.E. Krieger.

Frey, H. (2015). *Handbook of Thin-Film technology*. Berlin: Springer.

Ohring, M. (2006). *The materials science of thin films*. San Diego, Calif: Academic Press.

Pandalai, S. G. (2003). *Recent research developments in vacuum science & technology*. Trivandrum: Transworld research network.

Seshan, K. (2012). *Handbook of thin film deposition: Techniques, processes, and technologies*. Amsterdam: Elsevier.

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https://nanohub.org/tags/thinfilms

https://nanohub.org/resources/26056

https://nanohub.org/resources/11949	
Outcomes	➢ To familiarize them with the principles, equipment, use, and limitations ofdifferent deposition techniques. ➢ To give students an overview of the phenomena and concepts involved in thin film. ➢ To gain knowledge of the various process techniques to synthesis Nanostructured materials. ➢ To understand the factors controlling growth of the nanomaterials.

Name of the Course Teacher

Dr. K. Gurunathan, Professor & Head

Semester – I			
Course code: 533502	**condensed matter Physics**	**Credits: 4**	**Hours : 4**
Unit - I	**Crystalline Matter: -** Atoms in crystals – types of lattices-Cubic- Close packed structure **-** Atomic planes –reciprocal lattice- Brillouin zones-structure factor- Binding in crystals – types.		
Unit - II	**Properties: -** Lattice vibration in crystals – Mono atomic and two atoms per primitive cell – Optical properties in IR – Phonons – Electrical properties of metals – Free electron theory – Fermi energy – Brillouin zones – Semiconductor – Band theory- Kronig Penny Model – Effective mass – Impurity levels – Hall effect – Fermi energy of pure and doped semi conductor.		
Unit - III	**Dielectrics and Ferroelectrics: -** Depolarisation field E1, Lorentz field E2, Dielectric Constant and Polarisability – Clausius – Mosotti relation – Electronic polarisability, Ferroelectric crystals, Classification of ferroelectric crystals, soft optical phonon, Landau theory of phase transition, second order transition.		
Unit - IV	**Magnetism: -** Quantum theory of paramagnetism – Ferromagnetism- Ferromagnetic domains – Ferro and Anti-ferro magnetic materials - spin waves – Hard and Soft magnetic materials.		
Unit - V	**Superconductivity: -** Meissner effect – Type I & II super conductors – London equation – Thermodynamic properties – BCS theory - Super conducting tunneling – DC & AC Josephson effect – SQUID – High temperature super conductivity.		

Books for Study:

Azároff Leonid V. (1986). *Introduction to solids*. Bombay: Tata McGraw-Hill.

Kittel, C., & McEuen, P. (2018). *Introduction to solid state physics*. Hoboken, NJ: Wiley.

Phillips, P. (2015). *Advanced solid state physics*. Westview Press

Pillai, S. O. (2018). *Solid state physics*. London, UK: New Academic Science, an imprint of New Age International (UK) Ltd.

Robertson, C. (1980). *The solid state*. London: Polytechnic of North London.

S., N. G. B., & S., N. G. B. (n.d.). *Material science and Processes*. Khanna Pub.

Course Teacher: Prof. K. Gurunathan/Dr. G. Ramalingam

Supportive Courses for other Departments			
Course code: 533703	**Introduction to Nano Scale in Science and Technology**	**Credits: 2**	**Hours : 3**
Unit - I	**Scientific Revolutions: -** Types of Nanomachines and Nanotechnology-Periodic table-Atomic structure molecules and phase energy-Molecular and atomic size-Surfaces and dimensional space-Top down and bottom up.		
Unit - II	**Chemical bonding: -** Forces between atoms and molecule particles and grain boundaries surfaces-Strong inter molecular forces-Electrostatic and Vander Waals forces between surfaces-Similarities and differences between intermolecular and inter particle forces-covalent and coulomb interactions-Basic principles of Nano Scale materials, Synthesis, processing, Mechanical grainding,wet chemical synthesis- Sol-gel processing.		
Unit - III	**Band structure: -** Opportunity at the nano scale-length and time scale in structures-energy landscapes-Inter dynamic aspects of inter molecular forces-Evolution of band structure and Fermi surface.		
Unit - IV	**Quantum scale and biological membranes: -** Quantum dots - Nano wires - Nano tube 2D and 3D films Nano and mesopores, miscelles bilayers, vesides-binano machines-biological membranes.		
Unit - V	**Properties: -** Influence of nano structuring on Mechanical, optical, electronic, magnetic and chemical properties-Grain size effects on strength of metals optical properties of quantum dots and quantum wires-electronic transport in quantum wires and carbon nano tubes-magnetic behavior of single domain particles and nanostructures –surface chemistry of tailored monolayer-self assembling.		

Book for study:

Hornyak, G. L. (2009). *Fundamentals of nanotechnology*. Boca Raton: CRC Press.

Fiorani, D. (1994). *Fundamental properties of nanostructured materials: National School of the Condensed Matter Group, Rimini, Italy, September 20-25, 1993*. Singapore: World Scientific.

Goddard, W. A. (2007). *Handbook of nanoscience, engineering, and technology*. Boca Raton, FL: CRC Press.

Poole, C. P., & Owens, F. J. (2010). *Introduction to nanotechnology*. New Delhi: Wiley India.

Ratner, M. A., & Ratner, D. (2008). *Nanotechnology: a gentle introduction to the next big idea*. Upper Saddle River, NJ: Prentice Hall Professional Technical Reference.

Timp, G. (1998). *Nanotechnology*. New York: AIP Press.

Supportive Courses for other Departments			
Course code: 533704	**Nanotechnology and Advanced Drug Delivery System**	**Credits:2**	**Hours :3**
Unit - I	**Basic concepts of Nano-science and technology:** Properties and technological advantages of Nanomaterials - Quantum wire, Quantum well, Quantum dots and Carbon nanotubes : Synthesis – Top down and bottom up approaches; Characterization - Spectroscopic techniques and Microscopic observations.		
Unit - II	**Fundamentals and types of Nanocarriers:** Types - Viral nanocarrriers, Polymeric nanocarrier, lipid nanocarrier, carbon nanostructures, dendrimers, silica nanoparticles, Microbes and antibody based nanocarriers; Physicochemical properties - Size, Surface, Magnetic and Optical Properties		
Unit - III	**Nanotechnology for Drug Targeting: -** Drug targeting – Targeted (Microneedles, Micropumps, microvalves, Implantable microchips), non-targeted delivery, controlled drug release; Nanoparticle surface modification – bioconjugation, peglyation, antibodies cell- surface targeting; nanostructures for use as antibiotics, diseased tissue destruction using nanoparticles, drug encapsulation strategies.		
Unit - IV	**Nanotechnology for Imaging and Detection: -** Fluorophores and Quantum dots - Labeling and functionalization, Image analysis, Imaging facilitating surgical approaches; Nanoparticles for bioanalytical applications – Biosensors - DNA and Protein based biosensors – materials for biosensor applications- fabrication of biosensors, BioMEMs; Use of nanoparticles for MRI, X Ray, Ultrasonography Drug Delivery; Nano devices.		
Unit - V	**Nanomedicine: -** Nanotechnology in Cancer Therapy - Passive and Active Targeting Strategies in Cancer with a Focus on Nanotechnology Applications, Multifunctional Nanoparticles for Cancer Therapy - Neutron Capture Therapy of Cancer, nanoparticles and High Molecular Weight Boron Delivery Agents; Nanoneurology – Nanocardiology - Nano-Orthopedics - Nano-Ophthalmology.		

Reference and Textbooks:-

Bulte, J. W., & Modo, M. M. (2016). *Design and Applications of Nanoparticles in Biomedical Imaging*. Spinger. doi:10.1007/978-3-319-42169-8

Jain, K. K. (2017). *The Handbook of Nanomedicine*(Third ed.). Humana Press.

Kumar, P., & Srivastava, R. (2016). *Nanomedicine for Cancer Therapy: From Chemotherapeutic to Hyperthermia-Based Therapy*. Springer International Publishing. doi:10.1007/978-3-319-45826-7

Malhotra, B., & Ali, M. A. (2017). *Nanomaterials for Biosensors (1st ed.).*Elsevier.

Mishra, V., Kesharwani, P., Amin, M., & Iyer, A. (2017). *Nanotechnology-Based Approaches for Targeting and Delivery of Drugs and Genes*. Academic Press.

Mohapatra, S., Ranjan, S., Dasgupta, N., & Mishra, R. (2019). *Nanocarriers for drug delivery, Nanoscience and Nanotechnology in drug delivery*. Amsterdam: Elseiver.

Nikolelis, D., & Nikoleli, G. (2018). *Nanotechnology and Biosensors*. Amsterdam: Elseiver.

Shah, M. M., Imran, M., & Ullah, S. (2017). *Delivery and Diagnosis (1st ed.).* William Andrew.

Slevin. (2012). *Current Advances in the Medical Application of Nanotechnology (1st ed.).*Manchester: Bentham Press. doi:10.2174/97816080513111120101

Tuan, V. D. (2015). *Nanotechnology in biology and medicine methods, devices and Applications*(Second ed.). San Fransico: CRC press.

Varghese, T., & Balakrishna, K. (2012). *Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials*. Atlantic & Distributors

Weblink references 1. http://www.nanomedicinecenter.com 2. https://nptel.ac.in/courses/118107015/module4/lecture7/lecture7.pdf 3. https://nptel.ac.in/courses/102107058/ 4. https://nptel.ac.in/courses/118106019/Module%209/Lecture%203/Lecture%203.pdf 5. http://www.imm.org/Reports/rep048.pdf.	
Outcomes	➢ Comprehend the principles behind nanomedicine ➢ Gain a broad understanding of concepts and applications of nanomedicine ➢ Impart the knowledge to apply these nano-drug delivery systems for the diagnosis and therapy ➢ Understand the concepts of nanomedicine to a focused clinical area of their choice.

Name of the Course Teacher
Dr. N. Suganthy, Assistant Professor.

Brief- Bio-Data

Dr. K. Gurunathan
Professor & Head, Special Officer (Projects)
Department of Nanoscience & Technology
Science Campus,
Alagappa University
Karaikudi – 630 003
Tamil Nadu, INDIA
Email: kgnathan27@rediffmail.com

Academic Qualifications:

Ph.D (Chemistry-Energy) Highly Commended, 1994, University of Madras, Chennai
M.Sc (Chemistry), 74 %, 1986, Madurai Kamaraj University, Madurai
B.Sc (Chemistry), 79%, 1984, Madurai Kamaraj University, Madurai

Previous Post: Scientist & Program Coordinator, C-MET, Pune

.**Teaching Experience: 14 Years**

Research Experience: 31 Years

Additional Responsibilities

1. Member of Syndicate, Finance Committee (2016-19)
2. Member of Senate,Member of Standing Committee
3. Member of IQAC
4. Member of University & Dept. Admission committee
5. Member of University & Dept. Purchase committee

Research Interest: Photocatalysis, Hydrogen Energy, Nanosensor, Nano- Solar Cells, Conducting polymer Nanocomposites for Renewable energy.

Distinctive Achievements / Awards

1. **BOYSCAST** (DST, New Delhi) for the year 1999-2000. The work was carried out in University of Texas at Austin, Austin, TX, USA during March 2000-March 2001 in Lithium battery, Supercapacitor and cathode materials for Solid oxide fuel cell.
2. Brain Pool scientist by **Brain Pool program of KOFTS**, South Korea, during July 2005-June 2006 in " Development of Efficient Visible photocatalysts for Hydrogen Generation" The work was carried out in Korea Research Institute of Chemical technology (KRICT), Daejon, S. Korea.
3. Awardee of "**Rastriya Nirman Rattan**" by Economic Growth Society of India, Delhi awarded during the National seminar on "Individual achievements for Economic & Social Development" on 26th August, 2012 at Delhi.
4. **Fellow, Academy of Sciences, Chennai, 2018**

Cumulative Impact Factor (as per JCR) : 251
h-index 11
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Total Citations: 1281
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No. of Research Publications in Intl. Journals : 80
No. conference attended/ presented 225
Guest/Invited lecture delivered 60
Life Fellow in Professional Society : 4 (SAEST,MRSI, ISCA,ASC)
Membership in Professional Society 13

Publication (Listed Few)

1. Interactive Studies on Synthetic Nanopolymer decorated with Edible Biopolymer and its Selective Electrochemical determination of L-Tyrosine" **Scientific Reports- Springer Nature 2019(Accepted)**
2. Biodiesel production from Ulva linza, Ulva tubulosa, Ulva fasciata, Ulva rigida,Ulva reticulate by using Mn2ZnO4 heterogenous nanocatalysts, **Fuel** https://doi.org/10.1016/j.fuel.2019.115744
3. CuO–ZnO p–n junction enhanced oxygen sensing propertyof polypyrrole nanocomposite at room temperature, Journal of Materials Science: Materials in Electronics, **J. Materials Science: Materials in Electronics (2019) 30:9989–9998**
4. A.J. Heiner**, K. Gurunathan,** Fabrication of Room Temperature LPG Gas sensor based on Pani – CNT – V2O5 hybrid nanocomposite, **Appl. Nanosci. https://doi.org/10.1007/s13204-019-00967-w**
5. Effective harvesting of UV induced production of excitons from Fe3O4 with proficient rGO-PTh acting as Bi-functional redox photocatalyst, Renewable energy, doi.org/10.1016 /j.renene. 2017.09.031

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Brief Profile

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Publication Citations (As on Sep.2019)	**9536**
h-index	**54**
i10-index	**234**

Professor Muthupandian Ashokkumar (Ashok) is a Physical Chemist who specializes in Sonochemistry, teaches undergraduate and postgraduate Chemistry and is a senior academic staff member of the School of Chemistry, **University of Melbourne**. He is also one of the Associate Deans (International) in the Faculty of Science. Ashok is a renowned sonochemist who has developed a number of novel techniques to characterize acoustic cavitation bubbles and has made major contributions of applied sonochemistry to the Materials, Food and Dairy industry. He has received about **$ 15 million research grants** to support his research work that includes **several industry projects**. He has edited/co-edited several books and special issues for journals; published ~**320 refereed papers in high impact international journals** and books; and delivered over **150 invited/keynote/plenary lectures** at international conferences and academic institutions. Ashok has successfully organised **10national/international scientific conferences/workshops** and managed a number of national and international competitive research grants.

Education and training

- PhD, University of Madras 1989
- MSc, Madurai-Kamaraj University 1984
- BSc, Madurai-Kamaraj University 1982

Awards and honors

- Ian Potter Foundation, 1997
- Grimwade Prize in Industrial Chemistry.
- He is a Fellow of the RACI since 2007.
- Royal Australian Chemical Institute. Member since 2004.
- European Society for Sonochemistry. Member 2000

Most cited publications (Listed few)

1. The use of ultrasonics for nanoemulsion preparation Published in Innovative Food Science & Emerging Technologies in April, 2008, doi.org/10.1016/ J.IFSET.2007.07.005.

2. Effects of ultrasound on the thermal and structural characteristics of proteins in reconstituted whey protein concentrate, Published in Ultrasonics Sonochemistry in September, 2011, doi.org/10.1016/J.ULTSONCH.2010.12.016.

3. The characterization of acoustic cavitation bubbles – An overview Published in Ultrasonics Sonochemistry in July, 2011, doi.org/10.1016 /J.ULTSONCH. 2010.11.016

4. An overview on semiconductor particulate systems for photoproduction of hydrogen Published in International Journal of Hydrogen Energy in June, 1998, doi.org/10.1016/S0360-3199(97)00103-1.

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Profile

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Publication Citations **(As on Sep.2019)**	**6829**
h-index	**40**
i10-index	**96**

EDUCATIONAL QUALIFICATION:

Degree	Board/University	Year of Passing	Subject
B.Sc.,	Madurai Kamaraj University, PosuponMuthuramalingaThever College, Department of chemistry, Usilampatty.	1990	Chemistry Ancillary: Maths, Physics.
M.Sc.,	Anna University, Department of Chemistry. Chennai.	1992	Applied Chemistry
Ph.D.,	Anna University, Department of Chemical Engineering. Chennai.	1997	Adsorption, Nanoscience and Nanotechnology

PRIZES / HONORS / FELLOWSHIP AWARDED (Listed few)

1. Tamil Nadu Scientist Award (**TANSA** – 2009)
2. "Who's Who in the world" (2007)
3. Researcher" (NSC-2007 - National Science council). Graduate Institute of Environmental Engineering, National Central University-**Taiwan**, National Institute of Advanced Industrial Science and Technology- JAPAN.etc
4. "**JSPS**- Researcher Fellowship" (JSPS-2002 - Japan society for the promotion of science). National Institute of Advanced Industrial Science and Technology -JAPAN.

CONFERENCE ORGANISED (Listed few)

1. Organizing Secretary – National conference on 'Nanotechnology: Current Approaches and Applications' on Feb 5-6, 2010 Manonmaniam Sundaranar University
2. Organizing Secretary – National conference on 'Nanotechnology: Applications and its Advantages in Natural Science', Feb 4-5, 2011
3. Organizing Secretary- National workshop on Environmental Pollution and Assesement' Jan 10-1, 2017
4. Organizing Secretary- National Conference on 'Climate change ang mitigation', Feb 14-15, 2017 etc..

TEACHING AND RESEARCH EXPERIENCE:

20 YEARS, Ph.D Awarded – 12: Ph.D Ongoing –7: M.Phil Research Guidance and awarded: 5: B.Sc and M.Sc Research Guidance and awarded: 66 M.Sc Research Guidance – on going 5

RESEARCH PROJECTS (Listed Few)

1. Nano-porous adsorbent produced from fruits peel waste by using decolorization studies-UGC- Rs.5,62,300
2. Centre for Excellence In Tamil Nadu Higher Education , Chennai (Co - Coordinator)-2009-2012; Rs-100,00,000
3. Non –SAP (Co -Coordinator)UGC, New Delhi 2012-2013, Rs - 10,00,000
4. MSc., Nanoscience – UGC Innovative Programme

(Coordinator), UGC, New Delhi, 2013-2018, Rs-58,000,00etc

Profile

Dr. S Ravichandran
Principal Scientist
CSIR-CECRI
Karaikudi-India
Email:sravi@cecri.res.in

Publication Citations **(As on Sep.2019)**	**1295**
h-index	**16**
i10-index	**29**

Area of Research

Materials Electrochemistry
Energy storage and conversion devices
Electrochemical water treatment

Current Projects

1. Design and development of electrodes and electrolytes for water electrolysis to generate Hydrogen and hydrogen peroxide for sustainable energy and public hygiene - XII five year plan by Solar Energy to Chemical Energy Conversion – TAP SUN – CSIR.

Latest publication

1. Morphology-Dependent Photoelectrochemical and Photocatalytic Performance of γ-Bi2O3 NanostructuresB Jansi Rani, ES Babu, M Praveenkumar, S Ravichandran, G Ravi, ...Journal of nanoscience and nanotechnology 20 (1), 143-154

2. BiVO4 Nanostructures for Photoelectrochemical (PEC) Solar Water SplittingApplicationsBJ Rani, M Praveenkumar, S Ravichandran, G Ravi, RK Guduru, ...Journal of nanoscience and nanotechnology 19 (11), 7427-7435

3. Components of the diffuse ultraviolet radiation at high latitudes, MS Akshaya, J Murthy, S Ravichandran, RC Henry, J Overduin, Monthly Notices of the Royal Astronomical Society 489 (1), 1120-1126

4. Electrochemical surface modification of carbon for enhanced water electrolysisSS Zance, S Ravichandran, Applied Physics A 125 (7), 456

5. WO3 nanocubes for photoelectrochemical water-splitting applications, BJ Rani, MP Kumar, S Ravichandran, G Ravi, V Ganesh, RK Guduru, ...Journal of Physics and Chemistry of Solids

6. Ultrafine M-doped TiO2 (M= Fe, Ce, La) nanospherephotoanodes for photoelectrochemical water-splitting applications, BJ Rani, M Praveenkumar, S Ravichandran, V Ganesh, RK Guduru, ...Materials Characterization 152, 188-203

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Brief- Bio-Data

Dr. P. Shakkthivel
Professor, Department of Nanoscience and Technology
Science Campus, Alagappa University,
Karaikudi -630 002.
E-mail: apsakthivel@yahoo.com

Academic Qualifications:

Years of Experience

Teaching: 12 years, Research: 20 years

Administrative Experience:

i) Controller of Examination- Alagappa University, Karaikudi, INDIA 21.12.2017 -2/10/2018

ii) Chief Warden – Alagappa University Hostels, Karaikudi, Jan. 2016-Dec.2017

M.Sc., Ph.D., - Earned in Electrochemistry from Alagappa University, India (2001).

Awards/ Fellowships Received

1. Visiting Professor – Ming Chi University of Technology, Taiwan, 2018
2. Dongguk University Foreign Professor Fellow- 2015
3. Brain Korea 21 fellowship - 2007
4. Taiwan National Science Council Post Doc.fellowship-2006.
5. Marquis Who's Who in the World- name placed in 2009 & 2017 issues.

Area of Research Interest:

Li-ion Batteries, Magnetic Nanoparticles & Targeted drug Delivery
Modified electrodes & Bio-molecule diagnosis

Membership in Professional Bodies: 5 No.s

Guidance Rendered: Ph.D – 5 Awarded, 4-Ongoing

Extension Activities/ Invited Lectures: 25 National and International

Books / Chapter written

Book Title : Biocompatible Nanomaterials Synthesis, Characterization and Applications;

Chapter title: Synthesis, characterization and Application of Biocompatible Magnetic Nanoparticles, Page 171-208, Nova Science Publisher Inc., Newyork.

No. of Research Publications in Intl. Journals : 61

No. conference attended/ presented	**85**
Guest/Invited lecture delivered	**56**

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Brief- Bio-Data

Dr. C. Balalakshmi
Assistant Professor
Department of Nanoscience and Technology
Alagappa University
Karaikudi – 630 003 Tamil Nadu, INDIA

Academic Qualification: M.Sc., M.Phil., Ph.D.
B.Sc., Zoology 2000 Madurai Kamaraj University
M.Sc., Oceanography 2002 Alagappa University
M.Phil,Oceanography 2003 Alagappa University
Ph.D, Oceanography 2012 Alagappa University
Teaching Experience:**06 years**
Research Experience**: 09 Years**

Additional Responsibilities(Listed few)
Deputy Warden for Science Campus Womens hostel Alagappa University
Department Co-ordinator for National Service Scheme Programme Alagappa University
Treasurer, Department of Oceanography and Coastal Area Studies, Alumni Association
Member, Department Board of Studies, Alagappa University
M.Phil-Nano Science & Technology-Class incharge Alagappa University

Distinctive Achievements / Awards: (Listed few)
Worked as a project fellow in the sethusamudram ship channel project (DCI)

Events organized in leading roles(Listed few)
Parents Teachers Association organizing secretary in 2016 (Nano science & Technology) Organizing Member: Nanomaterials for Specialized Applications NMSA-2017 during Feb.9& 10, 2017.

Training Programs attended (Listed few)

1. Workshop on Molecular and Immunology Techniques attended at Life Tech Research center, vadapalani ,Chennai. (25-28 December 2004)
2. cience of Living, Academy of Human excellence (DST) Training programme attended at vadodara (GUJARAT) (9th-13th January 2017)

Recent Publications(Listed few)

1. New records of Pen Shells (Bivalvia, Pinnidae) from seagrass beds of palk Bay area in Tamilnadu –Seaweed Res.Utiln,32(1&2):185-188,2010 2.
2. New Distribution of Siratus Virgineus ponderosus (Sowerby, 1879)Family Muricidae, in Mandapam Coast, India ,World Journal of Zoology 6 (4):331-333,2011 3.
3. Using Sem Studies on the Radular Morphology of Chicoreus Species (Gastropods:Muricidae) collected from Palk Bay in Tamilnadu-Ecology and Fisheries, Vol.4(2):73-78,2011 4.
4. Four New Distributional Records of Bivalves species of Pectinidae family from Mandapam area –South-East Coast of India-proc.ICBAT.pp.17-20,2011.

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Brief- Bio-Data

Dr. G. Ramalingam
Assistant Professor
Department of Nanoscience and Technology
Quantum Materials Research Lab (QMRL)
Alagappa University-Karaikudi
Email:ramanloyola@gmail.com

Academic Qualifications:

Degree	**Name of University/Institute**
M.Sc(Physics)	University of Madras/Loyola College
B.Ed(Physical Science)	University of Madras
M.Phil(Physics)	University of Madras/Loyola College
Ph.D(Physics)	University of Madras/ Loyola College

Teaching and Research Experience: 7- Years 6 Months

National Institute of Technology (NIT), Calicut-Kerala, Central University of Tamil Nadu (CUTN), Thiruvarur. Sathyabama University, Chennai.

Ph.D Guidance: On-going-1

Achievements / Awards(Listed few)

1. Award of **Young Scientist** Fellowship from Tamailnadu State Science and Technology (Government of Tamilnadu) TNSCST.
2. Innovative Scientific Research Technologist & **Dedicated Academician** (Nanoscience &Tech.) award by globalawards-Malaysia
3. Best Research paper award at IIT-Madras (ISRS 2010)

Developing e-content:

1. Sol-gel synthesis of nanopartilces **11,6,287** Views at slider share
2. Hydrothermal/Solvothermal synthesis of Nanopartilces, **7942** Views at slider share.
3. Introduction to Nanoscience -**1612** Views at slider share

Number of Invited / Special Lectures delivered: **06 Country visited**: Malaysia, Singapore

Publication details

Number of paper published	18
Number of citation	67
Research gate score	:20.41

Vidwan score-Inflibnet :8.1 out of 10

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Brief- Bio-Data

Dr. N. Suganthy
Assistant Professor
Contact Address :Department of Nanoscience and Technology, Alagappa University, Karaikudi – 630 003, Tamil Nadu, INDIA
Contact Phone (Mobile) : +91-9790252506
Contact e-mail(s) : suganthy.n@gmail.com; suganthyn@alagappauniversity.ac.in

Academic Qualification : M.Sc, M.Phil, Ph.D
Research Experience : 14 yrs
Area of Research : Nanopharmocology, Nanotoixology, Nanobiotechnology
Publications
Cumulative Impact Factor : 58
h-index : 13
i10 index : 14
Total Citations : 552
Research Supervision/Guidance : **Ph.D Guiding 2**
Total Publications : In Journals : 26, Conferences-35, Books Chapter-5
Distinctive Achievements/Awards

4. Dr. D.S. Kothari Post Doctoral fellow, UGC, Govt. Of India (2014-2017).
5. State Eligibility Test (SET) for Lectureship Government of Tamil Nadu, India.
6. CSIR SRF (Direct), New Delhi, India (2011-2013).
7. Jawaharlal Nehru Fellowship for doctoral studies, New Delhi, India (2008-2010).

Abroad visit : Thailand
Membership : Life Member in Indian Science Congress
Life Member in Society of Biological Chemist

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