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 Graded as Category - I & Granted Autonomy

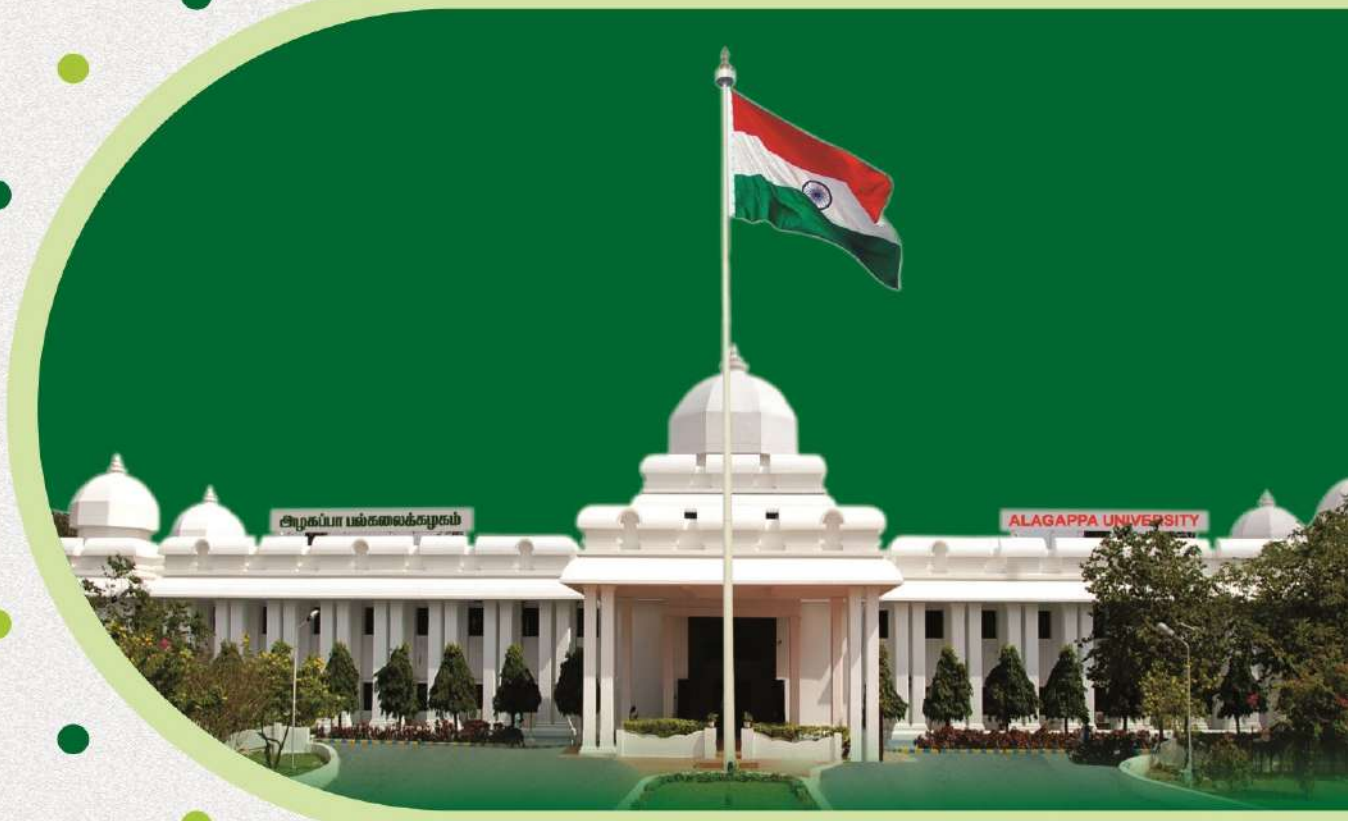
2018 MHRD Swachh Campus Rank : 4

2021 nirf National Institutional Ranking Framework Rank : 33

2021 University Rankings Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS



M.Sc., PHYSICS

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF PHYSICS
M.Sc., Physics

REGULATIONS AND SYLLABUS
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

ALAGAPPA UNIVERSITY
DEPARTMENT OF PHYSICS
Karaikudi - 630003, Tamil Nadu.

REGULATIONS AND SYLLABUS - (CBCS - University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department **:** Physics

Name of the Programme **:** M.Sc., Physics

Duration of the Programme **:** Full Time (Two Years)

Choice Based Credit System

A Choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their own tempo. Students shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learning, and make the best use of the expertise of available faculty.

Programme

"Programme" means a course of study leading to the award of a degree in a discipline.

Courses

"Course" is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures/tutorials/laboratory /seminar/project / practical training/report writing /Viva-voce, etc or a combination of these, to meet effectively the teaching and learning needs.

Credits

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses credits will be assigned on the basis of the number of lectures/tutorial/laboratory and other forms of learning required completing the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory/field work one credit is equal to two hours.

Semesters

An Academic year is divided into two Semesters. In each semester, courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5/6 days a week.

Medium of Instruction

Medium of instruction is English.

Departmental Committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department including the conduct of entrance tests, verification of records, admission, and evaluation. The Departmental Committee determines the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practicals, seminars etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committee. Courses approved by the Departmental Committee shall be approved by the Board of Studies/Broad Based Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The Non-major elective programme & MOOCs coordinators and Internship Mentor are responsible for submitting the performance sheet to the Head of the Department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to the Controller of Examinations.

Programme Educational Objectives - (PEO)

PEO1	To develop the ability to understand the various concepts of Physics and mastering in the fields of materials science.
PEO2	To cultivate and nurture the scientific approach and research aptitude.
PEO3	To practice problem solving skills to keep abreast at National Level.
PEO4	To stimulate creativity, innovation and out of box thinking while learning.
PEO5	To apply and testify the learned concepts to tackle the challenges in the advancement of Physics and promote interdisciplinary nature.
PEO6	To acquire interpersonal and leadership skills through academic collaborations.
PEO7	To inculcate societal relevance and professional ethics as a scholar.

PEO8	To uphold discipline specific sustainability and conservation towards mother nature.
PEO9	To contribute for the advancement of Science by taking research as a career.
PEO10	To train competitiveness for employability and entrepreneurship.

Programme Specific Objectives - (PSO)

PSO1	Introducing inclusiveness in teaching, learning, experimenting, practicing and researching in various dimensions of Physics to elevate students' competitiveness.	Competency in Basic and Advanced Scientific Concepts and methodology.
PSO2	Promoting critical thinking, reasoning, evolving and implementing these in deriving solutions for discipline specific problems to cultivate scientific approach and culture of research aptitude.	Use of creativity and innovation in problem solving and driving solutions
PSO3	Resourcing dynamic syllabus with the aid of modern analytical tools to address the current challenges in the advancement of Physics and in the society to boost acclimatization and interdisciplinary nature.	Awareness on recent developments and usage of analytical tools
PSO4	Fostering independency through internship, projects and field visit which strengthens interpersonal communication and consistency in knowledge enrichment.	Adaptability and self directed
PSO5	Training to exhibit impressive individual talent and develop skills to compete effectively with the peers and professionals.	Advancement in learning, Employability and Entrepreneurship.

Programme Outcome-(PO)

PO1	Acquiring and integrating knowledge in Physics Concepts.	Basic knowledge
PO2	Creating Ability to compare and contrast, inference and interpretation, gathering information and analyzing and making decision and problem solving.	Critical thinking
PO3	Enhancing tacking ability, evaluating information skillfully, testing the concepts, building the results and implementing.	Problem solving
PO4	Inculcating the process of breakdown of complex problems into components and understanding their interconnectivity for arriving solutions.	Analytical reasoning
PO5	Emulating curiosity and innovation to raise questions for gaining knowledge on scientific concepts and drawing conclusions.	Scientific reasoning
PO6	Devising methodology of learning with concern on society and environment for sustainability.	Environment and Sustainability
PO7	Aiding research and development with modern instruments to gain skills, competency and keep abreast	Use of analytical tools

PO8	Enabling out of the box thinking and implementing innovative ideas into practical applications.	Curriculum Design and Application
PO9	Upholding ethical values, responsive citizens and be professional.	Soft skills
PO10	Being consistent with knowledge enrichment towards self reliant, inventive, flexibility and collective development.	Adaptability and self directed

Programme Specific Outcome (PSO)

PSO1	Revisiting the basics of Physics in relevance to the course with inclusiveness of the students towards capacity building for experimenting, practicing and researching.	Competency in Basic and Advanced Scientific Concepts and methodology.
PSO2	Cultivating out of the box thinking and practicing analytical ability with research aptitude for the discipline specific problems.	Use of creativity and innovation in problem solving and driving solutions
PSO3	Updating with course related advancements and challenges to keep abreast while learning the course and discussing their societal relevance issues.	Awareness on recent developments and usage of analytical tools
PSO4	Enriching the knowledge with interdisciplinary in nature by promoting internship, projects and field visit.	Adaptability and self directed
PSO5	Acquiring interpersonal skills and exhibiting competitiveness among peers and professionals.	Advancement in learning, Employability and Entrepreneurship.

Eligibility for Admission

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

Minimum Duration of Programme

The programme is for a period of two years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semester shall be from June / July to October / November and even semester shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Components

A PG programme consists of number of courses. The term "course" is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of the courses suggested for the PG programme:

A. Core courses (CC) - "Core Papers" means "the core courses" related to the programme concerned including practicals and project work offered under the programme and shall cover core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-Specific Electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students, shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME) - Exposure beyond the discipline. Students have to undergo a total of two Non Major Elective courses with 2 credits offered by other departments (one in IInd semester another in IIIrd semester). A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives. Non Major Elective courses offered by the departments pertaining to a semester should be announced before the end of previous semester. Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or in online.

D. Self Learning Courses from MOOCs platforms. MOOCs shall be on voluntary for the students. All PG programmes students have to undergo a total of 2 Self Learning Courses (MOOCs) one in IInd semester and another in IIIrd semester. The actual credits earned through MOOCs shall be transferred to the credit plan of programmes as extra credits. While selecting the MOOCs, preference shall be given to the course related to employability skills.

E. Projects/Dissertation/Internships (Maximum Marks: 200): The students shall undertake the Projects/Dissertation/Internships work during the fourth semester.

Project/Dissertation

(a) Plan of work:

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

(b) Project work outside the Department:

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

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

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

Format to be followed for dissertation/project report

The format /certificate for thesis to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows

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

Format of the Title Page:

Title of Dissertaion/Project Work

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

By

Students Name:

Register Number:

Under the Guidance of

(Faculty Name)

University Logo

Department of Physics

ALAGAPPA UNIVERSITY

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank 216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi 630003

Month and Year

Format of certificates

Certificate – (Guide)

This is to certify that the Dissertation/Project entitled "----------" submitted to Alagappa University, Karaikudi - 630003 in partial fulfillment for the award of the degree of Master of Science in PHYSICS by Mr/Ms ---------- (Reg No:----------) under my supervision. This is based on the results of studies carried out by him/her in the Department of Physics, Alagappa University, Karaikudi - 630003. This dissertation/Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi Research Supervisor

Date: _____

Certificate - (HOD)

This is to certify that the Dissertation/Project entitled "----------" submitted by Mr/Ms ----------(Reg No: ----------) to the Alagappa University, in partial fulfillment for the award of the degree of Master of Science in Physics is a bonafide record of research work done under the supervision of Dr.----------, Assistant Professor, Department of Physics, Alagappa University. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date:_____ Head of the Department

Declaration - (Student)

I hereby declare that the Dissertation/Project entitled "----------" submitted to the Alagappa University for the award of the degree of Master of Science in Physics has been carried out by me under the guidance of Dr. ----------, Assistant Professor, Department of Physics, Alagappa University, Karaikudi – 630 003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date: _____

(Student)

Teaching methods

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

Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester(s) after completion of the programme, with the prior permission of the Registrar of the University.

Examination

The examinations shall be conducted separately for theory and practical to assess (remembering, understanding, applying, analyzing, evaluating, and creating) the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

A. Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory - 25 marks

S. No.	Content	Marks
1.	Average marks of two CIA tests	15
2.	Seminar/group discussion/quiz	5
3.	Assignment/field trip report/case study report	5
	Total	25

For Special Course - 25 marks

S. No.	Content	Marks
1.	Two presentations	15
2.	Group discussion/quiz	5
3.	Assignment	5
	Total	25

Practical - 25 Marks

S. No.	Content	Marks
1	Major Experiment	10
2	Minor Experiment	5
3	Observation	10
	Total	25

Project/Dissertation/Internship - 50 Marks (assess by Guide in-charge/HOD/Supervisor)

S. No.	Content	Marks
1	Two presentations (mid-term)	30
2	Progress report	20
	Total	50

B. External Examination

- There shall be examinations at the end of each semester, for odd semester in the month of October / November; for even semester in April / May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However, candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester.
- A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulation prescribed or belated joining or on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.
- For the Project Report/ Dissertation Work / Internship, the maximum marks will be 100 for project report evaluation and for the Viva-Voce it is 50 marks (if in some programmes, if the project is equivalent to more than one course, the project marks would be in proportion to the number of equivalent courses).
- Viva-Voce: Each candidate shall be required to appear for Viva-Voce Examination (in defense of the Dissertation Work /Project/ Internship).

C. Scheme of External Examination (Question Paper Pattern)

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective type questions)	10 × 1 = 10	10 questions – 2 each from every unit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 × 5 = 25	5 questions – 1 each from every unit
Section C	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 × 8 = 40	5 questions – Should cover all units

For Special course

Report	25 Marks
Viva-voce	50 Marks

Practical – Maximum 75 Marks

Experimental Description	25 Marks
Experimental setup	5 Marks
Execution Demonstration	25 Marks
Record note	10 Marks
Viva-voce	10 Marks

Dissertation /Project report/Internship report Scheme of evaluation

Dissertation /Project report/Internship report	100 Marks
Viva-voce	50 Marks

Results

The results of all the examinations will be published through the Department where the student underwent the course as well as through University Website.

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous Internal Assessment and End Semester Examinations marks together.
- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C.I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.

- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he /she get not less than 40% in each of the Project / Dissertation / Internship Report and Viva-Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce.
- A candidate who gets less than 50% in the Project / Dissertation / Internship Report must resubmit the thesis. Such candidates need to take again the Viva-Voce on the resubmitted Project report.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Paper / Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	**9.0 – 10.0**	**O**	**Outstanding**
80 - 89	**8.0 – 8.9**	**D+**	**Excellent**
75 - 79	**7.5 – 7.9**	**D**	**Distinction**
70 - 74	**7.0 – 7.4**	**A+**	**Very Good**
60 - 69	**6.0 – 6.9**	**A**	**Good**
50 - 59	**5.0 – 5.9**	**B**	**Average**
00 - 49	**0.0**	**U**	**Re-appear**
ABSENT	**0.0**	**AAA**	**ABSENT**

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).
b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).
c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).
d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).

g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).

h) Absence from an examination shall not be taken as an attempt.

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

GRADE POINT AVERAGE (GPA) = $\Sigma_i C_i \ G_i / \Sigma_i C_i$

GPA = Sum of the multiplication of Grade Points by the credits of the courses
Sum of the credits of the courses in a Semester

Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	**O+**	First Class – Exemplary*
9.0 and above but below 9.5	**O**	
8.5 and above but below 9.0	**D++**	First Class with Distinction*
8.0 and above but below 8.5	**D+**	
7.5 and above but below 8.0	**D**	
7.0 and above but below 7.5	**A++**	First Class
6.5 and above but below 7.0	**A+**	
6.0 and above but below 6.5	**A**	
5.5 and above but below 6.0	**B+**	Second Class
5.0 and above but below 5.5	**B**	
0.0 and above but below 5.0	**U**	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.

i) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.

e) Absence from an examination shall not be taken as an attempt.

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

CGPA = Sum of the multiplication of Grade Points by the credits of the entire Programme
Sum of the credits of the courses for the entire Programme

Where ‘Ci’ is the Credit earned for Course i in any semester; ‘Gi’ is the Grade Point obtained by the student for Course i and ‘n’ refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the PG Programme are alone eligible for this classification.

Maximum duration of the completion of the programme

The maximum period for the completion of M.Sc. Physics programme shall not exceed eight semesters continuing from the first semester.

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/ she has earned the minimum required credits prescribed for the Programme (i.e. 90 credits).

Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend outreach programs in environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three day based on the theme.1. Environmental awareness 2. Hygiene and Health. A minimum of two faculty members can accompany the students and guide them.

M.Sc. PHYSICS –PROGRAMME STRUCTURE

Sl. No.	Course Code No.		Title of the Course	T/P	No. of Credit	Contact Hours/ Week	Marks		Total
							Internal	External	
I SEMESTER									
1	521101	Core 1	Classical Mechanics	T	4	4	25	75	100
2	521102	Core 2	Mathematical Physics-I	T	4	4	25	75	100
3	521103	Core 3	Electronics	T	4	4	25	75	100
4	521104	Core 4 Lab 1	Electronics Laboratory	P	5	10	25	75	100
5	-----	DSE* 1		T	4	4	25	75	100
6	521106	SC*	Skill Development		3	3	25	75	100
7	-----		Library/Yoga		--	1	--	--	--
Total					**24**	**30**	**150**	**450**	**600**
II SEMESTER									
8	521201	Core 5	Quantum Mechanics-I	T	4	4	25	75	100
9	521202	Core 6	Mathematical Physics-II	T	4	4	25	75	100
10	521203	Core 7	Electromagnetic Theory	T	4	4	25	75	100
11	521204	Core 8 Lab 2	Advanced Physics Laboratory	P	5	10	25	75	100
12	-----	DSE*2		T	4	4	25	75	100
13	-	NME	Non Major Elective-I		2	3	25	75	100
14	*SLC - I		MOOCs		EC	---	----	----	----
15	-----		Library/Yoga		--	1	--	--	--
Total					**23+ EC**	**30**	**150**	**450**	**600**
III SEMESTER									
16	521301	Core 9	Advanced Molecular Spectroscopy	T	4	4	25	75	100
17	521302	Core 10	Quantum Mechanics-II	T	4	4	25	75	100
18	521303	Core 11	Condensed Matter Physics-I	T	4	4	25	75	100
19	521304	Core 12 Lab 3	Advanced Electronics Laboratory	P	5	10	25	75	100
20	-----	DSE* 3		T	4	4	25	75	100
21	-	*NME	Non Major Elective-II	T	2	3	25	75	100
22	*SLC - II		MOOCs	T	EC	---	----	----	----
23	VEP		Village Extension Programme (3 days)		---	---			----
24	-----		Library/Yoga		--	1	--	--	--
Total					**23+ EC**	**30**	**150**	**450**	**600**

IV SEMESTER									
19	521401	Core 13	Condensed Matter Physics-II	T	4	4	25	75	100
20	521402	Core 14	Nuclear and Particle Physics	T	4	4	25	75	100
21	521403	Core 15	Thermodynamics and Statistical Mechanics	T	4	4	25	75	100
22	521444	Core 16	Project & Viva-voce		8	18	50	150	200
Total					**20**	**30**	**125**	**375**	**500**
GRAND TOTAL CREDIT					**90+ EC**				**2300**

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

DSE – Student Choice and it may be conducted by parallel sections.

Non Major Electives offered to other departments				
Sl. No.	**Course Code No.**	**Title of the Course**	**No. of Credit**	**Contact Hours/Week**
1		Analytical Instrumentation	2	3
2		Imaging : Fundamentals and Applications	2	3

ELECTIVE COURSES

Sl. No.	Course Code No.	Title of the Course	No. of Credit	Contact Hours/Week
I SEMESTER				
1.	521501	Numerical Analysis and C-Programming	4	4
2.	521502	Basic Concepts of Instrumentation	4	
3.	521503	Solar Energy Utilization	4	
		Any one course		
II SEMESTER				
4.	521504	Modern Optics	4	4
5.	521505	Materials and Characterization	4	
6.	521506	Quantum Chemistry	4	
		Any one course		
III SEMESTER				
7.	521507	Communication Electronics	4	4
8.	521508	Physics of Nanomaterials	4	
9.	521509	Microprocessor and Instrumentation	4	
		Any one course		

SEMESTER – I

Core	Course code: 521101	CLASSICAL MECHANICS	T	Credits: 4	Hours: 4

UNIT I

Objective 1	To provide fundamental concepts and formulation of classical mechanics to the students.	
Lagrange and Hamilton Equations: Newtonian mechanics of single and many particle systems (Introductory area); Mechanics of particles and mechanics of system of particles - Conservation Laws-Conservation of linear and angular momentum-Work energy theorem; Open systems (with variable mass)- Constraints-their classification, Generalized coordinates –Symmetric properties – Homogeneity and Isotropy - Lagrange's equations for simple systems – non-holonomic systems – Principle of virtual work - D' Alembert's principle – Hamilton's equation- Ignorable coordinates – Routhian function - Application of Lagrange equation of motion: Bead on spoke of wheel – Atwood's machine, simple pendulum, linear harmonic oscillator.		
Outcome 1	Remembering the Newtonian mechanics and the evolution of classical mechanics from it. Formulate Lagrangian and Hamiltonian equations of motion to analyze dynamical problems	K1& K4

UNIT II

Objective 2	To know classical mechanics methods and theories.	
Hamiltonian Methods: Introduction-Hamilton's Principle-Hamilton's principle for a Conservative system-Principle of Least action-Characteristic Function and Hamilton-Jacobi Equation–Phase space and Liouville's Theorem– Special Transformation - Canonical Transformation-Condition for Canonical Transformation-Point Transformation -Poisson's Brackets- Equation of motion in terms of Poisson Brackets -Lagrange Brackets-Relation between Lagrange and Poisson Brackets-Invariance of Poisson Bracket with respect to Canonical Transformations - The calculus of variations and Euler-Lagrange's equations.		
Outcome 2	Understanding Hamilton's principle, characteristic function, special transformations and Poisson and Lagrange brackets. Apply this to check the nature of the transformations	K2 & K3

UNIT III

Objective 3	To demonstrate an understanding into the theory of relativity and inculcate the knowledge in properties of rigid dynamics.	
Kinetics of a Rigid Body Motion: Moments and products of Inertia – Moment of Inertia of a body about any line – Through the origin of coordinate frame – The momental Ellipsoid –Rotation coordinate Axes – Principal axes and Principal Moments – Kinetic Energy of a Rigid body rotating about a Fixed point–Angular momentum of a Rigid Body-Eulerian Angles-Compound pendulum – Euler's equations of motion-Torque free motion of a rigid body-Rotational motion of the earth.		
Outcome 3	Understanding how the laws of kinematics by using the application of Newtonian mechanics that describes the dynamics of rigid body and the formulation is an important tool in the computer simulation of mechanical bodies.	K2, K3& K6

UNIT IV		
Objective 4	To understand classical mechanical transformations, oscillations and concepts.	
Central Force Problem and Special theory of Relativity: Reduction to the equivalent one body problem – Centre of mass-Equation of motion and first integral-classification of orbits – Kepler problem: Inverse-square law of force-scattering in a central force field – transformation of scattering to laboratory coordinates – Theory of relativity, Equivalence of space and time – The Lorentz Transformation – Immediate consequences of Lorentz transformations: contraction of length, time dilation, composition of velocities – The mass of a Moving particle -Mass and Energy equivalence.		
Outcome 4	Evaluate the motion of a particle in a single central potential field using central-force problem	K5 & K3
UNIT V		
Objective 5	To investigate the behavior of an oscillating mechanism.	
Small Oscillations and Normal modes: Potential Energy and equilibrium – One dimensional oscillator: stable, unstable and neutral equilibrium – Two coupled oscillators – small oscillations in normal coordinates - normal coordinates and normal modes – General theory of small oscillations: secular equation and eigen value equation — Vibrations of a linear triatomic molecule.		
Outcome 5	Understand the effect of all possible small perturbations to a dynamical system in mechanical equilibrium and to evaluate the normal co-ordinates by analyzing its vibrations	K2,K5 &K4

Suggested Readings:

Sankara Rao. K (2005), *Classical Mechanics*, Prentice Hall India learning Pvt. Ltd.,

Haberzett .H. (2021).*Classical Mechanics. Lecture notes*. World scientific publishing.

Kamberaj.H.(2021). *Classical Mechanics*.DeGruyter publisher.

Emam .H. (2021) .*Covariant Physics: From classical mechanics to General relativity and Beyound*.Oxford university press-1st Edition.

Helliwell.T. (2021).*Modern Classical Mechanics*.Cambridge University press-1st Edition.

Deshmukh.P.C. (2022) *Foundations of classical Mechanics*. Cambridge University press.

Online Resources

http://ion.uwinnipeg.ca/~afrey/FW2021/imech/Idema-MechanicsRelativity.pdf

https://archive.nptel.ac.in/courses/115/106/115106123/

https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/

K1- Remember	K2- Understand	K3- Apply	K4- Analyze	K5-Evaluate	K6-Create

Course designed by Dr.M.Sivakumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)	L(1)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO3	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO4	S(3)	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
W.Av	**3**	**2.4**	**3**	**2.6**	**2**	**1**	**1.8**	**2.8**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	L(1)	L(1)	M(2)
CO2	S(3)	M(2)	M(2)	L(1)	M(2)
CO3	S(3)	M(2)	S(3)	L(1)	M(2)
CO4	S(3)	S(3)	M(2)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	L(1)	M(2)
W.Av	**3**	**2.2**	**2.2**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521102	MATHEMATICAL PHYSICS – I	T	Credits: 4	Hours: 4

UNIT I		
Objective 1	To provide a strong mathematical foundation in vector analysis.	
Vector Analysis: Introduction to vectors and product of vectors – Concepts of Gradient, Divergence, Curl – Line integral, surface integral, volume integral - Gauss's divergence theorem – Stoke's Theorem – Gauss's law and Poisson's Equation – Expression for Gradient, Divergence, Curl and Laplacian in Orthogonal, Cylindrical and Spherical Coordinates.		
Outcome 1	Student will be able to discuss vectors and vector fields and their need in Physics.	K1,K2,K4
UNIT II		
Objective 2	To understand the concepts of matrices.	
Matrices: Introduction to Matrix – Types of matrices and their properties – Determinant - Rank of a matrix – Cramer's rule - Characteristic equation - Eigen values, Eigen vectors – Adjoint of a matrix – Inverse of a matrix – Diagonalization of Matrices – Cayley-Hamilton's theorem - Problems.		
Outcome 2	Student will be able to explain the importance of matrices and matrix operations in various physical contexts.	K3,K4
UNIT III		
Objective 3	To provide a strong mathematical foundation in tensor analysis.	
Tensor Analysis: Definition of Tensors – Contravariant, covariant and mixed tensors – Rank of a tensor - Coordinate transformation – Summation convention – Summation of coordinates – Kronecker delta - Order of tensors - Transformation law – Algebraic operations on Tensors – Inner and outer product – Contraction of a tensor - Symmetric and anti-symmetric tensor - Quotient law – Cartesian Tensors – Metric Tensors – Conjugate tensors - Christoffel symbols.		
Outcome 3	Student will be able to explain the usefulness of tensors in different physical contexts.	K2,K4
UNIT IV		
Objective 4	To discuss the salient features of probability theory.	
Theory of Probability: Definitions of Probability – Addition law of probability – Multiplication law of probability – Random Variables – Probability Distribution - Binomial Distribution – Poisson Distribution – Gauss's Normal Distribution.		
Outcome 4	Student will be able to discuss concepts of probability theory.	K1,K2
UNIT V		
Objective 5	To discuss the importance of Fourier and Laplace transforms in Physics.	
Integral Transforms: Introduction and Definitions – Fourier Transforms – Cosine and Sine Fourier transforms – Linearity theorem – Parseval's theorem – Fourier Transform of Derivatives – Convolution Theorem – Laplace Transforms – Properties of Laplace transform - Laplace Transform of Derivatives – Convolution or Faltungs Theorem – Inverse Laplace Transform		
Outcome 5	Student will be able to solve the problems of Integral transforms	K2,K4,K5

Suggested Readings:

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

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

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

Arfken, G. (2000). *Mathematical Methods for Physists*. 5th Edition, Academic Press.

Kreyszig, E. (1983). *Advanced Engineering Mathematics*. Wiley Eastern.

Online Resources

https://eprints.ukh.ac.id/id/eprint/278/1/2013_Book_MathematicalPhysics.pdf

https://books.google.com/books/about/Mathematical_Physics.html?id=IzJdPqEn6VYC#v=onepage&q&f=false

http://ndl.ethernet.edu.et/bitstream/123456789/79541/4/Mathematical%20Physics%20(Gupta).pdf

K1- Remember	K2- Understand	K3- Apply	K4- Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Sivakumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	L(1)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	S(3)
W.Av	**3**	**3**	**2.4**	**3**	**2.2**	**1.2**	**1.6**	**3**	**2**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.Av	**3**	**2.8**	**2.6**	**2.6**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521103	ELECTRONICS	T	Credits: 4	Hours: 4

	UNIT I	
Objective 1	To distinguish different diode characteristics.	
Semiconductor diodes: - Introduction to Semiconductor. Intrinsic and extrinsic semiconductors- Open circuited PN Junction diode – The volt Ampere characteristics - Forward and Reverse bias of diode - Characteristics of FB and RB of diode - Zener diode- Gunn diode - Tunnel diode - Photo diode -Schottky diode - Laser diodes - Characteristics and Applications.		
Outcome 1	Remembering semiconductor Physics and understanding the characteristics of various diodes	K1,K2
	UNIT II	
Objective 2	To discuss transistor biasing and optoelectronic devices in detail.	
Transistor biasing and optoelectronic devices: Transistor action PNP NPN transistors - Transistor Amplifier - Transistor connections - DC load line – Homo and hetero junction devices - Operating point- Bias stability - Transistor biasing and stabilization - Need for biasing - Methods Transistor biasing - h parameters – Device characteristics, frequency response and its application - Classification of Amplifiers - Power amplifier - Push-pull amplifier - JFET - JFET Amplifier - Biasing - MOSFET - UJT - SCR - DIAC - TRIAC.		
Outcome 2	Understanding the transistor action amplifier mechanism in detail.	K2
	UNIT III	
Objective 3	To understand the classification of amplifiers.	
Operational amplifier applications: - Operational Amplifier - CMRR - Slew rate - Instrumentation amplifier - V to I and I to V converter- Op-amp stages - Equivalent circuits - Sample and Hold circuits. Feedback amplifier - Transfer gain with feedback - Applications of Op-Amp: Inverting. Non-Inverting Amplifiers- circuits Adder- Subtractor- Differentiator- Integrator- Schmitt Trigger - Triangular wave generator - Sine wave generator - Active filters: Low, High and Band pass filters.		
Outcome 3	Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators.	K4
	UNIT IV	
Objective 4	To impart fundamental aspects of digital electronics principles to the students.	
Sequential circuits, flip-flops, registers and counters: - Sequential Circuits – Flip-Flop – Definition - R-S Flip-Flops – Clocked R-S Flip-Flop – Data Latch or D-Flip-Flop – J K Flip-Flop –Master – Slave J K Flip-Flop – Registers – Shift Registers – Serial In Serial Out shift register, Serial In parallel Out shift register, Parallel In Serial Out shift register, Parallel In parallel Out shift register– Counters – Ring Counter – Ripple Counter – Mod Counters. Classification of memories and sequential memory - ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM.		
Outcome 4	Construct sequential circuits, flip-flops, registers and counters.	K3,K6

UNIT V		
Objective 5	To give advanced knowledge about A/D and D/A converter and their applications.	
A/D and D/A converter - Sampling theorem - Time division multiplexing – Quantization – DAC - Weighted resistor method - Binary Ladder network – ADC - successive approximation. Dual slope and Counter method - Voltage to Frequency conversion and Voltage to Time conversion – Comparators - Sample and Hold.		
Outcome 5	Construct data convertors and understand the requirements for A/D and D/A converters suitable for different applications.	K2,K3,K6

Suggested Readings:

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

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

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

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

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

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

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

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

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

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

Online Resources

http://www.electrical4u.com

https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2009/pages/lecture-notes/

https://www.tutorialspoint.com/basic_electrnics/index.htm

K1- Remember	K2- Understand	K3- Apply	K4- Analyze	K5-Evaluate	K6-Create

Course designed by Dr. G. Ravi, Dr. M. Ramesh Prabhu

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	M(2)	L(1)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	L(1)	S(3)
CO5	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)
W.Av	**3**	**2.8**	**1.8**	**2.2**	**3**	**2.4**	**2.6**	**2.8**	**1.4**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	L(1)	S(3)	S(3)
W.Av	**3**	**3**	**1**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

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

ELECTIVE COURSES
SEMESTER – I

DSE	Course Code: 521501	NUMERICAL ANALYSIS AND C-PROGRAMMING	T	Credits: 4	Hours: 4

Unit- I		
Objective 1	To understand the errors and approximation in numerical methods	
Error, computer arithmetic and root finding: - Errors: Definition, sources, Propagation of error, summation, least squares data fitting, eigen value problem, nonlinear systems - Bisection method, Newton's method: Error analysis, error estimation - Secant method: Error analysis, comparison of Newton and Secant methods – Truncation error – Horner's method – Method of false positioning.		
Outcome 1	Remember and understand error analysis for arithmetic operations and Newton method.	K1, K2
Unit – II		
Objective 2	To learn the concept of interpolation methods	
Interpolation: - Polynomial interpolation: linear interpolation, Quadratic interpolation, higher-degree interpolation, divided differences, properties of divided differences, Newton's divided difference interpolation – Lagrange interpolation – Central difference interpolation – Inverse interpolation.		
Outcome 2	Remember and understand polynomial interpolation, Newton's divided difference interpolation and Lagrange interpolation	K1, K2, K3
Unit – III		
Objective 3	To apply numerical techniques for differentiation and integration	
Numerical integration and ordinary differential equations: - Newton-cote's quadrature formula - The Trapezoidal and Simpson rules - Error formulae: An error formula for Trapezoidal and Simpson's rule - Richardson Extrapolation, periodic interpolation - Ordinary differential equations: theory of differential equations - Euler's methods - Taylor and Runge-Kutta methods second order and third order (no derivation).		
Outcome 3	Understand, analyze and apply Trapezoidal rule, Simpson rule, Euler's, Taylor and Runge-Kutta methods.	K2, K3, K4, K5
Unit - IV		
Objective 4	To understand the concept of linear equations to the students.	
Solution of systems of linear equations: - Systems of linear equations - Gaussian elimination: Partial Pivoting, calculation of inverse matrices, operations count - The LU Factorization: Compact Variants of Gaussian Elimination - Tri-diagonal systems - Iteration methods: Jacobi method and Gauss-Seidel method.		

Outcome 4	Understand, analyze and apply Gaussian Elimination, Jacobi method and Gauss-Seidel method.	K2, K3, K4, K5
Unit - V		
Objective 5	To impart understanding on the basics of C program and its applications	
C-programming: - Introduction – Basic structure of C Program – Operators and Expressions – Library functions – getchar Functions and putchar Functions – Control Statements – Arrays and strings – Pointers – Structures and Unions.		
Outcome 5	Remember and understand Basic structure of C Program and control statements	K2,K3,K6

Suggested Readings:-

Atkinson, K. Han, W. (2011). *Elementary Numerical Analysis*, Wiley-India, 3rd Edition

Balagurusamy, E. (2017). *Numerical Methods*, McGraw Hill Education.

Burden, R.L. Faires, J.D. Burden, A.M. (2016). *Numerical Analysis* (10th Edition), Cengage Learning.

Grewal, B.S. Grewal, J.S. (2013). *Numerical Methods in Engineering and Science*, Delhi, Khanna Publishers, 11th Edn.

E.Balagurusamy (2004), Programming in ANSI – C, Tata McGraw Hill publications.

Online Resources

https://archive.nptel.ac.in/courses/122/104/122104019/#

https://onlinecourses.swayam2.ac.in/cec20_ma11/preview

K1- Remember	**K2- Understand**	**K3- Apply**	**K4- Analyze**	**K5-Evaluate**	**K6-Create**

Course designed by Dr.S.Sudhahar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	L(1)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	M(2)	L(1)	S(3)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	S(3)	S(3)	M(2)	S(3)
W.Av	**3**	**2.8**	**2.8**	**2**	**2**	**1**	**2.2**	**2.8**	**1.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	L(1)	S(3)	S(3)
W.Av	**3**	**3**	**1**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course Code: 521502	BASIC CONCEPTS OF INSTRUMENTATION	T	Credit: 4	Hours: 4

Unit I

Objective 1	The main objective of this paper is to impart various aspects of basic concepts of instrumentation to the students.

Static characteristics of Instruments - Types of errors - Static Performance Parameters - Accuracy, Precision, Resolution - Linearity - Hysteresis - Dead Band - Backlash - Drift - Impedance loading and Matching. Mathematical description of data distribution function - functions - propagation error Analysis of data - systematic error. Static error- Statistical analysis of error – Probability of errors.

Outcome 1	Understand and describe the fundamental principles behind the methods of instrumentation.	K2

Unit II

Objective 2	To explain the static and dynamic characteristics of instruments.

Dynamic characteristics of instruments: -(measurements) - Instrumentation and system design Dynamic Response: Periodic Input Harmonic Signal - First order - Second order system instruments to periodic – Harmonic, Non – Harmonic, Response to step input and transient and random input - Compensation networks.

Outcome 2	Understand the dynamic characteristics of instruments.	K2,K3

Unit III

Objective 3	To understand the basic operations of electronic circuits and its applications.

Analog and digital transducers - Analog transducers: Electrochemical Potentiometric Resistive – Inductive - Capacitive linear variable differential transformer capacitive transducer – Piezo - Electric transducers - Digital transducers: Frequency Domain, Electromagnetic Frequency Domain - Opto-Electrical Frequency Domain - Vibrating String Transducers – binary codes – digital encoders.

Outcome 3	Demonstrate knowledge commonly used to process measurement devices.	K1,K3

Unit IV

Objective 4	To understand the physical principle of electronic based measurement.

Transducers – I - Moderate pressure - Pressure sensing elements : Manometers, Elastic Transducers, bourdon tube, diaphragm - High Pressure measurement – Temperature measurements: Non-Electrical Methods Bimetallic Thermometer - Liquid in Glass Thermometer – RTDs – Thermistor - Thermocouples –Pyrometers - Pressure Thermometers Low temperature thermometer-Semiconductor IC sensing - Magnetic thermometer Electrical Methods: Electrical Resistance Thermometers-semiconductor temperature sensors.

Outcome 4	Understand the salient features of transducers.	K2

Unit V

Objective 5	To know the importance of analog and digital transducers to real problems

Transducers – II - Transducer properties -Flow Measurement: primary or Quantity Meters - Positive Displacement Meters- Nutating Disc Meter - Sliding Vane Type - Lobed impeller meter - Acoustic Measurements - Sound Level Meter - Frequency Analysis of Noise Signal -Sound Intensity Measurements - Microphones - Capacitor Type Electret Microphone - Photo conduction detector - Photo emission detector Strain gauges -Piezo Electric Crystal Type and application of piezo Electric, properties of piezoelectric, force measurement - Piezo Electric Transducers - Electrodynamic Type.

Outcome 5	Knowledge of identification, design and operation of instrumentation.	K1,K2,K3

Suggested Readings:

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

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

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

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

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

Online Resources

https://instrumentationtools.com/static-and-dynamic-characteristics-of-an-instrument/

https://circuitglobe.com/transducer.html

https://www.brainkart.com/article/Digital-Transducers_12767/

K1- Remember	K2- Understand	K3- Apply	K4- Analyze	K5-Evaluate	K6-Create

Course designed by Dr. M. Ramesh Prabhu

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	L(1)	L(1)	M(2)	S(3)	L(1)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	L(1)	L(1)	M(2)	M(2)	L(1)	S(3)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	S(3)	S(3)	M(2)	S(3)
W.Av	**3**	**2.6**	**2.8**	**2**	**1.6**	**1**	**2.2**	**2.8**	**1.6**	**3**

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	M(2)	M(2)	S(3)
CO3	S(3)	M(2)	M(2)	S(3)	S(3)
CO4	S(3)	S(3)	M(2)	S(3)	S(3)
CO5	S(3)	S(3)	M(2)	S(3)	S(3)
W.Av	**3**	**2.6**	**1.8**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course code: 521503	SOLAR ENERGY UTILIZATION	T	Credits: 4	Hours: 4

Unit – I		
Objective 1	To impart fundamental aspects of solar energy utilization to the students.	
Heat Transfer & Radiation Analysis: Conduction Convection and Radiation – Solar Radiation at the earth's surface – Determination of solar time – Solar energy measuring instruments.		
Outcome 1	List the measuring instruments for solar energy and its analysis	**K1**
Unit –II		
Objective 2	To know the most important factors that determines the cost-efficiency of a PV system	
Solar Collectors: Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.		
Outcome 2	Explain the principles of Solar radiation and their thermal performance	**K2**
Unit – III		
Objective 3	To understand the basic concepts in convection and radiation	
Solar Heaters: Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.		
Outcome 3	Discuss the concepts and principles of solar water heaters	**K6**
Unit –IV		
Objective 4	To acquire basic knowledge on solar energy conversion	
Solar Energy Conversion: Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo-electric conversion - Process flow of silicon solar cells- Different approaches on the process- texturization, diffusion, antireflective coatings, metallization.		
Outcome 4	Examine the energy conversion types in solar	**K4**
Unit – V		
Objective 5	To impart the knowledge of nanomaterials in energy storage devices	
Nanomaterials in Energy Storage Devices Batteries- Basic Battery Theory – Definitions of fundamental quantities - Classifications of Batteries- Advantages of Batteries for Bulk energy storage. Use of nanostructures and nanomaterials in fuel cell technology - High and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts - Use of nano technology in hydrogen production and storage.		
Objective 5	Identify the basic concepts of nanomaterials in batteries. Evaluate the different types of energy storage materials	**K3 & K5**

Textbooks and References:

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

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

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

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

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

Online Resources

https://www.bharathuniv.ac.in/page_images/pdf/courseware_eee/Notes/CE3/BEE043%20SOLAR%20ENERGY%20UTILIZATION.pdf
https://science.osti.gov/-/media/bes/pdf/reports/files/Basic_Research_Needs_for_Solar_Energy_Utilization_rpt.pdf

K1- Remember	K2- Understand	K3- Apply	K4- Analyze	K5-Evaluate	K6-Create

Course Designed by Dr.M.Sivakumar and Dr.R.Suba Devi

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	S(3)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)	S(3)
CO2	S(3)	L(1)	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	S(3)	M(2)
CO3	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO4	S(3)	L(1)	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	S(3)
W.Av	**3**	**1.4**	**2.8**	**2.6**	**3**	**3**	**2**	**1.8**	**3**	**2.4**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/POs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	S(3)	M(2)
CO2	S(3)	S(3)	L(1)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	S(3)	L(1)
CO5	M(2)	S(3)	M(2)	M(2)	S(3)
W.Av	**2.4**	**2.8**	**2.2**	**2.6**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

SPECIAL COURSE

Special Course	Course Code: 521106	SKILL DEVELOPMENT	T	Credit: 3	Hours:3

Unit I		
Objective 1	To provide fundamental principles and concepts in basic skills to the learners	
Personality Skill: Phonetics and Grammar- Listening, Conversation, Reading , Writing and Presentation - Group Discussion - Concept of Achievement-Resume Writing – Writing Formal Letters - Inter- personal relations - Deal with complex feelings - Confidence building- Body language- Conflict - types and resolutions - Emotional intelligence –Dressing- Do's and Don'ts -Ethics and Social Responsiveness-Attitude- Nature, Formation and Change- Decision Making - Team Work- Concept of Achievement.		
Outcome 1	Develop their skills in various aspects.	K2
Unit II		
Objective 2	To felicitate the learners to understand the technical skills	
Technical Skill – I (Electrical): Concepts of Electricity – Wiring, Earthing, Transformers and Motors- Wiring Diagram – Wiring for Household – Working of Electrical Appliances – Maintenance.		
Outcome 2	Improve their personality skill.	K4,K5
Unit III		
Objective 3	To exercise the communicative English to the students	
Technical Skill – II (Sensors & Automation): Transducers – Transistors – Photodiodes – Colour Codes – Colour Sensor – IR sensor – Digital Circuits – Hydraulic – Pneumatic – Valves and actuators – Scheme for Automation.		
Outcome 3	Learn to use physics ideas for variety of society applications.	K4
Unit IV		
Objective 4	To develop the personality skill to the students	
Technical Skill – III (Testing of Materials): Indentation Hardness testing- Meyer, Vicker and Knoop hardness- Meyer's law-Micro and Nano hardness testing- Etching- Wet and Dry- Non-destructive testing- Visual, Magnetic particle testing- Ultrasonic testing- Radiography- Acoustic emission testing- Eddy current testing.		
Outcome 4	Apply the technical skills in day to day life activities.	K2,K5
Unit V		
Objective 5	To provide the additional skill to the students	
Technical Skill – IV (Manufacturing of Materials): Phase Diagram- Thermal Processes- Annealing- Sintering- Quenching- Ball milling- 3D printing-Introduction- Continuous Filament Fabrication.		
Outcome 5	Face the people with good communicative English.	K2,K4

Suggested Readings:

Edward Russo & Paul, J. H. Schoemaker. (2002). *Winning Decisions*. Doubleday agency of Random House Inc.

Indrajit Bhattacharya. (2008). *An Approach to Communication Skills*. New Delhi: Dhanpat Rai & Co.

Ravi Aggarwal. (2008). *Communication Today & Tomorrow*. Jaipur: Sublime Publications.

Odian, *Principles of Polymerization*, Wiley Inerscience, John Wiley and Sons, 4th edition, 2005

V. Raghavan ,*Materials Science and Engineering: A first course* , PHI Learning Pvt.Ltd., 2004.

S. N. Avner, *An Introduction to Physical Metallurgy* –McGraw-Hill Book Company.

Online Resources					
https://www.zwickroell.com/industries/materials-testing/ https://www.coursera.org/articles/communication-skills https://idoc.pub/download/material-science-and-engineering-v-raghavanpdf-d477e0k10y42 https://www.edx.org/certificates/professional-certificate/ritx-communication-skills					
K1-Remember	**K2-Understand**	**K3-Apply**	**K4-Analyze**	**K5-Evaluate**	**K6-Create**
Course designed by Dr. M. Ramesh Prabhu					

Course Outcome Vs Program Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	M(2)	L(1)	L(1)	M(2)	L(1)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**3**	**2.8**	**2.8**	**2.4**	**2**	**2.6**	**2.4**	**3**	**3**

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**2.4**	**2.8**	**2.2**	**2.8**

S-Strong (3), M-Medium (2), L-Low (1)

SEMESTER - II

Core	Course code: 521201	QUANTUM MECHANICS - I	T	Credits: 4	Hours: 4

UNIT I

Objective 1	The main objective of this paper is to impart knowledge on the fundamental aspects of quantum mechanics to the students.	

Foundations: A brief review of foundations of quantum mechanics - Postulates of quantum mechanics – Physical interpretation of wave function and probability current density – Types of Operators – Eigen function and eigen values – Degeneracy – Expansion coefficient – Heisenberg Uncertainty principle and applications – Wave particle duality – Schrodinger equation – both time dependent and independent – Commutator – Expectation values – Stationary states and its properties – Admissibility condition on wave function – Ehrenfest's theorem –Relationship between space and momentum representation- Applications to one dimensional problems – Free particle.

Outcome 1	Remember the basic concepts of quantum mechanics and understand the necessity to learn the quantum mechanics	**K1&K2**

UNIT II

Objective 2	To know the brief review of foundations of quantum mechanics and to explain the operator formalization of quantum mechanics.	

Discrete Eigen Value Problem: Physical application of Schrodinger equation to one dimensional problem- Particle in a box –quantum mechanical tunneling –Rectangular potential barrier – Application of barrier penetration (α- decay) – Particle in infinitely deep potential well- Square potential barrier – Spherical symmetry systems – Particle in a central potential - Three dimensional harmonic oscillator – Rigid rotator – Application to diatomic molecules – Hydrogen atom – Separation of variables and solution of R,θ,Φ equation – Discussion of bound states and parity.

Outcome 2	Understands the propagation of a particle in a simple one dimensional potential and spherically symmetric potential.	**K2**

UNIT III

Objective 3	To evolve the eigen value problem based quantum theory and representation theories.	

Representation Theories: Vector representation of states – transformation of Hamiltonian with unitary matrix - Hilbert space – Normalized and Orthogonal wave function –Orthonormality- inner product and unitary spaces – completeness – closure - Dirac's ket and bra vectors – One dimentional Harmonic oscillator –Solution using ladder operator and matrix representation - Schrődinger, Heisenberg and interaction pictures.

Outcome 3	Apply various representation theories which help in the determination of the state vector at a previous or future time	**K3**

UNIT IV		
Objective 4	To provides accurate descriptions for appropriate problem solving techniques.	
Approximation Methods: Time independent Perturbation theory – Non degenerate case – Degenerate case – Energy correction – Zeeman effect without electron spin – Stark effect in hydrogen atom – Variation method – Ground state of helium atom – Ground state of Deuteron – W.K.B approximation – Quantisation rule – tunneling through a barrier – qualitative discussion of α –decay.		
Outcome 4	Apply perturbation theory and analyze required problem solving methods	**K3 & K4**
UNIT V		
Objective 5	To understand the nature and behavior of matter and energy on the atomic and subatomic level.	
Time Evolution: Time dependent perturbation theory – Constant perturbation – Transition probability – Fermi golden rule – Periodic perturbation – Harmonic perturbation – Adiabatic and sudden approximation. Spontaneous emission – Stimulated emission – Einstein's A & B coefficients – Semi – classical and quantum theory of radiation – Rayleigh and Raman scattering – Selection rules – forbidden transitions.		
Outcome 5	Understand the application of time dependent perturbation theory in subatomic and atomic level and evaluate its eigen value and eigen function	**K2,K3 &K5**

Suggested Readings:

S. Rajasekar, R.Velusamy *(2015), Quantum Mechanics I: The Fundamentals*, CRC Press.

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

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

A.B. Gupta *(2015) Foundation of Quantum Mechanics*, Books and Allied (P) Ltd., Kolkata.

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

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

VA Fock *(2018) Fundamentals of Quantum Mechanics*-, 2nd Ed.,

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

L. Schiff *(1968) Quantum Mechanics* , McGraw Hill .

SatyaPrakash and Swati Saliya, KedarNath Ram *(2010) Quantum Mechanics* , Nath& Co., New Delhi.

Online Resources

https://www.lancaster.ac.uk/staff/schomeru/lecturenotes/Quantum%20Mechanics/index.html

https://www2.ph.ed.ac.uk/~ldeldebb/docs/QM/lect17.pdf

https://users.physics.ox.ac.uk/~palmerc/FQMfiles/lectures_1pp.pdf

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Suba Devi

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	L(1)	M(2)	S(3)	L(1)	L(1)	S(3)	L(1)	M(2)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO3	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	L(1)	M(2)	L(1)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	L(1)	S(3)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	L(1)	S(3)	L(1)	M(2)
W.Av.	**3**	**2.6**	**2.6**	**2.6**	**2.2**	**1**	**1.2**	**2.8**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	L(1)	L(1)	M(2)
CO2	S(3)	S(3)	M(2)	L(1)	M(2)
CO3	S(3)	M(2)	M(2)	L(1)	M(2)
CO4	S(3)	S(3)	M(2)	L(1)	M(2)
CO5	S(3)	S(3)	M(2)	L(1)	M(2)
W.Av	**3**	**2.4**	**1.8**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521202	MATHEMATICAL PHYSICS – II	T	Credits: 4	Hours: 4

UNIT I		
Objective 1	To elaborate the information on complex variable.	
Complex Variable: Complex functions and variables – Analytic function - Cauchy-Riemann Conditions – Cauchy's fundamental theorem - Cauchy's Integral Formula – Taylor and Laurent Expansions – Mapping, Conformal Mapping - Singularities – Calculus of residues and Contour integrals – Cauchy's residue theorem.		
Outcome 1	Student will be able to apply complex variables to solve problems with complex functions and contour integrals	K3,K4
UNIT II		
Objective 2	To understand the applications of partial differential equations.	
Application of Partial Differential Equations (PDEs) and Orthogonal Functions: Introduction of PDE **-** Method of separation of variables – Heat equation (one and two dimensional) – Laplace and Poisson equation - Wave equation (one and two dimensional) – Green's Function – Sturm-Liouville theory – Gram-Schmidt Orthogonalization process.		
Outcome 2	Student will be able to find solution to partial differential equations by separating the variables.	K2,K4,K5
UNIT III		
Objective 3	To elaborate the information on special functions such as Legendre and Bessel differential equations.	
Special Functions I: Gamma and Beta function – Relation between beta and gamma function - Legendre's differential equation: Legendre polynomial - Generating function - Recurrence relations - Rodrigue's formula – Orthogonality relation; Bessel's differential equation: Bessel polynomial - Generating function - Recurrence relations - Rodrigue's formula – Orthogonality relation.		
Outcome 3	Student will be able to illustrate the properties of beta and gamma functions and Legendre and Bessel differential equations.	K2,K3,
UNIT IV		
Objective 4	To know about the mathematical aspects of Hermite and Laguerre functions.	
Special Functions II: Hermite differential equation: Hermite polynomial - Generating function - Recurrence relations – Rodrigue's formula – Orthogonality relation; Laguerre differential equation: Laguerre polynomial - Generating function - Recurrence relations - Rodrigue's formula – Orthogonality relation.		
Outcome 4	Student will be able to find solution corresponding to Hermite and Laguerre differential equations.	K2,K4,K5
UNIT V		
Objective 5	To know about the concepts of group theory in mathematical physics.	
Group Theory: Definition of group – Sub groups - Cyclic groups and abelian groups - Homomorphism and Isomorphism of groups – Classes - Symmetry operations and symmetry elements – Representations of groups: Reducible and Irreducible – Proof of the Orthogonality theorem – Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules).		
Outcome 5	Student will be able to learn about group theory which is useful for crystallographical concepts.	K2,K4

Suggested Readings:

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

Kreyszig, E. (1983). *Advanced Engineering Mathematics*. Wiley Eastern.

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

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

Albert Cotton, F. (2009). *Chemical Applications of Group Theory*. 3rd Edition. Wiley India (P.) Ltd.

Online Resources

https://books.google.com/books/about/Mathematical_Physics.html?id=IzJdPqEn6VYC#v=onepage&q&f=false

https://www.schandpublishing.com/books/higher-education/physics/mathematical-physics/9789355012531/

https://www.cambridge.org/highereducation/books/mathematical-methods-for-physics-and-engineering/FC466374D5B94E86D969100070CA6483#overview

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Sivakumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**3**	**2.4**	**3**	**2.4**	**2**	**2.6**	**3**	**2.2**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	S(3)	M(2)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	S(3)
W.Av	**3**	**3**	**2.4**	**2**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

II Semester					
Core	**Course code: 521203**	**ELECTROMAGNETIC THEORY**	**T**	**Credits: 4**	**Hours: 4**

UNIT I		
Objective 1	To introduce basic fundamental concepts related to electromagnetic theory.	
Electrostatics, Magnetostatics and Electromotive Force: Columb's law - Gauss's law in differential form- Applications of Gauss's law - Poisson's equation - Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – Dielectrics and Conductors– Induced dipoles – Gauss's Law in the presence of dielectrics. Lorentz force– Biot-Savart Law – divergence and curl of B –Ampere's Theorem– Electromagnetic induction - Comparison of magnetostatics and electrostatics – Magnetic vector potential. Ohm's Law – electromotive force - Faraday's Law – induced electric field – inductance -energy in magnetic field.		
Outcome 1	Remember and understand the fundamentals of electro and magnetostatics using Ampere, Gauss and Ohm's Law.	K1
UNIT II		
Objective 2	To impart knowledge on the basics of electric and magnetic fields.	
Maxwell's Equation and Propagation of Electromagnetic Waves: Maxwell's equations – Poynting theorem – Wave equation in terms of scalar and vector potential – Transverse nature of electromagnetic wave- Conservation of energy and momentum – Displacement current from continuity equation. Propagation of plane electromagnetic waves in (a) free space, (b) Isotropic and Anisotropic non-conducting medium and (c) conducting medium-skin depth- Polarization of electromagnetic waves.		
Outcome 2	Clarify the relations using Maxwell's equation, free space, isotropic and anisotropic medium.	K2
UNIT III		
Objective 3	To develop a solid foundation in the analysis and application of electromagnetic fields, Maxwell's equations and Poynting theorem.	
Applications of Electromagnetic Waves: Boundary conditions at the surface of discontinuity - Reflection and refraction of electromagnetic waves at the interface of non-conducting media –Fresnel's equations – Reflection and transmission coefficients at the interface between two dielectric media -Brewster's law and degree of polarization -Total internal reflection.		
Outcome 3	Evaluate the fields at the boundaries of the medium and its applications.	K6
UNIT IV		
Objective 4	To become familiar with propagation of signal through transmission lines.	
Dispersion and Scattering of EM Waves: Normal and Anomalous dispersion – Dispersion in Gases – Experimental demonstration of Anomalous dispersion in gases- Solids and Liquids – Clasusius Mossotti relation – Lorentz formula – scattering and scattering parameters - Theory of scattering of e-m waves – Polarization of scattered light – Coherence and incoherence of scattered light.		
Outcome 4	Deduce the coherence and incoherence scattering of light and its applications.	K4

UNIT V		
Objective 5	To acquire the knowledge about the plasma physics and waves.	
Plasma Physics: Introduction - Conditions for plasma existence – Occurrence of plasma – charged particles in uniform constant electric field, in homogeneous magnetic fields, simultaneous homogeneous electric and magnetic fields, in nonhomogeneous magnetic fields – Magnetohydrodynamics – Magnetic confinement -Pinch Effect–Instabilities -Plasma waves.		
Outcome 5	Apply the dynamics, effect of homogeneous, non-homogeneous fields and occurrence of plasma wave theory.	K3
	Explain the generation of microwaves such as Klystron, and Magnetron	K5

Suggested Readings:

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

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

Akira Ishimaru. (2017). *Electromagnetic wave propagation*, Radiation, and Scattering. IEEE Press – 2ndEdn.

Jian-Ming Jin. (2015). *Theory and Computation of Electromagnetic Fields*. John Wiley & Sons.

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

Online Resources

https://www.plasma-universe.com/pinch/

https://www.brown.edu/research/labs/mittleman/sites/brown.edu.research.labs.mittleman/files/uploads/lecture13_0.pdf

https://pubs.aip.org/aip/adv/article/7/1/015018/240342/On-the-propagation-of-electromagnetic-waves-in

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.M.Sivakumar

Course Outcome Vs Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	M(2)	S(3)	L(1)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	M(2)	L(1)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	L(1)	L(1)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)
CO5	L(1)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
W.Av	**2.4**	**2.2**	**1.4**	**2.8**	**2.6**	**2.6**	**2.4**	**2.4**	**2.8**	**2.4**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	M(2)	S(3)	S(3)	M(2)
CO2	L(1)	S(3)	L(1)	M(2)	S(3)
CO3	M(2)	S(3)	S(3)	M(2)	M(2)
CO4	L(1)	S(3)	M(2)	S(3)	S(3)
CO5	M(2)	S(3)	S(3)	M(2)	S(3)
W.Av	**1.4**	**2.8**	**2.4**	**2.4**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course Code: 521204	ADVANCED PHYSICS LABORATORY	P	Credits: 5	Hours: 10
Objectives		➢ The main objective of this practical paper is to exercise the hands on training in various advanced analytical experiments to the students. ➢ To give basic knowledge on spectrometer and microscope experiments to the students. ➢ To give a basic knowledge on Young's modulus experiment to the students. ➢ To find the susceptibility of solid and liquid samples. ➢ To give the basic knowledge on crystal growth using various experiments like powder photograph, Pockels effect etc.,			
		(Any Fifteen of the following) 1. Alignment of Michelson's Interferometer using He-Ne laser to observe concentric circular fringes 2. Measurement of the wavelength of He-Ne Laser and Na lamp using circular fringes using Michelson Interferometer. 3. Study of fringes of equal inclination and equal thickness using Na lamp using Michelson Interferometer. 4. Ultrasonic Interferometer – calculate the velocity of ultrasonic sound through different liquid media 5. X-ray Powder diffraction - Determination of cell parameter and indexing lattice planes 6. Hall Effect – Mobility and Hall constant determination. 7. Susceptibility by Guoy's method. 8. Susceptibility by Quincke's method. 9. Reflection grating spectrometer. 10. Polarizability of liquids – Hollow prism – Spectrometer. 11. Young's modulus – Cornu's method. 12. Thermal expansion using optical air wedge. 13. Ultrasonic interferometer-calculate the adiabatic compressibility of the given liquid 14. Electron spin resonance spectrometer. 15. Magnetic Hysteresis loop tracer. 16. Determination of Plank's constant using photocell apparatus. 17. e/m by Millikan's oil drop method. 18. e/m by Thompson's oil drop method. 19. Pockels effect. 20. G.M. Counter - probability, Absorption measurements, half life.			

Outcomes	On successful completion of the course, a student will be able to ❖ Understand the basic principles of advanced physics experiments. ❖ Understand simple concepts to demonstrate an experiment. ❖ Understand the concepts of Plank's constant using photocell apparatus ❖ Demonstrate the Millikan's/Thompson's oil drop method ❖ Demonstrate magnetic hysteresis loop tracer

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Suba Devi, Dr. M. Ramesh Prabhu, Dr. R. Yuvakkumar

SEMESTER – II

DSE	Course Code: 521504	MODERN OPTICS	T	Credits: 4	Hours: 4

Unit –I

Objective 1	To motivate light as an electromagnetic field as it arises from first principles in Maxwell's equations	
Basic Concept of Optics and Optical Materials: Classification of optical processes, optical coefficients, complex refractive index and dielectric constant – Optical materials : Crystalline insulators and semiconductor, glasses, metal, molecular materials, doped glass and insulator characteristics – Optical Physics in the Solid state, crystal symmetry, electronic bands, vibronic band, the density of state, delocalized states and collective excitation – Light propagation: Propagation of light in dense optical medium - Atomic oscillator - Vibration oscillator - Free electron oscillation - The Kramers–Kronig relationship - Dispersion - Optical anisotropy – Birefringence - Matrix representation of polarization, Jones vector, Jones matrices, Jones calculus, orthogonal polarization - Reflection and refraction at a plane boundary – Fresnel's equations.		
Outcome 1	Understanding the physical aspects of polarization and diffraction and acquire an introductory knowledge of non-linear optics	K1,K2

Unit – II

Objective 2	To study the reflection and transmission of light at a dielectric surface, leading to the Fresnel equations	
Excitons: Basic concept - Free excitons in external electric and magnetic fields - Free Excitions at light densities - Frenkel excitons - Luminescence: Light emission in solids - Interband luminescence - Direct and indirect gap materials - Photoluminescence: Excitation and relaxation, degeneracy - Photoluminescence spectroscopy - Electroluminescence: General Principles of electroluminescence - Light emitting diodes, Diode laser - Spectral scanning and Separation by optical property - Applications in bioimaging.		
Outcome 2	Remembering the concepts of exciton and analyzing the various luminous spectra	K1

Unit – III

Objective 3	To study the polaritons and polarons using quantum theory	
Electromagnetism of Light Propagation: Electromagnetism in dielectrics – Electromagnetic fields and Maxwell equation – Electromagnetic waves – Quantum theory of radiative absorption and emission – Einstein coefficients – Quantum transition rates, selection rules – Basic concept of phonons – Polaritons and polarons.		
Outcome 3	Utilization of first principles in Maxwell's equations.	K1,K3

Unit – IV

Objective 4	To grasp the knowledge about nonlinear optics	
Nonlinear Optics: Physical origin of optical nonlinearities - Non resonant and resonant nonlinearities - Second order nonlinearities - Non liner frequency mixing - Crystal symmetry - Phase matching - Third order non linear media - Harmonic generation, mixing and parametric effects - Multiphonon processes - Two-photon absorption - Saturated absorption - Spectroscopy Rayleigh, and Raman scattering - Stimulated Raman effect - Hyper Raman effect - Coherent Antistoke Raman scattering - Self-focusing and self-phase modulation - Self-induced transparency - Solitons (Elementary ideas).		
Outcome 4	Constructing Knowledge about reflection and transmission of light at a dielectric surface, leading to the Fresnel equations.	K1

Unit – V		
Objective 5	To understand the optical design, Fourier optics and holography	
Optical Design, Fourier Optics & Holography: Revision of geometrical optics - Fourier transforms - Impulse response transfer function - Scalar diffraction, spatial and temporal coherence - Image forming systems - Coherent and incoherent imaging - Spatial filtering - Holography (Fresnel, Fraunhofer, Fourier) - Holographic techniques and applications - Fourier transforming property of thin lens - Optical communication sources (LED, Lasers etc.) and detectors and optical, electro- and magneto-optic effects - Laser-matter interaction.		
Outcome 5	Observation about holographic techniques and gaining knowledge about optical communication sources	K2,K3,K5

Suggested Readings:

Christoph Gerhard (2017) *Optics Manufacturing: Components and Systems*, 1st Edition, Christoph

Daniel Malacara Hernandez (2017) *Fundamentals and Basic Optical Instruments*, 1st Edition, CRC Press.Gerhard, CTC Press.

Izuka, K. (2008) *Engineering Optics*, Springer Verlag.

Roshan Aggarwal, L. (2018) *Introduction to Optical Components* 1st Edition, CRC Press.

Yu Kulchin, N. (2018) *Modern Optics and Photonics of Nano- and Microsystems*, 1st Edition, CRC Press.

Online Resources

https://www.physics.utoronto.ca/~phy485/LaserPhysics/dloads/ModOptNotes2010.pdf
http://lib.ysu.am/disciplines_bk/99750316d428e67f59b44ba674d76f0e.pdf

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.N.Anandhan

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	S(3)	S(3)	L(1)	M(2)	M(2)	M(2)	S(3)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)	L(1)	L(1)	M(2)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**2.6**	**2.6**	**2.6**	**3**	**1.6**	**2.4**	**2.6**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	L(1)
CO4	S(3)	S(3)	M(2)	S(3)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**2.6**	**2.8**	**2.6**	**1.8**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course Code: 521505	MATERIALS AND CHARACTERIZATION	T	Credits: 4	Hours: 4

Unit -I

Objective 1	To impart knowledge about crystal structures, various crystal growth methods and some of essential characterization techniques	
Crystal Growth: Importance of crystal growth – Classification of crystal growth methods - Crystal symmetry – Solution – Solubility, supersolubility – Expression of supersaturation – Miers T-C diagram – Nucleation - Low temperature solution growth: Slow cooling, solvent evaporation and temperature gradient methods – High temperature solution growth: Flux growth – Principles of flux growth – Choice of flux – Hydrothermal growth - Melt Growth: Bridgman technique – Czochralski technique.		
Outcome 1	Remember, understand and analyze crystal symmetry, nucleation, Bravais lattice, Bragg's law and Miers TC diagram, solution, gel, melt and vapor growth techniques.	K1, K2, K3, K4, K6

Unit - II

Objective 2	To understand the basic principles, methods and techniques of nanomaterials	
Nanomaterials: Nanoscience and nanotechnology – Need for nano –Top down and Bottom up approaches – Preparation: Polyol route – Colloidal precipitation - Types of nanomaterials: One dimensional (1D) – Two dimensional (2D) - Three dimensional (3D) nanostructured materials - Special Nanostructures: Quantum dots – Quantum wire - Quantum well - Magnetic NPs - Carbon Nanomaterials – Nanocomposites – ZnO - TiO_2 - MoS_2 – Excitation confinement in Quantum Dots.		
Outcome 2	Remember, understand and analyze the basics and importance of nanoscience and nanotechnology	K1, K2, K3, K4, K6

Unit - III

Objective 3	To study the importance and methodology of thin film deposition techniques	
Thin Film deposition Techniques: Physical Vapor Deposition (PVD) Techniques - Evaporation: Thermal evaporation, Electron beam evaporation, Laser ablation, and Cathode arc deposition. Sputtering: DC/RF Magnetron sputtering, Reactive Sputtering and Ion beam sputtering - Chemical Vapor Deposition (CVD) Techniques – APCVD, MOCVD, Spin coating and Spray Pyrolysis.		
Outcome 3	Remember, understand and analyze the basics and importance of thin film deposition techniques.	K1, K2, K3, K4, K6

Unit IV

Objective 4	To study the basic principles, methods and applications of solid state ionics	
Solid State Ionics: Theories and models of ionic conduction - phenomenological models, free volume theory - Superionic materials classification-Crystalline anionic and cationic conductors mixed ionic and electronic conductors, structural factors responsible for high ionic conductivity - Concepts and feasibility of ion conducting polymer nanocomposites and nanocrystalline ceramics - Electrolytes: Liquid Electrolytes-Polymeric electrolytes: molten salt –Lithium transport in lithium batteries-Polymer electrolytes in lithium batteries.		
Outcome 4	Remember, understand and analyze the basics and importance of solid state ionics.	K1, K2, K3, K4, K6

Unit V		
Objective 5	To provide a basic understanding with case studies on different surface non-destructive techniques and apply them for inspecting materials in accordance with industry specifications and standards	

Non-destructive Testing:

Surface Nde Methods: Liquid Penetrant Testing – Principles, types, advantages and limitations of various methods - Thermography Testing Methods: Thermography- Principles, Contact and non contact inspection methods,– infrared radiation and infrared detectors, Instrumentations and methods, Applications - Ultrasonic Testing (UT) and Acoustic Emission (AE): Ultrasonic Testing-Principle, pulse-echo method, Time of Flight Diffraction - Acoustic Emission Technique – Principle, AE parameters, Applications.

Outcome 5	Remember, understand, analyze and evaluate the basic principles and properties of non-destructive techniques.	K1, K2, K4, K5

Suggested Readings:

J.C. Brice (1986), *Crystal Growth Processes*, John Wiley and Sons, New York.

Lusia Filipponian Duncan Sutherland (2013), Nanotechnologies: *Principles, Applications, Implications and Hands-on Activities (ISBN 978 -92 -79 -21437 -0)* European Commission, B-1049 Brussels.

Heavens O S (1955), *"Thin Film Physics"*, Butter worths scientific publications.

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

Charles, J. Hellier (2001), *Handbook of Nondestructive evaluation*, McGraw Hill, New York.

Online Resources

https://archive.nptel.ac.in/courses/113/106/113106034/

https://onlinecourses.nptel.ac.in/noc22_mm14/preview

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.S.Sudhahar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	S(3)
CO2	S(3)	M(2)	L(1)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO3	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)
CO5	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)
W.Av	**3**	**2.2**	**1.8**	**2.6**	**2**	**2.4**	**2.6**	**2**	**1.4**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	M(2)	S(3)	S(3)
W.Av	**3**	**2.8**	**1.2**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course code: 521506	QUANTUM CHEMISTRY	T	Credits: 4	Hours: 4
Unit I					
Objective 1	To impart basic knowledge about quantum chemistry to the students				
Ab-Initio Methods: Accuracy and scaling- Classes of methods – Hartree-Fock (HF) - Post HF methods - Multi-configurational self-consistent field (MCSCF) - Density functional theory - Variational formulation- LDA					
Outcome 1	Describe the fundamentals of Ab-initio methods like multi-configurational self-consistent field, Hartee- Fock etc.				K1
Unit II					
Objective 2	To study the basic data recognizing and accounting for uncertainties				
Operator Concepts: Operators-second, third, fourth postulates of QM, derivative of an operator with respect to time - Eigen functions and position operator-Dirac Delta function- projection operator-density operator and density matrix.					
Outcome 2	Clarify the relations using Operators and second, third, fourth postulates of QM.				K2
Unit III					
Objective 3	To understand the basic knowledge on simple spectroscopic applications				
Simple Spectroscopic Applications: Quantum mechanical picture of chemical bonding – Symmetry aspects of molecular orbital – Valence bond – M-O bond theories – Comparison – Heitler – London theory for H_2 molecules.					
Outcome 3	Evaluate the molecular orbital, valence bond, and M-O bond theories.				K6
Unit V					
Objective 4	To study the molecular orbital theory				
Molecular Orbital Theory: LCAO approximation- The Huckle approximation – Hund's Rule and Exclusion principle-Bonding character of Orbitals- Hybridization – Molecular orbital of CH_4, C_2H_4, C_2H_2, Benzene, Water-Hydrogen bonding.					
Outcome 4	Deduce the Huckle approximation, Hund's rule and exclusion principle.				K4
Unit V					
Objective 5	To impart basic knowledge on symmetry, point groups and their properties				
Symmetry: Types of symmetry operations, point groups-Properties-Determination and representation-Character table-Symmetry properties and quantum mechanics.					
Outcome 5	Apply the approximation concepts for molecular orbital of CH_4, C_2H_4, C_2H_2, Benzene, and water-hydrogen bonding. Explain the types of symmetry operators and point groups with symmetry properties.				K3 & K5

Suggested Readings:

Albert Cotton, F. (2009). *Chemical applications of Group Theory* (3rd Edition). Wiley India (P.) Ltd. 3rd Edn. Reprint.

Chandra, A. K. (2012). *Introductory Quantum Chemistry (*4th Edn). Tata McGraw Hill, 9th reprint.

Donald A Mc Quarrie, (2016). *Quantum Chemistry.* Viva student edition.

Ira N. Levine. (2014). *Quantum Chemistry*. Pearson.

Prasad, R. K. (2007). *Quantum Chemistry* (3rd Edn). New Delhi: New Age International Publishers.

Online Resources

https://chem.libretexts.org/Workbench/Username%3A_marzluff@grinnell.edu/Unit_1%3A_Quantum_Chemistry%2C_Spectroscopy_and_Bonding/1%3A_Quantum_Mechanics_and_Spectroscopy

https://pressbooks.online.ucf.edu/chemistryfundamentals/chapter/molecular-orbital-theory/

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Suba Devi

Course Outcome Vs Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	M(2)	L(1)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	L(1)	S(3)	L(1)	S(3)	M(2)
CO4	S(3)	L(1)	S(3)	M(2)	M(2)	S(3)	M(2)	L(1)	S(3)	S(3)
CO5	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	L(1)
W.Av.	**3**	**2**	**2.6**	**2.4**	**2.2**	**2.2**	**2.6**	**1.6**	**2.6**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	S(3)	S(3)	L(1)
CO2	M(2)	S(3)	L(1)	M(2)	M(2)
CO3	S(3)	L(1)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	S(3)	S(3)	S(3)
W.Av	**2.6**	**2.4**	**2.4**	**2.6**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

SEMESTER – III

Core	Course code: 521301	ADVANCED MOLECULAR SPECTROSCOPY	T	Credits: 4	Hours: 4

UNIT I		
Objective 1	The overall goal of this course is to show how basic concepts of quantum mechanics can be utilized to quantitatively explain atomic and molecular spectra.	
Microwave Spectroscopy: Approximation Theory (Elementary idea's only) Born-Oppenheimer approximation. Rotation of Molecules -Rotational energy of a diatomic molecule – Rigid and non-rigid rotators – isotopic substitution – Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra -Stark effect – its importance in microwave spectroscopy – Rotational spectra of diatomic – polyatomic molecules – pure rotational Raman spectra –symmetric top molecules- Molecular structure – using IR & Raman spectroscopy.		
Outcome 1	Understanding the rotational spectra of molecules with examples of different molecules.	**K2**
UNIT II		
Objective 2	To comprehend the rotational spectroscopy.	
Infrared Spectroscopy: Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules-Franck-Condon principle – intensity distribution – portrait parabolae – disassociation - predisassociation – mutual exclusion principle. Normal modes of vibration in crystal-Interpretation of vibrational spectra-Group frequencies. IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications. Overtone and Combination Bands, Concept of multiple potential minima and inversion of NH_3.		
Outcome 2	Demonstrating the application of IR spectra using diatomic and polyatomic molecules and learn the tentative frequency assignments with proper frequency nomenclature.	**K5,K6**
UNIT III		
Objective 3	To learn about the vibrational spectroscopy and SERS.	
Raman Spectroscopy Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra. Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering. Photo acoustic Raman Scattering-Multi photon spectroscopy-Two photon absorption- Multiphoton absorption.		
Outcome 3	Employing Laser Raman and SERS techniques for molecules. Applying the Raman spectrometry for Photon absorptions.	**K3**

UNIT IV		
Objective 4	To understand the electronic spectroscopy and NMR.	
Resonance Spectroscopy: Basic principles – Quantum theory of NMR - magnetic resonance – relaxation processes- Bloch equations – chemical shifts. Dipole –Dipole interaction and spin lattice interaction- spin-spin coupling - Spectra and molecular structure – Fourier Transform NMR –Instrumentation – Applications. Basic principles – Quantum theory - g-factor – Nuclear Interaction and Hyperfine structure - Relaxation effects - Hyperfine interaction – line widths-ESR -NQR (principle only) spectrometer – Instrumentation – applications.		
Outcome 4	Describing the theory of resonance spectrometry with basic concepts, working of instrument and applications of resonance spectrometry.	**K1,K4**
UNIT V		
Objective 5	To give advanced knowledge about the interactions of EM radiation with matter and their applications in spectroscopy like IR, RAMAN, NMR, ESR, NQR and Mossbauer.	
Mossbauer Spectroscopy: Basic theory - Nuclear Electric quadrupole interaction – Energy levels – Transition frequency – Excitation and Detection – Effect of magnetic field – Instrumentation – applications. Mossbauer effect - recoilless emission and absorption - hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions – ` Instrumentation – applications – Electronic structure – molecular structure – crystal symmetry and molecular structures.		
Outcome 5	Deliberating influence of magnetic field on nuclear interactions and electronic spin resonance in Mossbauer spectrometry. Study the instrumentation of Mossbauer Spectroscopy and it's application in –	**K2,K3**

Suggested Readings:

Chaudhuri. Mekkaden, R.K, Raveendran, M.V, Narayan, A.V. (2010) *Recent Advances in Spectroscopy (Theoretical, Astrophysical and Experimental Perspectives)*, (Eds.), Springer-Verlag, Berlin.

Gunter Gauglitz, David, S. (2014). *Handbook of Spectroscopy*, 1- 4 Volume, 2nd Edition, John Wiley & Sons, Inc.

Rita Kakkar, (2015). *Atomic and Molecular Spectroscopy Basic Concepts and Applications*, Cambridge University Press.

Roderick Wasylishen, E. (2012) *NMR of Quadrupolar Nuclei in Solid Materials*, Ist Edition, Wiley.

Shu-Lin Zhang, (2012) *Raman Spectroscopy and its Application in Nanostructures*, John Wiley & Sons, Inc.

Online Resources

https://physicaeducator.files.wordpress.com/2018/02/barrow-introductiontomolecularspectroscopy.pdf

https://www.rnlkwc.ac.in/pdf/study-material/chemistry/Spectroscopy.pdf

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.N.Anandhan

Course Outcome Vs Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)	L(1)	M(2)	S(3)	S(3)	M(2)
CO4	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
W.Av	**3**	**2.4**	**2.6**	**1.8**	**2**	**1.4**	**2.2**	**2.4**	**2.4**	**2.4**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	L(1)	S(3)	S(3)
W.Av	**3**	**3**	**1**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521302	QUANTUM MECHANICS – II	T	Credits: 4	Hours: 4

UNIT I

Objective 1	The main objective of this paper is to impart in depth knowledge on the advanced theories of quantum mechanics to the students

Theory of Angular Momentum: Angular momentum of a system of particles –Angular momentum operators– Commutation relations –eigen value spectrum- Commutation relations of J_z, J_+, J_- – Eigen values of J^2 and J_z–Matrix representation of angular momentum –Spin Angular momentum – Spin ½, spin 1 -Pauli spin matrices and its properties –Addition of two angular momenta – Clebsch Gordon coefficients for j = ½ system only.

Outcome 1	Remember the concept and importance of angular momentum and represent it in operator form.	**K1**

UNIT II

Objective 2	This paper gives an introduction to theory of angular momentum, although there is certain microscopic system it directly applies to.

Self Consistent Field: Identical particles – Particle exchange Operator – Symmetric and anti-symmetric wave functions – Exchange degeneracy – Pauli's exclusion principle–spin statistics connection- Central field approximation –Thomson-Fermi Model of the Atom –Hartree equation – Hartree-Fock Equation –Classification of elements in Periodic Table - Alkali atoms Doublet intensity and doublet separation.

Outcome 2	Remember the nature of identical particles and to apply the approximation methods in central field approximation	**K1 & K3**

UNIT III

Objective 3	The purpose of this paper is to demonstrate how similar certain results in quantum mechanics and its relativistic particles are.

Relativistic Quantum Mechanics: Schrodinger relativistic equation–Klein-Gordan equation- charge and current densities – Interaction with electromagnetic field–Application to Hydrogen atom – Dirac's Relativistic Hamiltonian – Plane wave solution–Dirac matrices and properties- Covariant form of Dirac Equation – Negative energy states –prediction of electron spin and its relation with magnetic moment -Spin-orbit interaction –Zitterbewegung.

Outcome 3	Understand the relativistic theory in quantum mechanics and to	**K2 & K4**

UNIT IV		
Objective 4	It describes the principles of scattering theory.	
Elements of Field Quantization: Relativity and notations- Infinitesimal transformation – Natural units -Quantization of wave fields – Classical approach - Lagrangian and Hamiltonian equation – Elements of field quantization – Quantization of non-relativistic field –Creation, destruction and Number Operators – Anticommutation relations – Quantization of relativistic field- Klein Gordon field- Dirac Field – Quantization of Electromagnetic field.		
Outcome 4	Understand the elements required for field quantisation and to apply it to quantize relativistic fields	**K2 & K3**
UNIT V		
Objective 5	It provides information about relativistic equation which accounts for electron spin, electron magnetic moment and the concept of hole.	
Scattering Theory: Scattering cross section – Scattering amplitude –Kinematics of scattering process - Laboratory and center of mass reference systems – Green's function – Born approximation and its validity – Scattering by screened Coulomb potential. Partial wave analysis: Asymptotic behaviour – Scattering amplitude in terms of phase shifts - Optical theorem – Scattering length and effective range theory of low energy scattering –Resonant scattering –Ramsauer Townsend effect – Scattering by square well potential - Scattering of identical particles		
Outcome 5	Understand the particles in atomic level during scattering and applying the theory to analyse the nature of phase shift	**K2,K3 &K4**

Suggested Readings:

S. Rajasekar, R.Velusamy *(2015), Quantum Mechanics I: The Fundamentals*, CRC Press.

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

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

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

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

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

VA Fock *(2018) Fundamentals of Quantum Mechanics*-, 2nd Ed.,

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

L. Schiff *(1968) Quantum Mechanics* , McGraw Hill .

SatyaPrakash and Swati Saliya, KedarNath Ram *(2010) Quantum Mechanics* , Nath& Co., New Delhi.

Online Resources					
https://www.lancaster.ac.uk/staff/schomeru/lecturenotes/Quantum%20Mechanics/index.html https://quantummechanics.ucsd.edu/ph130a/130_notes/node1.html					
K1-Remember	**K2-Understand**	**K3-Apply**	**K4-Analyze**	**K5-Evaluate**	**K6-Create**
Course designed by Dr.R.Suba Devi					

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	L(1)	M(2)	L(1)	M(2)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)	M(2)	L(1)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	M(2)
W.Av	**3**	**2.6**	**2.6**	**2.6**	**2.2**	**1**	**1.8**	**2.6**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	L(1)	L(1)	M(2)
CO2	S(3)	S(3)	M(2)	L(1)	M(2)
CO3	S(3)	M(2)	S(3)	L(1)	M(2)
CO4	S(3)	S(3)	S(3)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	L(1)	M(2)
W.Av	**3**	**2.4**	**2.4**	**1**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521303	CONDENSED MATTER PHYSICS - I	T	Credits: 4	Hours: 4

UNIT I		
Objective 1	To give strong foundation in crystal physics.	
Crystal Physics: Crystal Structure - Symmetry and Physical Properties of Crystals – Point groups, Bravais lattices, Space groups, Crystal lattice and Crystal structure, Symmetry elements, Crystal systems – Type of lattices –Lattice representation - Simple symmetry operations - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.		
Outcome 1	Understand basic crystal physics and material structural properties.	K1, K2
UNIT II		
Objective 2	The conceptual understanding of solid state physics development with appropriate theoretical background.	
Crystal Diffraction: X-rays and their generation - Moseley's law – Absorption of X-rays –X-ray diffraction – Reciprocal lattice – Reciprocal lattice to SC, BCC and FCC crystals- Important properties of the Reciprocal lattice – Diffraction Intensity - The Powder method – Powder Diffractometry - The Laue method -The Rotating Crystal method - Neutron Diffraction - Electron diffraction Applications.		
Outcome 2	Remember crystal diffraction methods and mechanism in detail.	K2
UNIT III		
Objective 3	Understanding the content of crystal imperfections and ordered phases of matter.	
Crystal Imperfections and Ordered Phases of Matter: Defects and dislocations in crystals – Classification of Defects - Point imperfections – Concentrations of Vacancy, Frenkel and Schottky imperfections – Interstitial atom – Substitutional defects - Line imperfections – Edge dislocation - Screw dislocation (Burgers Vector) – Presence of dislocation – Plane defects (Surface/boundary imperfections) - Grain boundary, twin boundary and stacking fault. Ordered phases of matter: Translational and orientation order - Kinds of liquid crystalline order - Quasi crystals - Superfluidity.		
Outcome 3	Conceptual understanding of crystal defects with appropriate theory.	K1, K2
UNIT IV		
Objective 4	To impart knowledge about crystalline structures, lattice vibrations, to the students.	
Lattice Dynamics: Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum. Heat Capacity: Specific heat capacity of solids – Dulong and Petit's law - Vibrational modes - Einstein model - Density of modes in one and three dimensions - Debye Model of heat capacity.		
Outcome 4	Analyze and describe the theoretical background of lattice dynamics and heat capacity.	K4, K5

UNIT V		
Objective 5	To understand theory and to do experimental work.	
Theory of Electrons: Free electron theory, Band structure of solids, metals, insulators and semiconductors – Density of States - Hall effect and magneto resistance – Wiedemann – Franz law - Bloch functions - Bloch theorem - Kronig – Penney model - Limitations of K-P model.		
Outcome 5	Distinguish conductors and semiconductors on basis of band theory and to estimate hall effect.	K5, K6

Suggested Readings:

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

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

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

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

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

Online Resources

https://archive.nptel.ac.in/courses/115/106/115106061/

https://onlinecourses.nptel.ac.in/noc22_ph09/preview

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by Dr. R. Yuvakkumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO4	S(3)	M(2)	L(1)	M(2)	M(2)	L(1)	M(2)	M(2)	M(2)	L(1)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)
W.Av	**3**	**2**	**2.6**	**2.6**	**2.8**	**1.8**	**2.8**	**2**	**2.6**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)
W.Av	**3**	**2.8**	**2.8**	**2.6**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521304	ADVANCED ELECTRONICS LABORATORY	P	Credits: 5	Hours: 10

Objectives

- To understand the basic operations of electronic circuits and the concept of ICs manufacturing.
- To exercise the practice in various advanced digital electronics to the students.
- To acquire the knowledge of operational amplifier and its applications.
- To understand code conversion and different kinds of modulation techniques used in communication process.
- To learn about the differences between microprocessor and microcontroller and their programming.

(Any Fifteen of the following)

1. Half adders and Full adders.
2. Integrator and Differentiator circuits using IC 741.
3. Active filters using IC 741.
4. A/D converter.
5. Encoder - Decoder circuits.
6. Square wave, Sine wave and Triangular wave generators using IC.
7. Multiplexer circuits.
8. Flip – Flop circuits using IC.
9. Construction of Counters using discrete components.
10. Monostable multivibrator using op-amp.
11. Astable multivibrator using op-amp and using IC 555.
12. Schmitt trigger using op-amp.
13. Demultiplexer circuits.
14. Logic gates using IC's.
15. BCD to 7 segment display and BCD decoder.
16. Shift register and ring counter.
17. Operation of 7489 RAMS.
18. Arithmetic operations – Microprocessor 8085.
19. Logical operations - Microprocessor 8085.
20. Code conversion - Microprocessor 8085.
21. Any of the experiments of equal standard.

Outcomes

On successful completion of the course, a student will be able to

- Develop the programming skills of Microprocessor.
- Exercise the applications of electronic circuits.
- Design circuits like encoder/decoder and multiplexer/demultiplexer
- Exercise the BCD seven segment display and BCD decoder.
- Develop flip-flop circuits.

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.R.Suba Devi, Dr. M. Ramesh Prabhu, Dr. R. Yuvakkumar

SEMESTER – III

DSE	Course Code: 521507	COMMUNICATION ELECTRONICS	T	Credit:4	Hours:4

Unit I		
Objective 1	To understand the basic concepts of communication and optical communication systems	
Antennas & wave propagation: - Terms and Definition - Effect of Ground on Antennas-Grounded λ/4-Ungrounded Antenna λ Antenna- Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas- Sky Wave Propagation- Ionosphere- Eccles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation. Basic Antenna parameter, Antenna Measurements-Radiation pattern, Gain Impedance.		
Outcome 1	Describe the elements of Radar and television systems.	**K1, K2**
Unit II		
Objective 2	To identify different types of modulation and multiplexing formats and to compute a simple optical power budget	
Microwaves: - Microwave Generation-Multicavity Klystron-Reflex Klystron-Magnetron- Travelling Wave Tubes (TWT) and other Microwave Tubes-MASER-Gunn Diode, Microwave propagation: Line of sight propagation, Attenuation of Microwaves by Atmospheric gases water vapors and precipitates, RWH (Ridley- Watkins-Hit sum) Theory, Microwave cavities, Microwave circulators and isolators.		
Outcome 2	Understand the salient features of microwave generation	**K2**
Unit III		
Objective 3	To provide the basic knowledge about the Radar and television	
Radar and television: - Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems- Radar Antennas-Duplexers-Radar Receivers and Indicators- Pulsed Systems-Other Radar Systems- Colour TV Transmission and Reception, Application & limitations of Radar, Radar waveforms, Radar block diagram.		
Outcome 3	Elucidate the concepts of communication electronics. propagation	**K2, K3**
Unit IV		
Objective 4	To study the basics on communication methods in electronics	
Communication electronics: - Analog and Digital Signals - Modulation - Types of Modulation-Amplitude modulation theory - Frequency spectrum of the FM wave - Effects of noise on carrier, Amplitude- Modulation index, AM-receivers & FM Transmitters, FM- Broadcast receiver- Wireless telecommunication-Second generation-Third Generation-Fourth generation-Latest Generation.		
Outcome 4	Understand the functions of Antenna and wave	**K2, K3, K4**
Unit V		
Objective 5	Acquire the knowledge about optical fibers	
Optical fibers: - Propagation of Light in an Optical Fiber-Acceptance Angle-Numerical Aperture- Step and Graded Index Fibers-Optical Fiber as a Cylindrical Wave Guide-Fiber Losses and Dispersion-Applications - Single mode and Multimode Fibers, photonic crystal fibers, Preparation of optical fiber-Optical fibers cables and design-Laser based underwater communication systems.		
Outcome 5	Explore the applications of optical fibers.	**K2, K3**

Suggested Readings:

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

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

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

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

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

Online Resources

https://training.weather.gov/nwstc/NEXRAD/RADAR/Section1-2.html

https://www.elprocus.com/microwaves-basics-applications-effects/

https://www.javatpoint.com/antennas-and-wave-propagation

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr. M. Ramesh Prabhu

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
W.Av	**3**	**2**	**2.8**	**2.8**	**3**	**2**	**3**	**2.2**	**2.8**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)
W.Av	**3**	**2.8**	**2.8**	**2.6**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course code: 521508	PHYSICS OF NANOMATERIALS	T	Credits: 4	Hours: 4

Unit 1		
Objective 1	To impart the basic knowledge on the exotic properties of nanostructured materials at their nanoscale lengths.	
Introduction: Introduction – Nanoscience and Nanotechnology - Classification of nanomaterials: Definition of Zero, one and two dimension nano structures – Examples - Classification of synthesis methods - Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization - Steric stabilization – DLVO theory.		
Outcome 1	Understand the basic knowledge on the exotic properties of nanostructured materials at their nanoscale lengths.	K1, K2, K3
Unit II		
Objective 2	To acquire the knowledge on various functional nanomaterials	
Functional Nanomaterials: Carbon Fullerenes and Nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes - Micro and Mesoporous Materials: Ordered mesoporous structures, Random mesoporous structures, crystalline microporous materials - Core-shell structures: Metal-oxide structures, Metal-polymer structures, Oxide-polymer structures - Organic- Inorganic Hybrids - Intercalation Compounds – Nanocomposites.		
Outcome 2	Remember and gain knowledge in synthesis of nanomaterials.	K1, K2, K3
Unit III		
Objective 3	To understand the basic knowledge about synthesis techniques such as plasma arching, sol-gel, etc	
Properties: Physical properties of nanomaterials: Melting points, Specific heat capacity and lattice constants – Mechanical properties – Optical properties - Surface Plasmon Resonance – Quantum size effects – Electrical property: Surface scattering, charge of electronic structure, Quantum transport, effect of microstructure - Ferroelectrics and dielectrics – Variation of magnetism with size-Super paramagnetism-Diluted magnetic semi conductor.		
Outcome 3	Explore various properties of nanomaterials in detail.	K1, K2, K4, K5
Unit IV		
Objective 4	To exercise the students about the characterization techniques	
Synthesis: Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition plasma arching - Sol gel - Ball milling technique - Reverse miceller technique – Electrodeposition - Synthesis of Semiconductors: Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.		
Outcome 4	To understand the basic knowledge about synthesis techniques and various process techniques available for the processing of nanostructured materials.	K4, K5, K6

Unit V		
Objective 5	To provide the basic knowledge on the applications of nanomaterials.	
Characterization and Applications: Structural Characterization: X-ray diffraction – Scanning tunneling Microscopy – Transmission Electron Microscopy – Chemical Characterization: Elemental Analysis – Optical Properties. Applications: Molecular electronics and Nano electronics, Nano electromechanical systems- Colorants and pigments –DNA chips – DNA array devices – Drug delivery systems – Nano Energy Systems.		
Outcome 5	Gain noteworthy knowledge in nanoscicene and nanotechnology with microscopic technology and understand creation, manipulation and applications of materials at nanometer scale.	K3, K5, K6

Suggested Readings:

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

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

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

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

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

Online Resources

https://nptel.ac.in/courses/118104008
https://onlinecourses.nptel.ac.in/noc21_mm38/preview

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.G.Ravi, Dr.R.Yuvakkumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
W.Av	**3**	**2**	**2.8**	**2.8**	**3**	**2**	**3**	**2.2**	**2.8**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)
W.Av	**3**	**2.8**	**2.8**	**2.6**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

DSE	Course Code: 521509	MICROPROCESSOR AND INSTRUMENTATION	T	Credit: 4	Hours: 4

Unit I		
Objective 1	To develop an in-depth knowledge about the operation of microprocessors	
Microprocessor Architecture (8085 and 8086): Introduction, Intel 8085 : Architecture, Instruction Cycle, Timing Diagram: Op-code fetch, Memory read & Memory write – Instruction Set : Instruction and Data Format, Addressing Modes, Status Flags, Instructions Set, Data Transfer, Arithmetic, Branching, and Logical group operations - Interrupts - Architecture of 8086, Pin Configuration, Register organization, Minimum and Maximum mode operation – Addressing Modes – Interrupts – Hardware and Software.		
Outcome 1	Developing the programming skills of microprocessor.	K1, K6
Unit II		
Objective 2	To acquire programming skill using assembly language and understanding the concept of interrupts	
Programming of Microprocessor: Instructions for 8085 – Software development tools – Assembly language programs with data transfer, arithmetic, logical, bit level instructions and branch instructions - Interrupts and interrupt service routines-Subroutine – Flow charting – Loops – Pseudo instructions – Stack Operations- Programming and applications: Traffic control system.		
Outcome 2	Understanding the technical architecture of microprocessor and microcontroller.	K2
Unit III		
Objective 3	To familiarize the usage of microcontroller in applications	
Micro-Controller: Introduction to 8 bit micro-controller, Architecture of 8051- Hardware features of 8051 - Signal description of 8051-General Purpose and Special Function Registers- Oscillator and clock circuit-I/O Port-Memory organization and I/O addressing by 8051, Interrupts of 8051-Instructions set of 8051-Programming of 8051 (Simple Arithmetic and Logical programs)		
Outcome 3	Realizing the applications of microcontroller programming.	K3, K4
Unit IV		
Objective 4	To accustom with basic interfacing devices, its programming and designing application	
Interfacing Devices: Address space partition - Memory & I/O Interfacing – Data transfer schemes – Interrupts - I/O Ports – Programmable Peripheral Interface: 8255 – Programmable Interrupt Controller :8259– Programmable DMA Controllers:8257 – Programmable Communication Interface:8251 - A/D Sub systems- Applications – Temperature monitoring and Stepper motor control.		
Outcome 4	Writing programs based on assembly language. Interface basic peripheral devices and formulate microprocessor or microcontroller-based application.	K3, K4, K5
Unit V		
Objective 5	To buildup the application of transducers and instrumentation	
Electronic Instrumentation Instrumentation amplifiers, Sample and hold circuits, Comparators, – Interfacing of A/D and D/A converters with 8051 - Classification of transducers - Temperature transducers: thermo-resistive transducers, thermoelectric, p-n junction, chemical thermometry - Displacement transducers: potentiometer, resistive strain gauges, capacitive displacement transducer, LVDT transducers - Photoelectric transducers: photovoltaic cell, photoconductive cell- Piezoelectric transducers.		
Outcome 5	Designing and constructing transducer based instrumentation.	K3,K6

Suggested Readings:

Daniel Tabak. (2012). *Advanced Microprocessors*. New Delhi: Tata Mc Graw Hill.
Nagoor Kani, A. (2012). *Microprocessors and Microcontrollers.* New Delhi: Tata Mc Graw Hill.
Ram, B. (2010). *Fundamentals of Microprocessors and Microcomputers* (8th Edition). New Delhi: Dhanpat Rai Publications (P) Ltd.
Ramesh Gaonkar. (2010). *Microprocessor Architecture, Programming and Application.* New Delhi: Pri-Penram International Publishing.
Ray, A. K. (2006). *Advanced Microprocessors and Peripherals*. New Delhi: Tata Mc Graw Hill.

Online Resources

https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.htm
https://www.geeksforgeeks.org/data-transfer-instructions-8085microprocessor/?ref=lbp
https://www.javatpoint.com/microcontroller
https://www.eeeguide.com/interfacing-of-8257-with-8085/

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr. K. Sankaranarayanan

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	3	3	2.6	2.6	2.8	2.4	3	3	2.6	3

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	3	2.8	2.6	2.6	2.4

S-Strong (3), M-Medium (2), L-Low (1)

SEMESTER – IV

Core	Course code: 521401	CONDENSED MATTER PHYSICS - II	T	Credits: 4	Hours: 4

UNIT I

Objective 1	To learn the dielectric concepts.	
Dielectrics: Dipole moment - Polarization - Classification of polarization - Local electric field, Clauius-Mosotti relation-Polarization field - Lorentz field - Dielectric constant - Polarizability. The Classical theory of electronic polarizability - Ionic polarizabilities - Orientational polarizabilities - Frequency and temperature effects on Polarization - Dielectric breakdown and dielectric loss.		
Outcome 1	Understand the effect of macroscopic electric field on dielectric materials.	K1, K2

UNIT II

Objective 2	To understand the features of ferroelectrics and piezoelectrics.	
Ferroelectrics and Piezoelectrics: Ferroelectric Crystals - Classifications of Ferroelectric crystals - Ferroelectric Transition- Antiferroelectricity - Polarization catastrophe - Ferroelectric domains - Ferroelectric domain wall motion - Dipole theory of ferroelectricity – Piezoelectricity - Phenomenological approach to Piezoelectric effects - Piezoelectric parameters and their measurements - Piezoelectric materials.		
Outcome 2	Remember ferroelectrics and piezoelectric mechanism in detail.	K1, K2

UNIT III

Objective 3	To learn about the magnetism and magnetic materials.	
Magnetic Materials: Classification of magnetic materials - Langevin's theory of paramagnetism - Quantum theory of paramagnetism - Ferromagnetism - Curie law - Weiss molecular field theory - The physical origin of Weiss molecular field – Hund's rules - Ferromagnetic domains - Domain theory - Antiferromagnetism - Neel's theory - Farimagnetism and ferrites - Spin waves - Hard and soft magnetic materials.		
Outcome 3	Conceptual understanding of dia, para, ferro and antiferro magnetism in detail.	K1, K2, K3

UNIT IV

Objective 4	To understand the importance of superconductivity.	
Superconductivity: Introduction - Occurrence of superconductivity - destruction of superconductivity by magnetic fields - Meissner effect - Isotope effect - Type I and Type II superconductors - London equations - Coherence length - BCS Theory - Cooper pair - Normal tunneling and Josephson effect - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference - High temperature super conductors - Applications.		
Outcome 4	Analyze and describe the type I and type II superconducting materials.	K4, K5

UNIT V

Objective 5	To learn the physics of nanosolids and quantum confinement.	
Physics of Nanosolids: Definition of nanoscience and nanotechnology - Preparation of nanomaterials - Surface to volume ratio - Quantum confinement of nanostructures - Qualitative and Quantitative description - Density of states of nanostructures - Excitons in Nano semiconductors - Carbon in nanotechnology - Carbon nanotubes - Nano diamond - Graphene.		
Outcome 5	Understand nanoscicene and nanotechnology with microscopic technology.	K3, K5, K6

Suggested Readings:

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

Charles Kittel. (2019). *Introduction to Solid State Physics* (8 ed.). New Delhi: John Wiley & Sons. Pvt. Ltd.

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

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

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

Online Resources

https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-ph02/

https://nptel.ac.in/courses/115101009

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by Dr.G.Ravi, Dr. R. Yuvakkumar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	L(1)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	L(1)
CO5	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)
W.Av	**3**	**2**	**2.6**	**2.6**	**2.8**	**1.8**	**2.8**	**2.4**	**2.6**	**2.2**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**2.8**	**3**	**2.8**	**2.8**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course code: 521402	NUCLEAR AND PARTICLE PHYSICS	T	Credits: 4	Hours: 4

UNIT I		
Objective 1	To introduce students to the fundamental principles and concepts governing nuclear and particle physics.	
Nuclear Forces Characteristics of Nucleus forces – Exchange forces and tensor forces – charge independence-Spin dependence of Nucleus forces - Yukawa's Meson theory of nuclear forces- Ground state of deuteron, Normalization of deuteron wave functions - Nucleon-nucleon scattering singlet and triplet parameters – Nucleon-Nucleon scattering: Cross-section, Differential Cross-section, Scattering Cross-sections – Magnetic moment- Quadrupole moment–S and D state admixtures - Effective range theory of n-p scattering at low energies.		
Outcome 1	Identifying the fundamental models of nuclear structure that are used to describe various modes of nuclear excitation.	**K1**

UNIT II		
Objective 2	To understand the nuclear forces and different scattering mechanisms.	
Nuclear Models Binding energy & mass defect – Weizacker's formula – mass parabola, Liquid Drop model – Bohr Wheeler theory - Shell model – Single particle model, its validity and limitations – Rotational Spectra - Magic numbers – Spin – orbit coupling - Angular momentum of nucleus ground states – Magnetic Moments of the shell model – Schmidt lines – Magnetic dipole moment – Electric quadrupole moment – Collective Model of Bohr and Mottelson: Nuclear vibration – Nuclear rotation –Nelson model.		
Outcome 2	Describing the applications of semi-empirical mass formula and recognize the importance of spin-orbit interaction through different nuclear models.	**K3**

UNIT III		
Objective 3	To study the various nuclear models.	
Reactions and Reactors Nuclear Fission and Fusion - source of stellar energy. Nuclear reactions, reaction mechanisms, compound and direct nuclei reactions - Nuclear reaction cross section – Knock out reaction, Pick-up reaction, Stripping reaction – Compound nucleus theory – Formation – Disintegration energy levels - Resonance Scattering (Breit-Wigner dispersion formula) – Scattering matrix - Reciprocity theorem – Breit-Wigner one level formula. Interaction of neutron with matter – Thermal neutrons – Neutron cycle in a thermo nuclear reactor – Critical size – Types of nuclear reactors - cylindrical and spherical– controlled thermo nuclear reactions.		
Outcome 3	Understanding and analyzing the nuclear reactions along with nuclear reactors. Studying the properties of neutrons and describe their properties of nuclear reactors.	**K2,K4**

UNIT IV		
Objective 4	To acquire an idea about reaction cross sections, nuclear reactions and reactors	
Nuclear Decay Gamow's Theory of Alpha decay - Fermi's theory of Beta decay – Kurie plots –Selection rules, Fermi & G.T Selection rules – Electron capture – Parity violation in Beta decay - Neutrinos – Measurement of neutrino helicity – Gamma decay – Angular momentum and parity selection rules - Internal Conversion Nuclear Isomerism - Positron's -source of Positron emitters-Biological application of nuclear particles in cancer therapy.		
Outcome 4	Grasping enhanced knowledge about different nuclear decays and calculate the penetration probability using Gamow theory and study the measurement of neutrino helicity. Apply the studied concepts of nuclear particles in biological-	**K2,K3**
UNIT V		
Objective 5	To understand the concept of nuclear decay and elementary particles.	
Elementary Particle Physics Classification of fundamental forces–Particle Directory and quantum numbers (Charge, spin, parity, iso-spin, strangeness etc) – Leptons, Baryons and quarks - Spin and parity assignments, isospin, strangeness; The fundamental interactions - Phenomenology of weak interaction hadrons and leptons - Universal Fermi interaction–Elementary concepts of weak interactions– Translations in space – Rotations in space – Charge conjugation – Parity – Gell-Mann-Nishijima formula- Gell-Mann - Okubo mass formula for octet and decuplet hadrons - Time reversal–CPT invariance- Applications of symmetry arguments to particle reactions, Parity non-conservation in weak interaction; Relativistic kinematics.		
Outcome 5	Understating about particle physics in directory and their interactions. Study the elementary concepts of week interactions. Applications of symmetry arguments to particle reactions, Parity non-conservation in weak interaction; Relativistic kinematics.	**K2,K4,K6**

Suggested Readings:

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

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

Kakani Shubhra (2018) *Nuclear and Particle Physics* (Second Edition), Viva Publisher and Co.

Pandya, M.L, Yadav, P.R.S. (2016) *Elements of Nuclear Physics*, Kedar Nath Ram Nath publications, Meerut.

Tayal, D.C. (2018). *Nuclear Physics*, Himalaya Publishing House Pvt. Ltd., Vth Ed.

Online Resources

https://faculty.kfupm.edu.sa/PHYS/aanaqvi/Introductory-Nuclear-Physics-new-Krane.pdf
https://www.tgc.ac.in/pdf/study-material/physics/Nuclear_Physics.pdf

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr.N.Anandhan

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	L(1)	L(1)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	L(1)	L(1)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	L(1)	M(2)	S(3)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	L(1)	L(1)	S(3)	S(3)
W.Av	**3**	**2**	**2.6**	**2**	**2**	**3**	**1.2**	**1.4**	**3**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	M(2)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	L(1)	S(3)	S(3)
W.Av	**3**	**3**	**1**	**2.6**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Core	Course Code: 521403	THERMODYNAMICS AND STATISTICAL MECHANICS	T	Credits: 4	Hours: 4

UNIT – I		
Objective 1	The main objective of this paper is to impart knowledge about statistical mechanics to the students.	
Thermodynamics-Introduction - Basic postulates of thermodynamics- Fundamental relations and definition of intensive variables- Intensive variables in the entropic formulation- Phase space –Gibbs Duhem relation for entropy - Equations of state-Euler relation, densities- Thermodynamic potentials - Maxwell relations- Ideal gas and real gases- Microstate and Macrostate in classical system-Microstate and macrostate in quantum systems- Density of states and volume occupied by a quantum state- Thermodynamic processes: reversible, irreversible, quasi-state, adiabatic, isothermal.		
Outcome 1	Understand the connection between statistics and thermodynamics	**K2**
UNIT – II		
Objective 2	To discuss in detail about the basics of quantum statistics.	
Thermodynamics- Theory of ensembles - Classification of ensembles- Micro canonical distribution function- Two level system in micro canonical ensemble –Gibbs paradox and correct formula for entropy- The canonical distribution function- Contact with thermodynamics- Partition function and free energy of an ideal gas - Distribution of molecular velocities- Equipartition and Virial theorem- The grand partition function-Relation between grand canonical and canonical partition function-One orbital partition function-Derivation of thermodynamics from statistical mechanics principle.		
Outcome 2	Distinguish between three types of ensembles and derive their partition functions to explain the behaviour of classical and quantum systems.	**K4, K5**
UNIT – III		
Objective 3	To understand the connection between statistical concepts and thermodynamics.	
Quantum Statistics-I - Bose-Einstein and Fermi Dirac distribution – Thermodynamic quantities – Fluctuations in different ensembles – Bose and Fermi distributions in micro canonical ensemble – Maxwell Boltzmann distribution law for microstates in a classical gas – Physical interpretation of the classical limit – Derivation for Boltzmann equation for change of states with and without collisions – Boltzmann equation for quantum statistics – Equilibrium distribution in Boltzmann equation-non equilibrium process; Joule Thompson process – Free expansion and mixing – Thermal conduction – The heat equation – Thermionic emission.		
Outcome 3	Analyze the classical and quantum statistics	**K4**
UNIT – IV		
Objective 4	To acquire knowledge on different ensembles.	
Quantum statistics – II - Non-Interacting Bose gas and thermodynamic relations Chemical potential of bosons - pressure and energy density bosons - Black body radiations and Planck's distribution law – Number density of photons and Bose condensation – Thermodynamic relations for non-interacting Fermi gas - Fermi gas at zero temperature – Fermi energy and Fermi momentum-Pressure and energy density Fermi gas at low temperature - Mass less Fermi gas at any temperature, Particles and antiparticles-random walk, Brownian motion-transport processes; one speed and one dimension-All speeds and all directions-conserved properties-Distribution of molecular velocities-Equipartion and virial theorems.		
Outcome 4	Compare the statistical behaviour of ideal Bose gas and Fermi gas	**K2 K5**

UNIT – V		
Objective 5	To distinguish between classical and quantum distributions and understand heat capacities and phase transitions.	
Theory of Heat - Heat capacities of heteronuclear diatomic gas - Heat capacities of homonuclear diatomic gas - Heat capacities of solids: Dulong and Petit law, Einstein temperature and Debye theory - Heat capacities of metals - Heat capacity of Bose gas - One-dimensional Ising model and its solution by variational method - Exact solution for one dimensional Ising model - Phase transitions and criterion for phase transitions - Classification of phase transitions by order and by symmetry - Phase diagrams for pure systems - Clausius Clapeyron equation-Gibbs phase rule.		
Outcome 5	Understanding on heat capacities for gas, solids and elucidate phase transitions explain	**K2 K4**

Suggested Readings:

Palash B. Pal. (2008). *An Introductory Course of Statistical Mechanics*. New Delhi: Narosa Publishing House.

Garg, S.C. Bansal, R.M. Ghosh, C.K. (2017). *Thermal Physics: With Kinetic Theory, Thermodynamics and Statistical* Ansermet,

P. Brechet S.D. (2019). *Principles of Thermodynamics and Statistical Mechanics*. Cambridge University Press.

Koks, D. (2018). *An Introduction to Statistical Mechanics*. Springer.

Puglisi, A. Sarracino, A. Vulpiani, A. (2018). *Thermodynamics and Statistical Mechanics of Small Systems*. Basel: MDPI

Online Resources

https://web.stanford.edu/~peastman/statmech/thermodynamics.html

https://ocw.mit.edu/courses

https://phys.libretexts.org/Special:Search?qid=&fpid=230&fpth=&query=thermodynamics+&type=wiki

https://ocw.mit.edu/courses/3-020-thermodynamics-of-materials-spring-2021/pages/lecture-notes-and-latex/

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by **Dr. M. Ramesh Prabhu**

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	M(2)	L(1)	L(1)	M(2)	L(1)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**3**	**2.8**	**2.8**	**2.4**	**2**	**2.6**	**2.4**	**3**	**3**

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Av	**3**	**2.4**	**2.8**	**2.2**	**2.8**

S-Strong (3), M-Medium (2), L-Low (1)

NON MAJOR ELECTIVE COURSE

NME	Course Code:	ANALYTICAL INSTRUMENTATION	T	Credits: 2	Hours: 3

Unit I

Objective 1	To impart fundamental aspects of analytical instrumentation
Structural Characterization: Instrumentation of X-ray spectrometer – Detectors – X-ray fluorescence spectrometer – X-ray diffractometer – X-ray absorption – Application, strengths and limitation of X-ray diffraction.	
Outcome 1	Understand the different processes of structural and topographical characterization techniques

Unit II

Objective 2	To show insight into the fundamental structural properties of the material analysis
Spectral Characterization: Laser Raman spectrometer – Laser sources – Detectors – Sample handling. Infrared spectrophotometry – Instrumentation – Radiation sources – Detectors – Fourier Transform Interferometer – NMR basic principles – Continuous wave NMR spectrometer – ESR basic principles – ESR spectrometer.	
Outcome 2	Prepare the samples for various characterization techniques

Unit III

Objective 3	To discuss both experimental and theoretical parts of spectral characterization techniques
Optical Characterization: Ultraviolet absorption spectrophotometry – Instrumentation – Detectors – Filters – Monochromators – Instruments for absorption photometry – Photoluminescence principles – Instrumentation and applications.	
Outcome 3	Give details on different characterization tools to analyze the samples

Unit IV

Objective 4	To explore both thermal and mechanical characterization techniques
Thermal and Mechanical Characterization: Introduction to thermal methods – Thermogravimetric analysis – Differential thermal analysis – Differential scanning calorimetry – Mechanical principles – Methods of hardness testing and its applications.	
Outcome 4	Elucidate the optical spectroscopy techniques

Unit V

Objective 5	To impart fundamental principles of morphological characterization
Morphological Characterization: Basic Principles – Instrumentation: AFM – Contact and Non-Contact Mode – Scanning Electron Microscope (SEM) – Transmission Electron Microscopy.	
Outcome 5	Explain different electron microscopy techniques

Suggested Readings:

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

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

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

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

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

Online Resources

https://nptel.ac.in/courses/103108100

https://freevideolectures.com/course/3029/modern-instrumental-methods-of-analysis

Course designed by Dr. R. Yuvakkumar , Dr. S. Sudhahar

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	1	1	3	1	2	3
CO2	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	3	1	3	3	3	3
CO5	3	3	3	2	2	2	3	3	3	3

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3

S-Strong (3), M-Medium (2), L-Low (1)

NME	Course code:	Imaging : Fundamentals and Applications	T	Credits: 2	Hours: 3

Unit I	
Objective 1	To provide the fundamental properties of light
Properties of Light: Electromagnetic Waves - Revision of Maxwell's equations - Light as an electromagnetic wave – Light velocity in various media - index of refraction, - Fermat's Principle - Polarization – Wave Characteristics – Wavelength, Amplitude, Phase, Period, Frequency – Sources of Light – Wave Front – Huygens' Principle – Reflection, Refraction, Absorption, Transmission, Interference, Diffraction, Scattering	
Outcome 1	Learning the properties of light and its application in imaging
Unit II	
Objective 2	To felicitate the learners different light sources and detectors for imaging
Basics of Light Sources and Detectors: Monochromatic and Polychromatic Sources-Sodium Vapour, LED, LASER - Mercury and Halogen Lamps- Light Dependent Resistor, Photodiode-CCD	
Outcome 2	Construction of knowledge on different light sources and detectors and enable the students to distinguish and choose the suitable one for imaging
Unit III	
Objective 3	To gain the knowledge on lenses and the merit of the images
Lenses and Image Correction: Types of Lenses, Thin and Thick – Focal Point, Radii of curvature, Power of lenses – Image Formation using Convex and Concave Lenses – Defects in Images-Chromatic Aberration and Spherical Aberration – Image Corrections- Geometric Correction- Radiometric Correction.	
Outcome 3	The learner would be able to understand the concepts of lenses and the merit of the image
Unit IV	
Objective 4	To understand the science of fiber optics
Optical fibers: - Propagation of Light in an Optical Fiber-Acceptance Angle-Numerical Aperture-Step and Graded Index Fibers- Single mode and Multimode Fibers- Photonic crystal fibers-Optical Fiber as a Cylindrical Wave Guide-Fiber Losses and Dispersion-Applications.	
Outcome 4	The application of fiber optics felicitates the learner about remote imaging
Unit V	
Objective 5	To familiarize the different imaging tools
Principles of Imaging Tools: Camera, Microscope, Telescope, SEM, TEM, CLSM, AFM, Endoscope, MRI and Ultrasound.	
Outcome 5	The course also helps the students to be exposed to the various imaging tools in different areas of application

Suggested Readings :

Jerold Touger, (2006) *Introductory Physics: Building and Understanding*,, 1st Edition, Wiley India Pvt.Ltd., New Delhi.

Dr.J.Kumar, Dr.S.Moorthy Babu and Dr.S.Vasudevan, (2009), *Applied Physics, 2nd Edition*,Vijay Nicole Imprints Pvt.Ltd., Chennai.

M.A.Avadhanulu and P.G.Kshirsagar, (2019), *A Text Book of Engineering Physics, 9th Edition*, S.Chand and Company, New Delhi, 2019.

Hugh D Young and Roger A Freedman, (2018), *University Physics with Modern Physics*, 14th

Edition, Pearson India Education Services, Noida, 2018.
Feynman, Leighton and Sands, *The Feynman Lectures on Physics,(2009)*, Vol.1, Pearson India Education Services, Noida.

Online Resources

https://www.worldscientific.com/worldscibooks/10.1142/p770#t=aboutBook
https://www.kth.se/social/files/542d1224f27654321376a4b4/Compendium.Imaging.Physics.pdf

Course designed by Dr. K. Sankaranarayanan

Course Outcome Vs Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	1	3	1	3	3
CO2	3	2	3	2	3	2	3	2	3	3
CO3	3	2	2	2	2	2	3	3	3	3
CO4	3	2	3	3	2	2	3	3	3	2
CO5	3	2	3	2	3	3	3	3	3	2

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	1	2
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	3	3	2	2
CO5	3	2	3	2	2

S-Strong (3), M-Medium (2), L-Low (1)

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