CMS COLLEGE KOTTAYAM
(AUTONOMOUS)

Affiliated to the Mahatma Gandhi University
Kottayam, Kerala

CURRICULUM FOR POST GRADUATE PROGRAMME

MASTER OF SCIENCE IN APPLIED PHYSICS

UNDER CREDIT AND SEMESTER SYSTEM (CSS)
(With effect from 2019 Admissions)

Approved by the Board of Studies on 14th June 2019

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Department of Physics
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Department of Physics
CMS College Kottayam (Autonomous) (Member)

Dr. Thejal Abraham
Assistant Professor
Department of Physics
CMS College Kottayam (Autonomous) (Member)

ACKNOWLEDGEMENT

The Board of Studies of Department of Physics, CMS College, Kottayam places on record their gratitude to all the eminent academicians who contributed to the framing of post graduate syllabus 2019.The guidance and recommendations from the domain experts in designing different courses played a crucial role in shaping this curriculum to this present level. I also like to convey my gratitude to all the members of the Board of Studies whose pragmatic and collaborative approach made this venture a grand success.

Dr. Reenu Jacob
Chairman
Board of Studies

Kottayam
14.06.2019

PREFACE

The curriculum of an institution of higher learning evolves with time, reflecting the ever-changing needs of the society and the students. The dynamic feature of the curriculum makes the learning process a truly sublime experience for all.

Department of Physics has taken meticulous efforts to ensure a well-balanced curriculum. The Physics community of our College provides better understanding of the fundamental laws of nature, promoting the highest ethical principles in scientific research, critical thinking and openness to social and technological changes.

The M.Sc. programme is designed to develop professional skills for students to take up significant role in industrial or academic life, while giving the experience of independent work and team spirit. Further the curriculum enables students to develop insights into the specialized research areas such as non-linear dynamics, materials science, nano-science, and photonics along with the creative laboratory environment with a range of experiments from classic to advanced physics.

The syllabus intends to provide the students many opportunities to engage with the evolving world of learning. Focused efforts in developing programme and course outcomes provide cognitive and intellectual skills of the learners and provide confidence to carry out independent and scholarly research in area of professional interest and to position themselves in the global arena.

The syllabus is part of our resolve to create a stimulating academic culture in the institution to access knowledge and participate in its expansion and progression.

REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM 2019

Preamble

CMS College Kottayam (Autonomous) was conferred with the Autonomous status as per UGC No.F.22-1/2016(AC) Dtd. 9th March 2016 and Mahatma Gandhi U.O.No.2732/VII/2016/Acad. Dtd.12th May 2016.

REGULATIONS

CMS College Kottayam (Autonomous) follows Credit Semester System (CSS) for the Post Graduate programmes from the Academic year 2019-20. The Post Graduate programmes of the college are being redesigned and revised in tune with the modifications effected at the UGC Curriculum Framework. This will be reflected in the scheme, course content and mode of examination and Evaluation system. The scheme and syllabus of all the programmes are being revised accordingly. The revisions were effected based on the recommendations made at the Curriculum Revision workshops conducted for the purpose besides several sittings of the Curriculum Revision Committee.

1. TITLE

1.1. These regulations shall be called **"CMS COLLEGE KOTTAYAM (AUTONOMOUS) REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT AND SEMESTER SYSTEM 2019"**

2. SCOPE

2.1 Applicable to all regular Postgraduate Programmes conducted by the CMS College Kottayam (Autonomous) with effect from 2019 admissions.

2.2 Medium of instruction is English unless otherwise stated therein.

3. DEFINITIONS

3.1. **Academic Week** is a unit of five working days in which the distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day.

3.2. **Semester** means a term consisting of **90** working days, within **18** five-day academic weeks for teaching, learning and evaluation.

3.3. **Programme** means a two year programme of study and examinations, spread over four semesters, with a set of courses, the successful completion of which would lead to the award of a degree.

3.4. **Course** comprises a set of classes or a plan of study on a particular subject which will be taught and evaluated within a semester of a study programme.

3.5. **Core course** means a course which should compulsorily be studied by a student as requirement in the subject of specialization within a degree programme.

3.6. **Elective Course** means an elective course chosen from the discipline/ subject, in an advanced area.

3.7. **Credit** is the numerical value assigned to a course according to the duration of the classes or volume of the syllabus of the course**.**

3.8. **Department** means any teaching department in the college.

3.9. **Dean of Academic Affairs** is a teacher nominated by the Academic Council to coordinate the academic affairs of the college relating to academic planning, curriculum implementation and review.

3.10. **Dean of Student Affairs** is a teacher nominated by the Academic Council to coordinate the admissions, grievances and other student related services.

3.11. **Department Council** means the body of all teachers of a department in the college.

3.12. **Department Coordinator** is a teacher nominated by a Department Council to co-ordinate the In-Semester examination of the PG programme in that department.

3.13. **Faculty Advisor** means a teacher from the parent department nominated by the Department Council, who will advise the students of a class on academic matters.

3.14. **Course Teacher** means a teacher who is in charge of a course. If a course is taught by more than one teacher, one teacher should be assigned as course teacher, nominated by the HOD. The course teacher shall be responsible for the valuation of answer scripts of examinations and other continuous assessments.

3.15. **In-Semester Assessment (ISA)** means assessment consisting of Attendance, Assignment/Seminar/Viva voce and Examination (theory and practical).

3.16. **End Semester Assessment (ESA)** means Examination conducted at the end of each semester for all courses (theory and practical).

3.17. **Internal Examiner** means a teacher working in the college.

3.18. **External Examiner** means a teacher from outside the college.

3.19. **Grace Marks** shall be awarded to candidates as per the orders issued by Mahatma Gandhi University.

3.20. **Grade** means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Course/ Semester/Programme.

3.21. **Grade Point** (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.22. **College Average (CA)** means average mark secured (ISA+ESA) for a course at the college level.

3.23. Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the University, UGC Regulations and the Constitution of the CMS College Kottayam (Autonomous).

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

Eligibility for admission, norms for admission and reservation of seats for various Postgraduate Programmes shall be according to the regulations framed/orders issued by Govt. of Kerala, Mahatma Gandhi University and CMS College Kottayam in this regard.

5. PROGRAMME STRUCTURE

5.1 The nomenclature of all PG programmes shall be as per the specifications of University Grants Commission and the Mahatma Gandhi University.

5.2 Credit Semester System (CSS) will be followed for all PG Programmes from the academic year 2019– 2020.

5.3 All the PG Programmes will be of two-year duration with four Semesters. A student may be permitted to complete the Programme, on valid reasons, within a period of 8 continuous semesters from the date of commencement of the first semester of the programme.

5.4 There will be three/four/five courses in each semester and one viva voce and dissertation at the end of the fourth semester.

5.5 There will be three components for the programme viz. core course, elective course and project spread over four semesters.

5.6 The total credits required for completing a PG Programmeis**80**.

5.7 The Syllabus for all courses in each semester has been divided into five modules based on certain thematic commonalities.

6. EVALUATION SYSTEM

i. The evaluation scheme for each course shall contain two parts:
(a) In-Semester Assessment (ISA)
(b) End-Semester Assessment (ESA)

ii. The proportion of ISA to ESA will be 1:3.

iii. The marks secured for each course shall be converted as grades. The grades for different semesters and overall programme are assigned based on the corresponding semester grade point average and cumulative grade point average respectively.

iv. A separate minimum of 40% is mandatory for both ISA and ESA to pass for every course.

6.1 EVALUATION OF THEORY COURSES

The marks allotted for theory courses in End-Semester Assessment shall be 120 and that for the In-Semester Assessment will be 40.

A. IN-SEMESTER ASSESSMENT

The In-semester assessment for theory is based on the marks obtained for Attendance, Assignment, Major Seminar and two Test Papers for a particular course.

(i) Attendance

Percentage of attendance	Mark
90 and above	6
85 – 89	5
80 – 84	4
76 – 79	3
75	2
Below 75	0

Maximum marks = 6

(ii) Assignment (One assignment per course)

Evaluation Component	Mark
Review of related literature	2
Content	3
Reference	2
Punctuality	1

Maximum marks = 8

(iii) Major Seminar

A student should present one Major Seminar in a Semester. The faculty advisor should allot students to the respective course teacher in a semester. The seminar topics shall be incorporated in the syllabus for each course/ declared in the beginning of each semester. The student shall prepare the seminar paper with the guidance of the course teacher. The student is expected to make a detailed presentation in a common session in the department, with students and all course teachers. The student shall also make a brief conclusion including the future scope of studying the topic. The teacher in charge of the particular course has to act as the moderator for the seminar.

The course teachers of that semester shall evaluate the seminar and give marks for their course or the average mark of all the evaluators shall be taken as the seminar mark for each course of a semester.

Evaluation Component	**Mark**
Involvement/punctuality	1
Review of related literature	1
Content	3
Presentation	3
Interactions/ justification	1
Conclusion	1

Maximum marks = 10

(iv) Test paper

For each course, two In-Semester examinations of total 16 marks shall be conducted. One of the test paper will be centralized examination of 8 marks and the remaining 8 marks will be awarded with one or more class tests conducted by the course teacher.

B. END -SEMESTER ASSESSMENT

End-Semester examinations for each course are conducted at the end of every semester with a maximum marks of 120. The examination for each course will have two components viz., descriptive test and an objective type test. Questions shall be set to evaluate the attainment of course outcomes. The question paper for each course will be generated from the Question Bank which is prepared by due mapping of Course outcomes and Program Specific Outcomes.

(i) Descriptive Test

A written examination with a maximum marks of 100 and of three hours duration will be conducted.

PATTERN OF QUESTIONS

A question paper shall be a judicious mix of short answer type, short essay/problem solving type and long essay type questions.

No.	Section	Type of questions	Total Questions	Number of questions to be answered	Mark for each question	Total Marks
1	Section A	Short answer type	8	5	4	20
2	Section B (One pair should be from each module)	Short essay/problem solving type	10 (Either/or)	5	8	40
3	Section C	Long essay type	4	2	20	40
	Total		**22**	**12**	-	**100**

(ii) Objective Test

A Multiple Choice Objective type Test shall be a component of the End-semester examination which will be conducted in the online mode for each course. The marks obtained shall be converted into 20. The objective type examination for all courses in a semester shall be conducted in a session of one hour. The number of questions in Arts stream will be 50 and that of Science and Mathematics stream will be 40. Questions should be equally distributed among the courses in a semester. There will be four choices for each question. Each question carries 4 marks for correct answer, zero marks for no answer and -1 marks for wrong answer.

6.2 EVALUATION OF PRACTICAL COURSES

Practical examination will be conducted at the end of each semester/ end of an academic year. The time of conduct of the practical examination will be decided by the respective BOS.

A. **IN-SEMESTER ASSESSMENT**

Evaluation Component	Mark
Attendance	6
Lab Involvement	8
Test	12
Record	8
Viva	6

Maximum Marks = 40

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

B. **END- SEMESTER ASSESSMENT**

Evaluation Component	Mark
Attendance	18
Lab Involvement	24
Test	36
Record	24
Viva	18

Maximum Marks = 120

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

6.3 EVALUATION OF PROJECT

An academic project work shall be done and a dissertation shall be submitted in the final semester of the programme. There will be both In semester and End semester assessment for the project work.

A. **IN- SEMESTER ASSESSMENT**

Evaluation Component	Mark
Relevance of the topic	5
Project content and report	15
Presentation	15
Project viva	10

Paper presentation* in Seminar/Conference or publications with ISBN/ISSN (*valid certificate to be submitted)	5

Maximum marks = 50

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

B. **END -SEMESTER ASSESSMENT**

The dissertation at the end of final Semester will be evaluated by a panel of one internal evaluator assigned by HOD and one external evaluator / a panel of two external evaluators, as may be decided by the respective BOS.

Evaluation Component	**Mark**
Relevance of the topic	15
Project content and report	45
Presentation	45
Project viva	30
Paper presentation* in Seminar/Conference or publications with ISBN/ISSN (*valid certificate to be submitted)	15

Maximum marks = 150

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

6.4 EVALUATION OF COMPREHENSIVE VIVA VOCE

A comprehensive viva voce shall be done at the end of the final semester. There will be both In-semester and End-semester assessment for the viva voce examination.

A. IN - SEMESTER ASSESSMENT

Evaluation Component	**Mark**
+2/ UG level questions	4
PG syllabus level questions	10
Subject of interest based questions	8
Advanced level questions	3

Maximum marks = 25

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

B. END- SEMESTER ASSESSMENT

The comprehensive Viva Voce Examination at the end of final Semester will be evaluated by a panel of one internal evaluator assigned by HOD and one external evaluator / a panel of two external evaluators, as may be decided by the respective BOS.

Evaluation Component	**Mark**
+2/ UG level questions	12
PG syllabus level questions	30
Subject of interest based questions	24
Advanced level questions	9

Maximum marks = 75

The components and the marks can be modified by the concerned BOS/Expert committee within the limit of maximum marks.

7. Grievance Redressal Mechanism

In order to address the grievance of students regarding In-Semester assessment, a two-level Grievance Redressal mechanism is established.

Level 1: Department Level: The Department cell is chaired by the HOD, Department Coordinator as member secretary and Course teacher in-charge as member. If the grievance is not redressed at the Department level, the student shall report the grievance to the College Level Grievance Redressal Cell.
Level 2: **College level**: College Level Grievance Redressal Cell has the Vice-Principal as the Chairman, Dean of Student Affairs as the Member Secretary and HOD of concerned Department as member.

8. Eligibility for End Semester Examination

A minimum of 75% average attendance for all the courses is mandatory to register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the College on valid grounds. Attendance may be granted to students attending University/College union/Co-curricular activities for the days of absence, on production of participation/attendance certificates, within one week, from the teacher in charge of the activity and endorsed by the Dean of Student Affairs. This is limited to a maximum of 10 days per semester. Monthly Attendance report will be published in the college website on or before the 10^{th} of every month. Those students who are not eligible even with condonation of shortage of attendance shall repeat the semester along with the next batch after obtaining readmission.

9. Promotion to the next Semester

Those students who possess the required minimum attendance and have registered for the End Semester Examination during an academic semester are promoted to the next semester.

Those students who possess the required minimum attendance and progress during an academic semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next semester.

10. Eligibility for Readmissions

An additional chance of readmission will be given to those students who could not register for the examination due to shortage of attendance. Readmitted students shall continue their studies with the subsequent batch of students. If an applicant for readmission is found to have indulged in ragging or any other misconduct in the past, readmissions shall be denied.

11. MARK CUM GRADE CARD

The College under its seal shall issue to the student a MARK CUM GRADE CARD on completion of each semester/programme, which shall contain the following information:

(a) Name of the College
(b) Title of the Postgraduate Programme
(c) Name of the Semester
(d) Name and Register Number of the student
(e) Date of publication of result
(f) Code, Title, Credits and Maximum Marks (ISA, ESA & Total) of each course opted in the semester.
(g) ISA, ESA and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester
(h) College average (CA) of the marks of all courses
(i) The total credits, total marks (Maximum & Awarded) and total credit points in the semester
(j) Semester Grade Point Average (SGPA) and corresponding Grade.
(k) Cumulative Grade Point Average (CGPA) and corresponding Grade.

The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the study programme and the overall mark/grade for the total programme.

There shall be a College Level Monitoring Committee comprising Principal, Vice Principal as member-secretary, Dean of Academic Affairs, Controller of Examinations, IQAC Director and Administrative Assistant as members for the successful conduct of the scheme.

12. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a course is calculated using the formula:-
CP = C × GP, where C is the Credit and GP is the Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:-
SGPA = TCP/TC, where TCP is the Total Credit Point of that semester, ie, $\sum_1^n \mathrm{CPi}$; *TC is the Total Credit of that semester ie,* $\sum_1^n \mathrm{Ci}$, *where n is the number of courses in that semester*

Cumulative Grade Point Average (CGPA) is calculated using the formula:-
CGPA = TCP/TC, where TCP is the Total Credit Point of that programme ie, $\sum_1^n \mathrm{CPi}$; *TC is the Total Credit of that programme, ie,* $\sum_1^n \mathrm{Ci}$ *, where n is the number of courses in that programme*

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	Grade with Indicator
4.5 to 5.0	A+ Outstanding
4.0 to 4.49	A Excellent
3.5 to 3.99	B+ Very Good
3.0 to 3.49	B Good (Average)
2.5 to 2.99	C+ Fair
2.0 to 2.49	C Marginal
Up to 1.99	D Deficient (Fail)

13. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of six months from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

The Principal is also authorized to issue orders for the perfect realization of the regulations.

Annexure I

(Model Mark Cum Grade Card)

CMS COLLEGE KOTTAYAM (AUTONOMOUS)

Affiliated to Mahatma Gandhi UniversityKottayam

(Autonomous College as per UGC order no.F.22-1/216(AC)dated 9th March 2016)

MARK CUM GRADE CARD

Section :
Name of the Candidate :
Unique Permanent Registration Number :
Degree :
Programme :
Stream :
Name of the Examination :
Date of Publication of Result :

Course Code	Course Title	Credits (c)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (C x GP)	College Average	Result
			ISA		ESA		TOTAL						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					

ISA - In - Semester Assessment, ESA – End - Semester Assessment

SGPA: **SG:**

Checked by **Section Officer** **Controller of Examinations**

Date:

Annexure II

CMS COLLEGE KOTTAYAM (AUTONOMOUS)

Kerala, India – 686 001Website: www.mscollege.ac.in

e-mail:kottayamcmscollege@gmail.comTel: 91-481-2566002, Fax: 91-481-2565002

Affiliated to Mahatma Gandhi University Kottayam, Kerala

(Autonomous College as per UGC Order No.F.22-1/216 (AC) dated 9th March 2016)

CONSOLIDATED MARK CUM GRADE CARD

Name of the Candidate:

Unique Permanent Register Number (UPRN):

Degree:

Programme:

Stream:

Date of Birth:

Date of Eligibility for the Degree:

PHOTO

CMS COLLEGE KOTTAYAM (AUTONOMOUS)

Name: UPRN:

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CxGP)	College	Result
			ESA		ISA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					

Final Result

Cumulative Grade Point Average CGPA :

Semester Summary

Sl.No	Semester	Credit	SGPA	Grade	Month/year	Result
	Semester 1					
	Semester 2					
	Semester 3					
	Semester 4					

Date: **Controller of Examinations**

Annexure III

(Reverse side of the Mark cum Grade Card (COMMON TO ALL SEMESTERS))

Description of the Evaluation Process

Grade and Grade Point

The Evaluation of each Course comprises of Internal and External Components in the ratio 1:3 for all Courses.

Grades and Grade Points are given based on the percentage of Total Marks (Internal + External) as given in Table 1

(Decimals are to be rounded mathematically to the nearest whole number)

Table 1

% Marks	Grade	GP
Equal to 88 and above	A+ Outstanding	5
Equal to 76 and < 88	A Excellent	4
Equal to64 and < 76	B+ Very Good	3
Equal to 52 and < 64	B Good(Average)	2
Equal to 40 and below 52	C Marginal	1
Below 40	D Deficient (Fail)	0
	Ab Absent	

Credit point and Credit point average
Grades for the different Semesters and overall Programme are given on a 7-point Scale based on the corresponding CPA, as shown in Table 2.

Table 2

CPA	Grade with Indicator
4.5 to 5.0	A+ Outstanding
4.0 to 4.49	A Excellent
3.5 to 3.99	B+ Very Good
3.0 to 3.49	B Good (Average)
2.5 to 2.99	C+ Fair
2.0 to 2.49	C Marginal
Up to 1.99	D Deficient (Fail)

Credit point (**CP**) of a paper is calculated using the formula $CP = C \times GP$,**where C is the Credit; GP is the Grade Point**
Semester or Programme (cumulative) Grade Point Average of a Course/Programme is calculated using the formula
SGPA/CGPA = $\frac{TCP}{TC}$**, where TCP is the Total Credit Point; TC is the Total Credit**

NOTE

A separate minimum of 40% marks each for internal and external (for both theory and practical) are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade C** is required for all the individual courses. If a candidate secures**D Grade** for any one of the course offered in a Semester/Programme**only D grade** will be awarded for that Semester/Programme until he/she improves this to **C GRADE** or above within the permitted period.

CURRICULUM

GRADUATE PROGRAMME OUTCOMES (GPO) – POST GRADUATE PROGRAMMES

At the completion of the Post Graduate Programme, the student will be able to accomplish the following programme outcomes.

GPO No.	Graduate Programme Outcomes
GPO.1	**Critical Thinking**: Ability to engage in independent and reflective thinking in order to understand logic connections between ideas.
GPO.2	**Effective Communication:** Development of communication skills for effectively transmitting and receiving information that focuses on acquiring knowledge, problem solving, improving on arguments and theories thereby paving the way for better employability and entrepreneurship.
GPO.3	**Social Consciousness:** Acquire awareness towards gender, environment, sustainability, human values and professional ethics and understand the difference between acting, responding and reacting to various social issues.
GPO.4	**Multidisciplinary Approach:** Combining various academic disciplines and professional specializations to cross borders and redefine problems in order to explore solutions based on the new understanding of complex situations.
GPO.5	**Subject Knowledge:** Acquiring knowledge at a higher level that would help develop the necessary skills, fuel the desire to learn and contribute to the field of expertise thereby providingvaluable insights into learning and professional networking with the aim of cateringto the local, national and global developmental needs.
GPO.6	**Lifelong Learning**: Understanding the necessity of being a lifelong learner for personal enrichment, professional advancement and effective participation in social and political life in a rapidly changing world.

PROGRAMME SPECIFIC OUTCOMES

PSO No.	**Intended Programme Specific Outcomes** *Upon completion of M.Sc Applied Physics Programmes, the graduates will be able to:*	GPO NO:
PSO-1	Acquire high-level knowledge in classical mechanics, quantum mechanics, electrodynamics and statistical mechanics and apply it to complex problems in physics and other areas	1,5
PSO-2	Develop proficiency in the analysis of complex physical problems and the use of mathematical or other suitable techniques to solve them	1,2,5
PSO-3	Apply theoretical knowledge and critical reasoning skills to model and solve practical problems	1,2,5
PSO-4	Develop understanding of application in areas of telecommunications, optoelectronics and solar physics	4,5,6
PSO-5	Learn fundamental techniques of applied physicsand gain work experience with standard computational tools used in industry	1.4
PSO-6	Develop skills for a research career in academia or industry by learning advanced ideas and techniques emphasizing the underlying concepts of Physics	3,5,6

PROGRAMME DESIGN

1.1 Theory Courses:

There are sixteen theory courses distributed in the four semesters in the M.Sc. Physics Programme. Among the sixteen courses, twelve courses are common to all the students. Semester I and semester II include four core papers while semester III and semester IV have two core papers. Four elective papers are given in the elective bunchout of which two elective papers comes in the semester III and the other two in semester IV.

1.2 Practical:

All semesters have practical courses. Semester I&II & IV have common practical courses while semester III practical will subject to the elective bunch. A minimum of twelve experiments should be done and recorded for each semester.

Besides theory and practical courses, project and viva voce examination will also be there at the end of semester IV.

The course design is given below:

Sl.No	Course Type	No. of Courses	Total Credits
1.	Core Courses	12	46
2.	Core Practical	3	12
3.	Elective Courses	4	14
4.	Elective Practical	1	4
5.	Viva voce	1	2
6.	Dissertation	1	2
	Total		**80**

PROGRAMME STRUCTURE

	Code	Course Name	Credit	Hrs/W	Total Credits
Semester 1	AP1921101	Classical Mechanics and Nonlinear Dynamics	4	4	19
	AP1921102	Electromagnetic Theory	4	4	
	AP1921103	Spectroscopy	4	4	
	AP1921104	Applied Mathematics I	3	3	
	AP1921601	General Physics Practical	4	10	
Semester 2	AP1922105	Applied Mathematics II	4	4	19
	AP1922106	Electronics and Communication	4	4	
	AP1922107	Solid State Physics	4	4	
	AP1922108	Introduction to Quantum Mechanics	3	3	
	AP1922602	Electronics Practical	4	10	
Semester 3	AP1923109	Thermal and Statistical Physics	4	4	19
	AP1923110	Quantum Mechanics	4	4	
	AP1923301	Elective Course I	4	4	
	AP1923302	Elective Course II	3	3	
	AP1923701	Elective Practical	4	10	
Semester 4	AP1924111	Computational Physics	4	4	23
	AP1924112	Nuclear Physics	4	4	
	AP1924303	Elective Course III	4	4	
	AP1924304	Elective Course IV	3	3	
	AP1924603	Computational Physics Practical	4	10	
	AP1924801	Project/Dissertation	2	-	
	AP1924901	Viva Voce	2	-	
	Total				**80**

Elective Courses:

1. Bunch A: Photonics

Code	Course Name	Credit	Hrs/W	Semester
AP1923301	Laser Physics and Solar Cells	4	4	3
AP1923302	Photonics I	3	3	3
AP1924305	Photonics II	4	4	4
AP1924306	Fiber Optics	3	3	4
AP1923701	Photonics Practical	4	10	3

2. Bunch B: Optronics

Code	Course Name	Credit	Hrs/W	Semester
AP1923303	Bio Photonics	4	4	3
AP1923304	Solar thermal energy collection and storage	3	3	3
AP1924307	Optical Instrumentation	4	4	4
AP1924308	Applied Optics	3	3	4
AP1923702	Optronics Practical	4	10	3

DETAILED SYLLABUS OF ALL COURSES

SEMESTER I

Course	Details
Code	AP1921101
Title	**CLASSICAL MECHANICS AND NONLINEAR DYNAMICS**
Degree	M.Sc.
Branch(s)	Applied Physics
Year/Semester	1/I
Type	Core
Credits	4 **Hours/week** 4 **Total Hours** 72

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*	Cognitive Level	PSO No.
1	Understand Lagrangian and Hamiltonian dynamics	U	1,2
2	Discuss the variational principle	E	1,2
3	Analyze canonical transformation	An	1,2
4	Explain Hamilton Jacobi theory	An	1,2
5	Analyze the theory of small oscillations	An	1,2
6	Discuss the central force problem	E	1,2
7	Understand the dynamics of a rigid body	U	1,2
8	Understand General Theory of Relativity	U	1
9	Discuss non-linear dynamics	E	1
10	Solve problems in classical mechanics	Ap	2,3

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Lagrangian Formulation and Hamiltonian Dynamics**		
1.1	Review on Lagrangian dynamics	2	1
1.2	Generalized momentum and cyclic coordinates	1	1
1.3	D'Alembert's Principle	1	1
1.4	Lagrange's equations from D'Alembert's Principle	2	1
1.5	Conservation theoremsand Symmetry properties	2	1
1.6	Hamilton's equation of motion	2	1
1.7	Principle of least action	2	1
1.8	Variational principle	1	2

1.9	Calculus of variations	2	2
1.10	Examples for calculus of variation	2	2,10
1.11	Derivation of Lagrange's equations from Hamilton's principle	2	2
2.0	**Canonical Transformations, Hamilton-Jacobi Theory**		
2.1	Equations of canonical transformation	2	3
2.2	Example- Harmonic oscillator	2	3
2.3	Poisson brackets and its fundamental properties	1	3
2.4	Equation of motion in Poisson bracket form	1	3
2.5	Canonical invariance of Poisson bracket	1	3
2.6	Lagrange brackets	1	3
2.7	Angular momentum Poisson brackets	1	3
2.8	Hamilton-Jacobi equation for Hamilton's principal function	1	4
2.9	Harmonic oscillator problem as an example	2	4,10
2.10	Action angle variables	2	4
2.11	Harmonic oscillator problem using action angle variable	1	4,10
3.0	**Theory of small oscillations, Central force problem**		
3.1	Equilibrium and potential energy	1	5
3.2	Theory of small oscillations	2	5
3.3	Normal modes and normal coordinates	1	5
3.4	Two coupled pendula	1	5,10
3.5	Longitudinal vibrations of a linear triatomic molecule	2	5,10
3.6	Equations of motions and first integrals for central force problem	1	6
3.7	Equivalent one dimensional problem	1	6
3.8	Classification of orbits	2	6
3.9	Virial theorem	1	6
3.10	The differential equation for orbits	1	6
3.11	Kepler problem	2	6
4.0	**Rigid Body Dynamics**		
4.1	Independent co-ordinates of a rigid body.	1	7
4.2	Angular momentum and kinetic energy of motion about a point	2	7
4.3	Inertia tensor and principal axes	1	7,10
4.4	Euler's angles	1	7
4.5	Euler equations of motion	1	7
4.6	Torque free motion of a rigid body -Symmetric top	2	7
4.7	Rate of change of a vector	1	7
4.8	Coriolis force	2	7,10
4.9	Gyroscopes	1	7
5.0	**General Theory of Relativity, Nonlinear Dynamics**		
5.1	Principle of equivalence	1	8
5.2	Principle of General Covariance	1	8
5.3	Bending of light in a gravitational field	1	8

5.4	Relativity in the Global Positioning System (GPS)	2	8
5.5	Phase trajectories of linear systems- linear and damped harmonic oscillator	2	9
5.6	Phase trajectories of non-linear conservative systems	1	9
5.8	Singular points of trajectories	1	9
5.9	Duffing oscillator as an example of non-linear system	2	9

Text Books for Study

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rdP Ed.
2. Classical Mechanics, G Aruldhas, PHI Learning Private Limited
3. Classical Mechanics, J. C. Upadhyaya, Himalaya Publishing House

Text Books for References:

1. Classical Mechanics, N. C. Rana and P. S. Joag Tata McGraw Hill.
2. Classical Mechanics,A. K. Raychauduri, Oxford Uni. Press.
3. Dynamics, S. N. Rasband, John Wiley.
4. Introduction to Dynamics, I. Percival and D. Richard, Cambridge University Press.
5. Lagrangian and Hamiltonian Mechanics, Calkin M. G. Allied Pub. Ltd.
6. Classical Mechanics: Applied Mechanics and Mechatronics, J. Awrejcewicz, Z. Koruba, Springer 2012

Course	Details				
Code	AP1921102				
Title	**ELECTROMAGNETIC THEORY**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/I				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive Level	PSO No.
1	Understand basic theories of electrostatics and magnetostatics	U	1,3,4
2	Interpret the applications of electrostatics and magnetostatics	Ap	1
3	Distinguish Maxwell's equations and its physical significance	U	3
4	Discuss the relativistic aspects of electrodynamics	E	1,3
5	Categorize the conservation laws related to electromagnetic waves	An	4
6	Analyze the applications of electromagnetic radiation and wave guides	An	4,5
7	Solve problems related to electrostatics, magnetostatics, EM Theory and Maxwell's equations	Ap	1, 2

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Electrostatics and Electrostatic fields in matter**		
1.1	Recent developments in electrodynamics	1	1,8
1.2	Gauss's law and its applications	1	1,2,7
1.3	Laplace and Poisson's equations	1	1,2,7
1.4	Electrostatic boundary conditions	1	1,2,7
1.5	Electrostatic fields in matter	1	1,2,7
1.6	Polarization	1	1,2,7
1.7	The field of a polarized object	1	1,2,7
1.8	Electric displacement and Linear dielectrics	2	1,2,7
2.0	**Magnetostatics and Magnetostatic fields in matter**		
2.1	Ampere's law and its applications	2	1,2,7
2.2	Magnetostatic boundary conditions	2	1,2,7
2.3	Magnetic Fields in Matter	1	1,2,7
2.4	Magnetization	1	1,2,7
2.5	The field of a magnetized object	1	1,2,7

2.6	The auxiliary Field H in Linear and Non linear media	2	1,2,7
3.0	**Maxwell's equations and Relativistic electrodynamics**		
3.1	Maxwell’s equations	2	1,3,4,7
3.2	The Potential Formulation :Vector and scalar potentials	1	1,3,4,7
3.3	Gauge transformations: Lorentz gauge & Coulomb gauge	2	1,3,4,7
3.4	Structure of space time: Four vectors	1	1,3,4,7
3.5	Proper time and proper velocity	1	1,3,4,7
3.6	Relativistic dynamics - Minkowski force	2	1,3,4,7
3.7	Magnetism as a relativistic phenomenon,	1	1,3,4,7
3.8	Lorentz transformation of electromagnetic field	2	1,3,4,7
3.9	Electromagnetic field tensor	2	1,3,4,7
3.10	Electrodynamics in tensor notation	2	1,3,4,7
3.11	Potential formulation of relativistic electrodynamics	2	1,3,4,7
4.0	**Conservation laws and Electromagnetic waves**		
4.1	The Continuity equation- Energy & momentum in electrodynamics	2	1,5,7
4.2	Newton’s third law-Poynting’s Theorem-	2	1,5,7
4.3	Maxwell’s stress tensor.	1	1,5,7
4.4	Waves in One Dimension: The wave equations, Boundary conditions & Polarization	2	1,5,7
4.5	Electromagnetic waves in vacuum: The wave equation for E and B.	2	1,5,7
4.6	Monochromatic plane waves, Energy and momentum in EM waves	2	1,5,7
4.7	Electromagnetic waves in matter-Propagation in linear media,	2	1,5,7
4.8	Reflection and transmission at normal and oblique incidence	2	1,5,7
4.9	Absorption and Dispersion: EM waves in conductors.	1	1,5,7
4.10	Reflection at a conducting surface	1	1,5,7
4.11	Frequency dependence of permittivity	1	1,5,7
5.0	**Electromagnetic Radiation & Waveguides**		
5.1	Retarded Potentials-Jefimenko's equations	3	1,6,7
5.2	LienardWiechert Potentials	3	1,6,7
5.3	Electromagnetic radiation: Radiation from electric & magnetic dipoles	4	1,6,7
5.4	Radiation from a moving point charge,	3	1,6,7
5.5	TE & TM waves in rectangular waveguides	3	1,6,7
5.6	Impossibility of TEM wave in rectangular wave guide	2	1,6,7

Text Books for study:

1. Introduction to electrodynamics by David J Griffiths: PHI Learning; 3rd edition (2012).
2. Classical Electrodynamics by J D Jackson; John Wiley & Sons; 3rd Edition
3. Antenna & waveguide propagation, K. D. Prasad

Reference Books:

1. Electromagnetic waves & Radiating Systems, E.C Jordan & K. G.Balmain, PHI.
2. Elements of electromagnetic, Mathew N. O. Sadiku, Oxford University Press.
3. Electromagnetic waves & radiating system, Jordan &Balmain
4. Electromagnetics- Schaum's outline series, Joseph A. Edminister

Course	Details				
Code	AP1921103				
Title	**SPECTROSCOPY**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/I				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Recognize the role and practical application of physics of atoms and molecules in the modern world.	U	3
2	Solve problems related to Zeeman effect and Stark effect.	Ap	2
3	Understand the principles of ESR, NMR and Mössbauer spectroscopy.	U	4,6
4	Explain rotational, vibrational, electronic and Raman spectra of molecules.	U	4
5	Evaluate the modern developments in spectroscopy.	E	6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Atomic Spectra**		
1.1	Vector atom model	1	1
1.2	Electron spin-Stern-Gerlach experiment	2	1
1.3	LS and jj coupling schemes-spectroscopic terms	2	1
1.4	Pauli's exclusion principle	1	1
1.5	Spin-orbit interaction-interaction energy	2	1
1.6	Interaction energy in LS and jj coupling schemes	3	1
1.7	Selection rule-Hund's rule-Lande interval rule	1	1
1.8	Normal and anomalous Zeeman effect	3	1,2
1.9	Paschen-Back effect and Stark effect in one electron systems	2	1,2
1.10	Hyperfine structure-width of spectral lines.	1	1,2
2.0	**Resonance spectroscopy**		
2.1	ESR-theory-relaxation process	2	1,3
2.2	Experimental setup	1	1,3,5
2.3	Hyperfine structure-applications	2	1,3

2.4	NMR-classical and quantum theories	2	1,3
2.5	Relaxation process-experimental technique	2	1,3,5
2.6	Chemical shift-spin-spin coupling-applications.	2	1,3
2.7	Mössbauer effect	2	1,3
2.8	Chemical isomer shift	2	1,3,5
2.9	Magnetic hyperfine interactions	2	1,3
2.10	Electric quadrupole interaction-applications	1	1,3
3.0	**Microwave spectroscopy**		
3.1	Rotational spectra of rigid diatomic molecules	2	1,4
3.2	Isotopic effect-intensity of rotational lines	2	1,4
3.3	Non rigid rotator-linear polyatomic molecules	2	1,4
3.4	Symmetric top molecules	1	1,4
3.5	Microwave spectroscopy and information from rotational spectra.	1	1,4,5
4.0	**Infrared spectroscopy**		
4.1	Vibrating diatomic molecules as harmonic and an harmonic oscillators	2	1,4
4.2	Diatomic vibrating rotator	1	1,4
4.3	Breakdown of Born-Oppenheimer approximation	1	1,4
4.4	Vibrational spectra of polyatomic molecules	2	1,4
4.5	Overtones and combinations	1	1,4
4.6	Influence of rotation on the spectra of linear and symmetric top molecules	2	1,4
4.7	IR spectroscopic analysis-FT-IR spectroscopy.	1	1,4,5
5.0	**Raman Spectroscopy & Electronic Spectroscopy**		
5.1	Raman effect- theory	1	1,4
5.2	Rotational Raman spectra-linear molecules	1	1,4
5.3	Symmetric top molecules	1	1,4
5.4	Vibrational Raman spectra-rotational fine structure	1	1,4
5.5	Raman activity-mutual exclusion principle	1	1,4
5.6	Structure determination using Raman and IR spectroscopy	1	1,4,5
5.7	Laser Raman spectrometer, basic idea of nonlinear Raman effects	1	1,4,5
5.8	Stimulated Raman effects, Hyper Raman effect	1	1,4
5.9	Inverse Raman effect and CARS.	1	1,4
5.10	Electronic spectra of diatomic molecules- progressions and sequences	2	1,4
5.11	Frank Condon principle	2	1,4
5.12	Rotational fine structure of electronic vibration spectra	2	1,4
5.13	The Fortrat parabola-dissociation-pre-dissociation	2	1,4
5.14	Fluorescence and phosphorescence.	1	1,4,5

Text Books:

1. Introduction to atomic spectra, White H. E., McGraw Hill.
2. Spectroscopy Volume 1, Straughan and Walker, John Wiley & Sons.
3. Spectroscopy volume 2 Straughan and Walker, John Wiley & Sons.
4. Molecular structure and spectroscopy, G. Aruldhas, PHI.

5. Fundamentals of molecular spectroscopy, C. N. Banwell and E. M. McCash, TMH.
6. Raman spectroscopy, D. A. Long, McGraw Hill Inc.

Reference Books:

1. Introduction to molecular spectroscopy, G. M. Barrow McGraw Hill.
2. Elements of spectroscopy, Gupta, Kumar and Sharma, PrgathiPrakshan.
3. Molecular spectra and molecular structure, Vol. I, II & III, Hertzberg G., Van Nostrand, London.
4. The infrared spectra of complex molecules, Vol I and II, Bellamy L. J. Chapman and Hall.

Course	Details				
Code	AP1921104				
Title	**APPLIED MATHEMATICS – I**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/I				
Type	Core				
Credits	3	**Hours/week**	3	**Total Hours**	54

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	**Cognitive Level**	**PSO No.**
1	Explain linear dependence and linear combination of vectors as quantities in physics and identify various types of matrices and explain how one type of matrix differs from another	Ap	1
2	Understand the differentiation and integration of vector fields through vector calculus	U	4
3	Understand the distributions including binomial, Poisson and Normal distribution	U	1
4	Express Dirac Delta function	U	1
5	Apply integral transform (Fourier and Laplace) to solve mathematical problems of interest in physics	Ap	4, 7
6	Understand the introductory concepts in tensors	U	4

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO. No.
1.0	**Linear Algebra: Matrices**		
1.1	Linear system of equations	1	1
1.2	Gauss elimination method	1	1
1.3	Product theorem, Diagonal matrices, Trace	1	1
1.4	Matrix inversion: Gauss-Jordan matrix inversion	1	1
1.5	Orthogonal matrices	1	1
1.6	Complex matrices: Hermitian, Skew-Hermitian	1	1
1.7	Unitary matrices	1	1
1.8	Pauli matrices – Symmetry properties	1	1
1.9	Similarity transformation: Orthogonal & Unitary	1	1
1.10	Eigen vectors, normalized eigen vectors and eigen values	1	1
1.11	Cayley Hamilton theorem	1	1
1.12	Diagonalization of matrices	1	1
1.13	Normal modes of vibration	1	1
1.14	Introduction to tensors	1	6

2.0	**Probability and distribution**		
2.1	Probability - Laws of probability	1	3
2.2	Binomial distribution	1	3
2.3	Poisson distribution	1	3
2.4	Normal distribution	1	3
3.0	**Vector Calculus**		
3.1	Differential Calculus – Gradient, Divergence and Curl	1	1, 2
3.2	Integral calculus: line, surface and volume integrals	1	1, 2
3.3	Fundamental theorem for – gradient , divergence	1	1, 2
3.4	- curl	1	1, 2
3.5	Equation of continuity	1	1, 2
3.6	Potential theory	1	1, 2
3.7	Gauss's law and Poisson's equation	1	1, 2
3.8	Orthogonal curvilinear coordinates: Spherical and Cylindrical	2	1, 2
3.9	Differential vector operators in orthogonal coordinates	1	1, 2
3.10	Dirac delta function – properties	1	4
3.11	Linear vector spaces	1	1, 2
3.12	Self adjoint and unitary operators	1	1, 2
3.13	Eigen values and Eigen vectors of self adjoint operators	1	1, 2
3.14	inner product space	1	1, 2
3.15	Schimdtorthogonalisation	2	1, 2
3.16	Schwartz inequality	1	1, 2
4.0	**Fourier Transforms**		
4.1	Introduction to Fourier series and Fourier integral	1	5
4.2	Fourier transform	1	5
4.3	Cosine and Sine transform	1	5
4.4	Fourier transform Applications - Square wave, Gaussian function, Full wave rectifier	1	5
4.6	Finite wave train, Linearity theorem	1	5
4.7	Fourier transform of derivatives	1	5
4.8	Convolution theorem, Parseval's theorem	1	5
4.9	Momentum representation, Harmonic oscillator	1	5
4.10	Ground state of hydrogen atom	1	5
5.0	**Laplace Transform**		
5.1	Laplace transform, inverse laplace transform	1	5
5.2	Linearity theorem, First shifting theorem	1	5
5.3	Convolution theorem	1	5
5.4	Laplace transform of derivatives, Applications to simple differential equations	2	5

5.5	Earth’s nutation	1	5
5.6	Damped, driven oscillator	1	5
5.7	LCR circuit	1	5

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken& H.J. Weber, 4th Edition, Academic Press.
2. Introduction to Mathematical physics, Charlie Harper, PHI.
3. Mathematical Physics, B.D. Gupta, VikasPub.House, New Delhi
4. Mathematical Physics, H.K Dass&Dr. Rama Verma, S. Chand & Co.
5. Mathematical Physics, B.S Rajput, PragatiPrakashan.
6. Mathematical Physics, Satya Prakash, S.Chand& Sons.

Reference Books:

1. Advanced Engineering Mathematics, E. Kreyszig, 7th Ed., John Wiley.
2. Introduction to mathematical methods in physics, G.Fletcher, Tata McGraw Hill.
3. Advanced engineering mathematics, C.R. Wylie, & L C Barrett, Tata McGraw Hill.
4. Advanced Mathematics for Engineering and Physics, L.A. Pipes & L.R. Harvill, Tata McGraw Hill.
5. Mathematical Methods in Physics, J. Mathew & R.L. Walker, India Book House.
6. Mathematical Physics, H.K. Dass, S. Chand & Co. New Delhi.
7. Vector Analysis, Schaum’s outline M.R. Spiegel Tata McGraw Hill.

Course	Details				
Code	AP1921601				
Title	**GENERAL PHYSICS PRACTICAL**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/ I				
Type	Core Practical				
Credits	4	**Hours/week**	10	**Total hours**	180

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive Level	PSO No.
1	Describe the methodology of science and the relationship between observation and theory.	R	2
2	Practice the methodology by performing laboratory experiments.	Ap	2
3	Acquire necessary skills to makeaccurate measurements and proper tabulation.	U	3
4	Understand data and draw inferences wisely.	An	4,6
5	Rediscover concepts of physics through experiments.	E	3
6	Express knowledge and ideas in a proper format.	C	6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

(Minimum of 12 experiments should be done and recorded)

Section	Description	CO.No.
1.1	Y, n, σ – Cornu's method (i) Elliptical fringes (ii) Hyperbolic fringes	2
1.2	Absorption spectrum of KMnO4 solution and Iodine vapour	2
1.3	Arc spectra (i) iron (ii) copper	2
1.4	Arc spectrum – Identification of elements of an alloy	
1.5	Hall effect (i) carrier concentration (ii) mobility (iii) Hall coefficient	4
1.6	Resistivity of (i) Ge (ii) Si at various temperatures by Four Probe Method and determination of band gap	4
1.7	Band gap energy of (i) Ge (ii) Si	2
1.8	Ultrasonics	2
1.9	Oscillating disc – Viscosity of a liquid	4
1.10	e/m – Thomson's method	4
1.11	Charge of electron – Millikan's experiment	4
1.12	Determination of e/k using diode	4
1.13	Study of absorption spectrum – Hartman's method	5

1.14	Magnetic Susceptibility-Gouy's method/Quincke's method.	2
1.15	Michelson Interferometer - λ and dλ / thickness of mica.	2
1.16	Characteristic of a thermistor - Determination of the relevant parameters.	5
1.17	Silicon diode as a temperature sensor.	2
1.18	Determine the Young's modulus of the material of a bar by flexural vibrations.	4
1.19	Determine the Stefan's constant of radiation using a suitable method.	4
1.20	Measure the operating voltage of a GM counter and determine the linear absorption co-efficient and half value thickness of a thin metal foil using a beta-ray source.	4
1.21	Using a multichannel analyzer study the energy spectrum of an alpha source.	5
1.22	Determine the Planck's constant using a photoelectric cell/LED.	4
1.23	Determine the wave length of the given laser source by observing the diffraction patterns of (a) cross wire and (b) wire mesh. (c) single slit (d) double slit (e) reflection grating (f) transmission grating (g) pin hole (h) single wire (any 4 compulsory)	4
1.24	Plot the beam profile of a given laser. Measure the spot size of the beam at three equidistant locations in the far-field and determine the half divergence angle.	5
1.25	Determine the numerical aperture of the given optical fibre from a measurement of its far field.	4
1.26	Study the macro bend-induced loss in the given optical fibre.	2
1.27	Draw the B-H curve of a ferromagnetic material and determine the retentivity and coercivity of the material	5
1.28	Measure the thermo emf of a given Cu-Fe thermocouple as function of temperature. Also prove that Seebeck effect is reversible	5
1.29	Verify the temperature dependence of ceramic capacitor and verify Curie-Weiss law	5

SEMESTER II

Course	Details				
Code	AP1922105				
Title	**APPLIED MATHEMATICS – II**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/II				
Type	Core				
Credits	4	**Hours/week**	4	**TotalHours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Distinguish between various differential equations	U	2
2	Solve Bessel, Hermite and Legendre differential equations and develop the corresponding recurrence formulae.	Ap	3
3	Understand the introductory concepts in Tensors.	U	2
4	Understand basic properties of standard PDE's.	Ap	3
5	Apply a range of techniques to find solutions of standard Partial Differential Equations (PDE)	Ap	3
6	Master the basic elements of complex mathematical analysis, including the integral theorems, obtain the residues of a complex function and use the residue theorem to evaluate definite integrals in solving physical problems	Ap	2,4
7	Gain a working idea of groups	U	2

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No
1.0	**Functions of a complex variable**		
1.1	Functions of a complex variable	1	6
1.2	Analytic functions	1	6
1.3	Cauchy–Riemann equations	1	6
1.4	Harmonic functions	1	6
1.5	Cauchy's integral theorem	1	6
1.6	Cauchy's theorem for multiply connected domains	1	6
1.7	Cauchy's integral formula	1	6
1.8	Derivatives of analytic functions	2	6
1.9	Taylor expansion	2	6
1.10	Laurent expansion	1	6
1.11	Singularities-poles and zeros	1	6
1.12	Residue theorem	1	6
1.13	Evaluation of definite integrals	2	6

1.14	Jordan’s lemma	1	6
1.15	Cauchy principal value	1	6
2.0	**Tensors and Group theory**		
2.1	Tensors-co-ordinate transformations-	1	3
2.2	Contravariant, covariant and mixed tensors	1	3
2.3	Einstein’s summation convention, Symmetric & skew-symmetric tensors, Fundamental operation with tensors	1	3
2.4	Contraction & Direct product-Quotient rule	1	3
2.5	Levi-Civita symbol	1	3
2.6	Christoffel symbols	1	3
2.7	Covariant differentiation	1	3
2.8	Tensor form of gradient, divergence	2	3
2.9	Geodesic equation	1	3
2.10	Definition of group	1	7
2.11	Discrete group (Examples)	1	7
2.12	Continuous group (Examples)	1	7
2.13	Matrix Groups	1	7
2.14	Special Unitary(2) group	1	7
2.15	Orthogonal(3) group	1	7
3.0	**Partial differential equations**		
3.1	Introduction to partial differential equations	1	4
3.2	Separation of variables: Cartesian coordinates	2	4
3.3	Separation of variables: circular cylindrical coordinates	2	4
3.4	Separation of variables: spherical polar coordinates	2	4
3.5	Examples of partial differential equations and boundary conditions-Heat equation	2	5
3.6	Inhomogeneous equation - Green’s function	1	5
3.7	Symmetry of Green’s function	1	5
3.8	Green’s function for Poisson equation	1	5
3.9	Helmholtz equation	2	5
3.10	Forms of Green function	2	5
3.11	Application of Green’s function in scattering problem	2	5
4.0	**Differential equations and special functions I**		
4.1	Gamma and Beta functions-Different forms	1	1
4.2	Evaluation of standard integrals	1	2
4.3	Bessel differential equation- series solution	2	2
4.4	Bessel function of first kind and the second kind	1	2
4.5	Generating function for Bessel functions	1	2
4.6	Recurrence relations	1	2
4.7	Orthogonality property	1	
5.0	**Differential equations and special functions II**		
5.1	Legendre differential equation- series solution	1	2
5.2	Legendre polynomials	1	2
5.3	Generating function	1	2
5.4	Recurrence formula- Orthogonality of Legendre polynomials	2	2
5.5	Rodrigues formula for Legendre polynomials	1	2

5.6	Hermite differential equations – series solution	1	2
5.7	Hermite polynomial- Recurrence relation- generating function	2	2
5.8	Orthogonality property of Hermite polynomial	1	2
5.9	Quantum mechanical harmonic oscillator	1	2
5.10	Laguerre differential equation	1	2

Text Books:

1. Mathematical Physics – B D Gupta – Vikas Pub. House Pvt Ltd- New Delhi -1997.
2. Mathematical method for Physics – G. B. Arfken& H. J. Weber.
3. Mathematical Physics, Satya Prakash, S.Chand& Sons.
4. Elements of Group Theory for Physicists- A W Joshi

Reference Books:

1. Advanced engineering mathematics – CR Wylie – Tata McGraw Hhill.
2. Advanced mathematics for engineers & scientists- Schaum’s outline M R Spiegel Tata McGraw-Hill.
3. Matrices & Tensors in Physics-A.W Joshi.
4. Mathematical Physics, P.K.Chottapadhyay, New Age International (P.) Ltd.

Course	Details				
Code	AP1922106				
Title	**ELECTRONICS AND COMMUNICATION**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/II				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1.	Describes and analyse the compensating circuits and different filter circuits	R	1,4
2.	Compares the functions of oscillators and generators.	An	1,4,5
3.	Discuss various modulation techniques, its classification advantageous and related interfacing devices	U	2
4.	Analyse modulation techniques through the mathematical derivation and graphical representation	An	4
5	In-depth knowledge on architecture for microprocessor 8086	E	1
6	Skill in designing Microprocessor and Microcontroller based systems to design Physics related measuring, controlling, and automated systems	Ap	1
7	Interpret, represent and process continuous ,discrete/digital signals and systems	U	2
8	Explain the principle of signal analysis to filtering	U	2

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Frequency Response of an Op-amp Active Filters and Oscillators**		
1.1	Frequency response – Compensating networks	2	1
1.2	High frequency op-amp equivalent circuit	1	1
1.3	Open loop gain as a function of frequency – Closed loop frequency response	2	1
1.4	Circuit stability - slew rate	1	1
1.5	Active filters – First order and second order low pass Butterworth filter	2	1
1.6	First order and second order high pass Butterworth filter	2	1
.7	Wide and narrow band pass filter - wide and narrow	2	1

	band reject filter- All pass filter		
1.8	Oscillators: Phase shift and Wien-bridge oscillators	2	2
1.9	Square, triangular and sawtooth wave generators	2	2
1.10	Voltage controlled oscillator	2	2
2.0	**Communication Systems**		
2.1	Modulation	1	3
2.2	Amplitude modulation	1	3,4
2.3	SSB technique	1	3
2.4	Frequency modulation	1	3,4
2.5	Frequency spectrum of FM wave	2	3
2.6	Phase modulation	1	3,4
2.7	Generation of FM	2	3,4
2.8	Pulse modulation	1	3
2.9	Pulse modulation – Pulse width, pulse position	2	3,4
2.10	pulse code modulation	1	3
2.11	Digital communication – Digital codes	2	3,4
2.12	Error detection and correction	1	3,4
2.13	Modem classification – Modem interfacing	2	3
3.0	**Microprocessors**		
3.1	Intel 8086 – Architecture	2	5
3.2	Pin Configuration	1	
3.3	Addressing modes	1	5
3.4	Instruction sets	2	5
3.5	Assembler directives	1	5
3.6	8086 based microcomputer	1	5
3.7	Basic ideas of 8088, 80186, 80286, 80386, 80486 and Pentium processors	1	5
4.0	**Microcontrollers**		
4.1	Evolution of microcontrollers	1	6
4.2	Comparison of microprocessors and microcontrollers	1	6
4.3	8 bit microcontrollers	1	6
4.4	8051 architecture	2	6
4.5	Hardware - I/O pins, ports and circuits	1	6
4.6	External memory	1	6
4.7	Basic programming concepts	1	6
4.8	Applications	1	6
5.0	**Digital Signal Processing**		
5.1	Continuous time (CT) and discrete time (DT) systems	1	7

5.2	Discrete time (DT) signals	1	7
5.3	Some elementary discrete time signals – Classification of discrete time signals	1	7
5.4	Classification of discrete time systems	1	7
5.5	Convolution sum – Correlation of discrete time signal	1	7
5.6	Z transform	2	7
5.7	Analysis of CT signals – Fourier series and Fourier transforms	1	7
5.8	Analysis of DT signals – Fourier series and Fourier transforms	2	7
5.9	Discrete Fourier transform of DT signals	2	7
5.10	Fast Fourier transform	2	7
5.11	Digital filtering in time domain	2	7
5.12	FIR filters	1	8
5.13	IIR filters	1	8

Text Books:

1.Op-amps and linear integrated circuits, R.A. Gayakwad 4thEdn. PHI
2. Electronic communication system, George Kennedy, TMH.
3.Signals and Systems – A.V. Oppenheim, A. S. Willsky and I. T. Young – PHI.
4. Digital Signal Processing – John G. Proakis, Dimitris G. Manolakis – 4/E, PHI.
5. 8051 Microcontroller by Kenneth J.Ayala.
6. Microprocessors: Theory and Applications, Rafiquzzaman, Pearson Education India
7. Microprocessor and Microcontroller by R.Thyagarajan, Sci Tech Publication, Chennai.

Reference Books:

1. Linear Integrated Circuits and Op Amps, S Bali, TMH.
2. Digital Signal Processing-P. Ramesh Babu, Scitech.
3. Fundamentals of Microprocessor and Microcontrollers, B. Ram, DhanpatRai Publications (seventh edition).

Course	Details				
Code	AP1922107				
Title	**SOLID STATE PHYSICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/II				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Describe the different types of crystal structures	U	2
3	Understand the theory of lattice vibrations and use it to determine the thermal properties of solids.	C	2,3,6
4	Explain thermal and electrical conductivities based on free electron theory.	U	2,3
5	Analyse the behavior of electrons in a periodic potential.	An	2
6	Distinguish solids based on their magnetic and dielectric properties.	U	5,6
7	Understand superconductivity based on the BCS theory and also its applications.	U	3,6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Crystal Structure**		
1.1	Crystal structure fundamental	1	1
1.2	Bragg law-reciprocal lattice vectors	1	1,2
1.3	von Laue formulation of X-ray diffraction by crystals	1	2
1.4	Equivalence of the Bragg and von Laue formulations.	1	2
1.5	Ewald construction	1	2
1.6	Brillouin zones – reciprocal lattice to SC, BCC and FCC lattices	1	1,2
1.7	The geometrical structure factor-structure factor of BCC and FCC lattices	1	1,2
1.8	The atomic form factor	1	2
1.9	**Lattice Vibrations -** Vibrations of monoatomic lattices	1	3
1.10	Lattice with two atoms per primitive cell	1	3
1.11	Quantization of lattice vibrations-phonon momentum	1	3
1.12	Thermal properties-Lattice heat capacity	1	3

1.13	Einstein model-density of modes	2	3
1.14	Debye model-Anharmonic crystal interactions	1	3
1.15	Thermal expansion-thermal conductivity	1	3
1.16	Thermal resistivity-Umklapp processes-second sound.	2	3
2.0	**Free Electron Theory**		
2.1	Drude-Lorentz theory of metals (quantitative idea)	1	4
2.2	Fermi –Dirac distribution	1	4
2.3	Sommerfeld theory – Free electron gas in one and three dimensions	2	4
2.4	Heat capacity of the electron gas – electrical conductivity and Ohm's law-experimental electrical resistivity of metals.	2	4
2.5	Motion in magnetic fields. Hall Effect – thermal conductivity of metals	1	4
2.6	The Wiedemann-Franz law.	1	4
3.0	**Energy Bands**		
3.1	Nearly free electron model-origin of energy gap	1	5
3.2	Bloch functions-Kronig-Penny model	3	5
3.3	Wave equation of electron in a periodic potential-solution of the central equation	3	5
3.4	Approximate solution near a zone boundary-number of orbitals in a band	2	5
3.5	Metals, insulators and semiconductors.	1	5
3.6	Brillouin zone in one and two dimensions-extended-reduced and periodic zone schemes-representations	2	5
4.0	**Magnetic Properties**		
4.1	Langevin diamagnetism equation	2	6
4.2	Quantum theory of paramagnetism	2	6
4.3	Hund's rules-Cooling by adiabatic demagnetization of a paramagnetic salt.	1	6
4.4	Ferromagnetic order	1	6
4.5	Curie point and exchange integral	1	6
4.6	Antiferromagnetic order-Susceptibility below Neel temperature	1	6
4.7	Ferrimagnetism and ferrites, Ferromagnetic domains	2	6
5.0	**Dielectrics and Superconductivity**		
5.1	Dielectrics-Local electric field at an atom	1	6
5.2	Dielectric constant and polarizability (Clausius-Mossotti relation)	2	6
5.3	Electronic polarizability	1	6
5.4	Ferroelectric crystals-Polarization catastrophe	1	6
5.5	Landau theory of phase transition	2	6
5.6	Ferroelectric domains-antiferroelectricity.	1	6

5.7	Superconductivity-Meissner effect	2	7
5.8	Energy gap-isotope effect	3	7
5.9	Type I, type II superconductors	2	7
5.10	Thermodynamics of superconducting transition-London equation	3	7
5.11	BCS theory- dc and ac Josephson effects	3	7
5.12	Flux quantization – High Tc superconductivity-applications.	3	7

Text Books:

1. Introduction to solid state physics, C. Kittel, Wiley India Pub.
2. Solid State Physics Structure and properties of materials, M. A. WahabNarosa Pub. House (2010).

Reference Books:

1. Solid State Physics - N W Ashcroft and N D Mermin, Cengage Learning Pub (2011).
2. Solid State Physics – A J Dekker, Macmillan & Co Ltd (1967).

Course	Details				
Code	AP1922108				
Title	**INTRODUCTION TO QUANTUM MECHANICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/II				
Type	Core				
Credits	3	Hours/week	3	Total Hours	54

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1.	Explain the concept that quantum states live in a vector space.	U	2
2.	Understand the mathematical tools of Quantum Mechanics	U	2
3.	Predict connections between mathematical development and conceptual understanding	C	2
4.	Apply the mathematical tools to solve quantum mechanical problems	Ap	1,4
5	Define time evolution operator, Heisenberg and Schrodinger picture	R	1
6	Solve problems using such tools as state vectors, time evolution operators in Schrodinger and Heisenberg pictures.	Ap	2
7	Apply scattering and partial wave analysis to solve quantum mechanical problems.	Ap	2,4
8	Discuss the Born approximation	U	1,2
9	Use the Born Approximation to Quantum Mechanical Problems	Ap	2,4

*PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Mathematical Tools of Quantum Mechanics**		
1.1	Hilbert space-Dimension and Basis of a vector space	1	1
1.2	Dirac notation-Ket space-Bra space-inner products	1	2,3
1.3	Operators-Eigen values and Eigen vectors of an operator	1	2,2
1.4	Hermitian,Unitary operators (Eigen values & Eigen	2	2,3

	vectors),Projection operators		
1.5	Compatible Observables	1	2,3
1.6	Uncertainty relation between two operators	2	2,3
1.7	Matrix representations of Kets, Bras & Operators	1	2,3
2.0	**Change of Bases & Unitary transformations**		
2.1	Change of Bases & Unitary transformations	2	2,3
2.2	Unitary equivalent observables	1	2,3
2.3	Position representation-Translation-Momentum as a generator of translation	1	2,3
2.4	Position-momentum uncertainty relation- Canonical commutation relations	1	2,3
2.5	Position space wave function	1	2,3
2.6	Momentum operator in the position basis	1	2,3
2.7	Momentum space function-Connection between position and momentum space function	1	2,3,4
2.8	Gaussian wave packets-Expectation value of x,x^2,p,p^2 for a Gaussian wave packet	2	2,3,4
3.0	**Quantum Dynamics**		
3.1	Time evolution Operator	2	5
3.2	Schrodinger equation, time evolution operator & formal solutions	2	6
3.3	Energy eigenkets-Time Dependence of expectation values-Energy Time uncertainty relation	1	6
3.4	Schrodinger picture & Heisenberg picture	2	5
3.5	Behaviour of state kets& Observables	2	6
3.6	Heisenberg equation of motion	1	6
3.7	Ehrenfest’s theorem	2	6
3.8	Energy eigenkets& eigenvalues of a simple Harmonic Oscillator using creation and annihilation operators.	3	4
3.9	Physical significance of creation and annihilation operators	1	4,6
4.0	**Scattering: Born Approximation**		
4.1	Scattering amplitude	3	7
4.2	Differe8ntial Scattering cross section and Total Scattering cross section	1	7
4.3	The firstBorn approximation	2	8
4.4	Validity of Born approximation	1	8

4.5	Application of Born approximation to square well potential	1	9
4.6	Application of Born approximation to Yukawa potential	1	9
4.7	Application of Born approximation to screened coulomb potential	1	9
5.0	**Scattering: Partial Wave Analysis**		
5.1	Method of Partial waves	2	7
5.2	Scattering by a perfectly rigid sphere	2	7
5.3	Scattering by a square well potential	3	7
5.4	Optical theorem	1	7
5.5	Ramsauer-Townsend effect and Resonance Scattering	1	7

Text Books for Study:

1. Modern Quantum Mechanics-J. J. Sakurai, Pearson Education.
2. Introduction to Quantum Mechanics -David J. Griffiths.
3. Quantum concepts and Applications –NouredineZettili, John Wiley & Sons.
4. A modern approach to Quantum Mechanics-Townsend, Viva Books Pvt. Ltd. McGraw Hill

Reference Books:

1. A Text book of Quantum Mechanics-P. M. Mathews & K. Venkatesan.
2. Quantum Mechanics-L. I. Schiff.
3. Quantum Mechanics-Ghatak and Loknathan.
4. Quantum Mechanics-G. Aruldas.
5. Quantum Mechanics-V. K. Thankappan, New Age Int. Pub.
6. Quantum Mechanics-L. D. Landau and E. M. Lifshitz.
7. Quantum Mechanics-Messiah A. P. Q. Q. M - Vol I & II.
8. Quantum Mechanics- an Introduction-W. Greiner, Springer Verlag.

Course	Details				
Code	AP1922602				
Title	**ELECTRONICS PRACTICAL**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	1/ II				
Type	Core Practical				
Credits	4	Hours/week	10	Total hours	180

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive level	PSO No.
1	Design the different oscillator, filter, amplifier circuits for various frequencies	C	2,3
2	Create amplitude modulation, frequency modulation and phase modulation its generation and demodulation circuits	C	3,6
3	Design FET based circuits, PLL, frequency multiplier and DC & AC milli – voltmeter construction and calibration	C	3
4	Select the appropriate integrated circuit modules to build a given application.	E	2,3
5	To understand the principle and working of different amplifiers, oscillators, filters, converters, op amp and FETs	U	3,6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

(Minimum of 12 experiments should be done and recorded)

Section	Description	CO.No.
1.1	Differential amplifier using Op Amp.	1,5
1.2	Differential Amplifier using Transistors(with constant current source)	1,5
1.3	RC coupled CE Amplifier	1,5
1.4	First order low pass & High pass filter	1,5
1.5	Second order low pass & High pass filter	1,5
1.6	Square wave Generator	1,5
1.7	Triangular wave generator	1,5

1.8	AstableMultivibrator	1,5
1.9	Wein-Bridge Oscillator using Op.Amp.	1,5
1.10	Voltage regulator using Op.Amp.	1,5
1.11	Wave form generators using Op.Amp.	1,5
1.12	Voltage controlled Oscillator – IC 555	1,5,4
1.13	PLL and frequency multiplier	3
1.14	Frequency mixing, AM and demodulation	2
1.15	Frequency modulation and demodulation	2
1.16	DC and AC milli – voltmeter construction and calibration	3
1.17	R F Oscillator - above 1 MHz frequency measurement.	1
1.18	Push-pull amplifier using complementary - symmetry transistor power gain and frequency response.	1
1.19	R F amplifier - frequency response & band width - Effect of damping.	1
1.20	Instrumentation amplifier using transducer	1,5
1.21	Amplified DC meter (FET Voltmeter)	3
1.22	Pulse width modulation	2

SEMESTER III

Course	Details				
Code	AP1923109				
Title	**THERMAL AND STATISTICAL PHYSICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/III				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Acquire a basic idea on the laws of thermodynamics and their consequences.	U	1
2	Apply the principles of statistical mechanics to selected problems.	Ap	5
3	Derive a relationship between microscopic and macroscopic properties in terms of probabilities.	Ap	4
4	Understand and to compare the principles of classical and quantum statistical physics.	U	1
5	Develop analytical ability to solve problems relevant to statistical mechanics.	U	2,3,6
6	Have a basic idea on fluctuation and phase transitions	U	6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO. No.
1.0	**Thermodynamics and Statistical Theory**		
1.1	Basic ideas about heat, temperature, work done - Laws of thermodynamics & their consequences - T S diagrams & equations.	4	1
1.2	Physical significance of entropy –ClausiusClapeyron equation - Thermodynamic potentials, Maxwell's relations	6	1
1.3	Micro and Macrostates -Thermodynamic probability - Phase Space - Concept of Entropy and Thermodynamic probability	6	3
1.4	Microcanonical, Canonical & Grand Canonical ensembles.	2	3
2.0	**Classical Statistical Mechanics**		
2.3	Classical Statistical Mechanics: Classical Statistical Mechanics - Thermodynamics of an ideal monatomic gas - Gibb's Paradox – Partition function	4	4

2.4	Canonical Partition function - Translational, rotational & vibrational partition functions - electronic & nuclear partition functions - homonuclear molecules.	3	4
2.5	Grand canonical partition function	2	4
3.0	**Quantum Statistical Mechanics**		
3.1	Need of quantum statistics - Symmetry of wave functions-Bosons - Fermions - Pauli's exclusion principle	2	4
3.2	Need of quantum statistics - Symmetry of wave functions-Bosons - Fermions	2	4
3.3	Pauli's exclusion principle BE &FD Distribution	4	4
3.4	Density matrix -Equation of motion of the density matrix - ensembles in quantum statistical mechanics -Calculation of Partition functions.	3	2
4.0	**Ideal Bose and Fermi gases**		
4.1	Ideal Fermi gas-Equation of state of an ideal Fermi gas - High & Low temperature limits -	3	2
	Electron gas at absolute zero-degeneracy - free electron model.	3	2
4.2	Ideal Bose gas - Equation of state - Photons – Black body radiation & Planck's distribution law.	6	2
4.3	Phonons - BE Condensation - Liquid Helium Lambda transition.	4	2
5.0	**Fluctuations & Phase transitions**		
5.1	Energy fluctuations in canonical ensembles - Density fluctuations in grand canonical ensembles	5	6
5.2	Fluctuations in quantum statistics - One dimensional random walk problem-Brownian motion and random walk	3	6
5.3	First & second order phase transitions -	4	6
5.4	Critical exponents - Scaling hypothesis -Ising model.	6	6

Text Books:

1. Introductory Statistical Mechanics,R. Bowley and M. Sanchez, Oxford University Press
2. Statistical Mechanics, R. K. Pathria, Butterworth-Heinemann

References Books:

1. Statistical Mechanics, Kerson Huang, Wiley Eastern.
2. Statistical Mechanics, B. K. Agarwal & M. Eisner, New Age Int.Pub.1998.
3. Fundamentals of Statistical Mechanics, B. B. Laud, New Age Int.Pub.1998.
4. Thermodynamics, M.W. Zeemansky, Tata McGraw Hill (1997)
5.Thermodynamics and Statistical Mechanics, W.G. Greiner, Neise and Stoker, Springer
6. Phase Transitions and Critical Phenomena, H. E. Stanley, Oxford Univ. Press.

Course	Details				
Code	AP1923110				
Title	**QUANTUM MECHANICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/III				
Type	Core				
Credits	4	**Hours/week**	4	**Total hours**	72

CO. No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive Level	PSO No.
1	Apply fundamental time independent approximation methods for various problems in quantum mechanics	Ap	1,2,3
2	Evaluate the energy eigen states and eigen functions of hydrogen atom using Schrodinger equation.	Ap	1,3
3	Explain basic theories of angular momentum and its interpretations	U	1,2
4	Analyze and discuss the basic theories of time dependent perturbation theory	An	1,2
5	Apply the concepts of relativistic quantum mechanics in various problems.	Ap	1,3
6	Discuss the basics of Quantum devices	U	1,2

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Time Independent Approximation Methods**		
1.1	Non degenerate time independent perturbation theory	2	1
1.2	First order correction to wave function and energy to second order.	1	1

1.3	Anharmonic oscillator	1	1
1.4	Quadratic Stark effect	2	1
1.5	Degenerate time independent perturbation theory: Secular equation	1	1
1.6	Linear Stark Effect in Hydrogen atom	1	1
1.7	Zeeman effect in Hydrogen atom	1	1
1.8	The variational method	1	1
1.9	Ground state energy of Harmonic Oscillator and Hydrogen atom	2	1
1.10	The WKB method, Connection formulas	2	1
1.11	Validity of WKB method, Barrier penetration, Potential well	2	1
1.12	Quantization condition and Harmonic Oscillator	2	1
2.0	**Hydrogen atom and the Theory of Angular Momentum**		
2.1	Hydrogen atom: Angular part of the hydrogen wave function	2	2
2.2	Hydrogen atom: Radial part of the hydrogen wave function	2	2
2.3	Orbital Angular momentum; General formalism of angular momentum	2	3
2.4	Eigenstates and eigenvalues of the angular momentum operator- Matrix representation of Angular Momentum	2	3
2.5	Geometrical representation of angular momentum	2	3
2.6	Spin angular momentum – general theory of spin, Spin ½ and Pauli matrices	2	3
2.7	Eigenfunctions and eigenvalues of orbital angular momentum	2	3
2.8	Rotations in classical and quantum physics- infinitesimal rotations, finite rotations, properties of rotation operator	2	3
2.9	Euler rotations, Representation of rotation operator	2	3
2.10	Rotation Matrices and the Spherical Harmonics	2	3
2.11	Addition of angular momentum, Calculation of Clebsch-	2	3

	Gordan coefficients		
3.0	**Time dependent Perturbation Theory**		
3.1	Interaction Picture	1	4
3.2	Equation of motion for the state vectors & operators	1	4
3.3	Time dependent perturbation theory	2	4
3.4	Dyson series	2	4
3.5	Transition probability	1	4
3.6	Constant perturbation	2	4
3.7	Harmonic perturbation	2	4
3.8	Adiabatic & Sudden approximations	2	4
3.9	Interaction of atoms with classical radiation field- Electric dipole approximation	2	4
4.0	**Relativistic Quantum Mechanics**		
4.1	Klein Gordon equation	2	5
4.2	Probability conservation	1	5
4.3	Dirac equation-Conserved current representation	2	5
4.4	Dirac matrices	2	5
4.5	Free particle at rest	1	5
4.6	Plane wave solutions	2	5
4.6	Physical interpretation	2	5
5.0	**Quantum devices**		
5.1	Quantum wells, quantum wires and dots	3	6
5.2	Single electron transistors	2	6
5.3	Quantum computers (qualitative ideas)	1	6

Text Books:

1. Quantum concepts and Applications –NouredineZettili, John Wiley & Sons
2. Modern Quantum Mechanics-J. J. Sakurai, Pearson Education
3. Introduction to Nanotechnology-Charles P. Poole.

4. Single Charge Tunneling – Coulomb Blockade Phenomena in Nanostructures” by Hermann Grabert and Michel H. Devoret
5. An Introduction to Quantum Computing- Phillip Kaye, Raymond Laflamme and Michele Mosca.

Reference Books:

1. Introduction to Quantum Mechanics: David J Griffiths,Prentice Hall New
2. Relativistic Quantum Mechanics: Walter Greiner,Springer-Verlag
3. Quantum Mechanics: V.K Thankappan, New Age International
4.Quantum Mechanics (Schaum's Outline Series): YoavPelegetal, Tata Mcgraw Hill education Private Limited
5. QuantumMechanics: Non-Relativistic Theory (Course of Theoretical Physics Course Vol 3): L.D Landau and E.M.Lifshiftz,Pregamon Press.

Course	Details				
Code	AP1923701				
Title	**PHOTONICS PRACTICAL**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/ III				
Type	Elective				
Credits	4	Hours/week	10	Total hours	180

CO No.	Expected Course Outcomes *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Analyse the behaviour of laser and measure its characteristics	Ap	1,2,3
2	Evaluate the wavelength of known laser through its reflection and diffraction principles	Ap	4,5,6
3	Analyse the properties of optical fibre along with various losses associating it	Ap	1,2,3
4	Evaluate the crystal structures from diffraction pattern of cubic crystals	Ap	4,5,6
5	Numerically solve problems in physics using Fortran programs.	Ap	1,2
6	Analyse solar cell characteristics	Ap	3,4
7	Solve some mathematical problemsusing Fortran program.	Ap	1,2
8	Analyse optical instrumental setups	Ap	3,4
9	Analysepolarisation of light	Ap	3,4

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

(Minimum of 12 experiments should be done and recorded)

Section	Description	CO.No.
1.1	Determination of Wavelength of laser beam using reflection and diffraction gratings	2
1.2	Beam profile of a laser	1
1.3	Bending laws of an optical fibre	3
1.4	Numerical aperture of an optical fibre	3
1.5	Coupling laws of an optical fibre	3
1.6	Michelson Interferometer	2
1.7	Comparison of resolving limit of optical instruments with human eye	8
1.8	Characteristics of photo diode, photo transistor, LDR, LED	6
1.9	Solar cell characteristics	6
1.10	Determination of lattice constant of a cubic crystal with	4

	accuracy and indexing the Bragg reflections in a powder X-ray photograph of a crystal	
1.11	He – Ne laser- verification of Malus law, measurement of Brewster angle, refractive index of a material	9
1.12	Finding the roots of a nonlinear equation by Bisection method by Fortran programming	5
1.13	R.K Method by Fortran programming	5
1.14	Sort a group of numbers in ascending / descending order without duplication by Fortran programming	5
1.15	Sort a group of names in alphabetic order by Fortran	7
1.16	Program to check whether a number is palindrome or not by Fortran	7
1.17	Program to check whether a number is prime or not by Fortran	7
1.18	Euler Method by Fortran programming	5
1.19	Simson’s 1/3 method by Fortran programming	5
1.20	Gauss elimination method for solving a system of linear equations by Fortran programming	5
1.21	Program to solve quadratic equations by Fortran	7
1.22	Matrix multiplication by Fortran programming	7
1.24	Least square regression for straight line fitby Fortran programming	5

SEMESTER IV

Course	Details				
Code	AP1924111				
Title	**COMPUTATIONAL PHYSICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/ IV				
Type	Core				
Credits	4	**Hours/week**	4	**Total hours**	72

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Discuss the various methods to solve algebraic, transcendental equations and linear equations	U	1,6
2	Solve algebraic and transcendental equations using these equations	Ap	2,3
3	Explain the methods to solve interpolation, differentiation and integration	U	2,4
4	Apply various interpolation, differentiation and integration to solve numerical problems	Ap	2,4
5	Explain the methods for curve –fitting and ordinary differential equations	U	1,6
6	Solve numerical problems of curve fitting and ordinary differential equations	Ap	2,3,4
7	Discuss an overview of Fortran programs with elements in a sample program	U	1,6
8	Outline various structures in Fortran to control, process and transfer data	An	2,3,4
9	Describe an overview of C++ programs with elements in a sample program	U	1,6
10	Analyse various structures in C++ to control, process and transfer data	An	3,4
11	Discuss an overview of Matlab programs with elements in a sample program	U	1,6
12	Identify various structures in Matlab to control,process and transfer data	An	3,4
13	Apply Fortran, C++ and Matlab concepts to solve various numerical and graphical problems	Ap	3,4,5

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No
1.0	**Numerical Methods of Analysis**		
1.1	Solution of algebraic and transcendental equations	1	1
1.2	Bisection Method	1	1,2
1.3	Iterative	1	1,2
1.4	Newton- Raphson method	1	1,2
1.5	Solution of simultaneous linear equations	1	1
1.6	Gauss elimination	1	1,2
1.7	Interpolation	1	3,
1.8	Newton and Lagrange formulas	2	3,4
1.9	Numerical differentiation- Newton's forward and backward methods	2	3,4
1.10	Numerical Integration- Trapezoidal, Simpson and	2	3,4
1.11	Gaussian quadrature method	1	3,4
1.12	Least-square curve fitting, Straight line and polynomial fits,	2	5
1.13	Numerical solution of ordinary differential equations	1	5,6
1.14	Runge- Kutta methods	1	5,6
2.0	**Fortran Programming**		
2.1	Flow charts	1	7
2.2	Algorithms	1	7
2.3	Fortran 77 Overview, A sample program	1	7
2.4	Fortran constants and variables, subscripted variables	1	7
2.5	Mixed-mode expressions, intrinsic functions	1	7
2.6	Control of execution- if-else structure ,relational expressions	2	7,8
2.7	Logical expressions, do-while structure,	2	7,8
2.8	Arithmetic statements, Input and output statements	1	7,8
2.9	Subprograms -Subroutines and functions	2	7,8
2.10	Operation with files	1	7,8
3.0	**Object Oriented programing C++**		
3.1	Principle of Object Oriented Programming	1	9
3.2	Introduction to C++ with a simple program	1	9,10
3.3	Tokens, Keywords, Identifiers, Constants	1	9
3.4	Operators, Manipulators	1	9
3.5	Control structure	2	9,10
3.6	Struct and union	1	9,10
3.7	Function prototyping, Function overloading, Inline functions	1	9,10
3.8	Classes, objects	1	9,10
3.9	Constructors and destructors	1	9,10
3.10	Operator overloading	1	9,10
3.11	Graphics-text mode graphic functions	2	9,10
3.12	Graphic mode graphic functions, colors, Rectangles and lines, Polygons generating functions	2	9,10
4.0	**Matlab Programming**		
4.1	Introduction-Matlab Features -Matlab Help and Demos	1	11

4.2	Matlab Functions, Characters, Operators and Commands.	1	11
4.3	Basic Arithmetic in Matlab-Basic Operations with Scalars	1	11,12
4.4	Vectors and Arrays-Matrices and Matrix Operations-Complex Numbers	1	11,12
4.5	Matlab Built-In Functions-Illustrative Examples	2	11,12
4.6	Control Flow Statements: if, else, else if	2	11,12
4.7	Switch Statements-for, while Loop Structures-break	2	11,12
4.8	Input/Output Commands	1	11,12
4.9	Function m Files-Script m Files.	2	11,12
5.0	**Numerical methods and programming**		
5.1	Roots of nonlinear equations(bisection),	2	13
5.2	Solution of linear equations (basic Gauss elimination)	2	13
5.3	Interpolation (Lagrangian)	1	13
5.4	Fitting polynomials(least square fitting)	1	13
5.5	C++ program to draw Rectangles and lines and circles with different colours,	2	13
5.6	Projectile motion	2	13
5.7	Matlab program to draw Rectangles and lines and circles and plots	2	13
5.8	Solving differential equations	1	13

Text Book:

1. Introductory Methods of Numerical Analysis, S. S. Sastry, Prentice Hall India.
2. Numerical Methods, E. Balagurusamy
3. Computer Programming in FORTRAN 77, Rajaraman
4. Object Oriented Programming with C++ ,Balagurusamy
5. Object Oriented Programming in Turbo C++ , Robert Lafore.
6. Programming for Computations –MATLAB/OCTAVE, SveinLinge, Hans PetterLangtangen

Reference Books:

1. Numerical methods in Science and Engineering- M.K. Venkataraman-National Publishing Co. Madras.
2. Applied Numerical Analysis: Gerald - Pearson Education.
3. Numerical Methods for Engineers and Scientists, Joe D. Hoffman.
4. Numerical Methods for Scientific and Engineering Computation- M.K. Jain - New Age International.
5. Computational Methods in Physics and Engineering - Wong.
6. Computer Oriented Numerical Methods - Rajaraman.
7. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipman, Jonathan Rosenberg-Cambridge University Press.
8. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press-London.
9. Getting Started WithMatlab-RudraPratap-Oxford University Press-New Delhi.
10. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P. Denier- Springer-Verlag-London.
11. Numerical Methods Using Matlab-John Mathews & Kurtis Fink-Prentice Hall-New Jersey.

12. Numerical methods for scientific and Engineering computation M.K Jain, S.R.K Iyengar, R.K. Jain, New Age International Publishers
13. Mathematical Methods, G. Shanker Rao, K. Keshava Reddy, I.K. International Publishing House, Pvt. Ltd.
14. Classical mechanics with matlab applications.

Course	Details				
Code	AP1924112				
Title	**NUCLEAR PHYSICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/IV				
Type	Core				
Credits	4	**Hours/week**	4	**Total Hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Identify the various properties of nucleus and the nuclear forces	An	3
2	Understand the different nuclear models	U	3
3	Explain the theory of α and β decay in radioactivity	An	3
4	Discuss the concept of radioactivity and radiation hazards	An	3
5	Classify the nuclear detectors, counters and particle accelerators	Ap	2
6	Differentiates the different types of fission and fusion reactors	Ap	2
7	Explain the properties of elementary particles and their interactions	An	3,5
8	Explain the applications of Nuclear Physics	Ap	2,5
9	Solve problems in Nuclear Physics	An	2,5

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Nuclear Properties, Forces and Nuclear Models**		
1.1	Nuclear Angular Momentum – Parity	1	1
1.2	Nuclear magnetic dipole moment, electric quadrupole moment –	1	1
1.3	Simple theory of Deuteron	2	1
1.4	Properties of Nuclear forces, Spin dependence of nuclear force	1	1
1.5	Binding energy	1	1, 9
1.6	Semi-empirical mass formula	2	2, 9
1.7	Liquid drop model	1	2
1.8	Evidence of shell structure	2	2

1.9	Single-particle shell model, its validity and limitations	1	2
1.10	Spin orbit coupling	2	2
1.11	Schmidt's lines and prediction of angular momentum and parity of nuclear ground states.	2	2
1..12	Collective model of Bohr and Mottelson – rotational States and Vibrational levels	2	2
2.0	**Radioactivity, Fission and Fusion**		
2.1	Radio activity	1	4
2.2	Units, alpha and beta decay, half life,decay constants	2	4, 9
2.3	Gamow's theory of alpha decay	2	3 , 9
2.4	Neutrino hypothesis	1	3
2.5	Fermi's theory of beta decay	1	3
2.6	Nuclear fission	1	6
2.7	Controlled fission reactions	2	6
2.8	Fission reactors	1	6
2.9	Nuclear fusion	1	6
2.10	Controlled Fusion reactors	2	6
3.0	**Detectors, accelerators**		
3.1	Particle detectors	1	5
3.2	Ionization chamber	1	5
3.3	GM counter	1	5
3.4	Bubble chamber	1	5
3.5	Cloud chamber	1	5
3.6	Particle accelerators -Van de graff generator	2	5
3.7	Cyclotron	1	5,9
3.8	Synchrotron	1	5, 9
4.0	**Particle Physics**		
4.1	Classification of Fundamental forces	1	7
4.2	Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.).	3	7, 9
4.3	Gell Mann-Nishijima formula.	2	7, 9
4.4	Baryons and mesons	1	7
4.5	Quark model	2	7
4.6	Confined quarks	1	7
4.7	Coloured quarks, quark-gluon interaction	2	7
4.8	CPT invariance	1	7
4.9	Application of symmetry arguments to particle reactions.	1	7
4.10	Parity non-conservation in weak interaction.	2	7
4.11	Grand unified theories.	2	7

5.0	**Application of Nuclear Physics**		
5.1	Trace element Analysis	2	8
5.2	Mass spectroscopy with Accelerators	2	8
5.3	Alpha Decay-Applications	2	8
5.4	Diagnostic Nuclear Medicine	2	8
5.5	CAT, PET, MRI	3	8
5.6	Therapeutic Nuclear Medicine	2	8

Text Books:

1. Nuclear Physics, D. C. Tayal, Himalaya Pub. House.
2. Introductory Nuclear Physics, K. S. Krane, Wiley.
3. Nuclear Physics, Dr. S. N. Ghoshal,S.Chand Publications

Reference Books:

1. Introduction to High Energy Physics, D. H. Perkins.
2. Introduction to Elementary Particles, David Griffith, Harper and Row, N.Y, 1987.
3. B. L. Cohen, Concepts of Nuclear Physics, TMH, 1971.
4. R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int. ,1983.
6. Introduction to Nuclear Physics, HeraldAEnge, Addison, Wesley Pub, (1972).
7. Nuclear Physics, I. Kaplan, Narosa publishing House,(1962).

Elective Courses

1. Bunch A: Photonics

Course	Details				
Code	AP1923301				
Title	**LASER PHYSICS AND SOLAR CELLS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/III				
Type	Elective				
Credits	4	**Hrs/Week**	4	**Total hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Discuss the operating principles of lasers	An	1,2,5,6
2	Discuss the different types of lasers	U	1,2,5
3	Summarise the different laser cavity modes	An	1,5
4	Explain various features and properties of laser systems	E	1,3,5,6
5	Understand the applications of lasers	U	3,5
6	Understand the characteristics of solar cell	U	5,6
7	Discuss the various parameters related to solar cells	An	5,6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Lasers – Operating principles**		
1.1	Thermal equilibrium	1	1
1.2	Absorption, spontaneous and stimulated emissions	2	1
1.3	Principle of detailed balance	1	1
1.4	Absorption and stimulated emission coefficients	2	1
1.5	Homogeneous broadening and inhomogeneous broadening	1	1
1.6	Absorption and gain on homogeneously broadened radiative transition	2	1
1.7	Gain coefficient and stimulated emission cross section for homogeneous broadening	1	1
1.8	Relationship of gain coefficient and stimulated emission cross section to absorption coefficient and absorption cross section	1	1
1.9	Population inversion	1	1
1.10	Saturation intensity	2	1
1.11	Exponential growth factor	2	1
1.12	Threshold requirements for laser with and without mirrors	2	1

2.0	**Theory of Lasers –I**		
2.1	Inversions and two-level systems	1	2
2.2	Steady-state inversions in three and four-level systems	1	2
2.3	Three level laser with the intermediate level as the upper laser level	2	2
2.4	Three level laser with the upper laser level as the highest level	2	2
2.5	Four level laser	1	2
2.6	Pumping mechanism	1	2
2.7	Direct pumping - indirect pumping-three types of indirect principles	2	2
3.0	**Theory of Lasers –II**		
3.1	Laser cavity modes	1	3
3.2	Longitudinal laser cavity modes	1	3
3.3	Fabry-Perot resonator	1	3
3.4	Longitudinal mode number	1	3
3.5	Transverse laser cavity modes	1	3
3.6	Development of transverse modes in a cavity with plane parallel mirrors	1	3
3.7	Transverse mode frequencies	1	3
3.8	Properties of laser modes-Properties of Gaussian beams	1	3
4.0	**Theory of Lasers – III and Applications**		
4.1	Q – Switching and its theory	2	4
4.2	Methods of Q – switching	1	4
4.3	Mode locking and its theory	2	4
4.4	Methods of mode locking	1	4
4.5	Pulse shortening techniques	1	4
4.6	Self-phase modulation and pulse compression	2	4
4.7	Ring lasers	1	4
4.8	Distributed feedback lasers	1	4
4.9	Properties of laser beams- Temporal coherence, spatial coherence and directionality	2	4
4.10	Applications of lasers (Qualitative idea)- Lasers in science, industry and medicine	2	5
4.11	Laser induced fusion	1	5
4.12	Lasers and holography	1	5
4.13	Laser cooling	1	5
5.0	**Solar Cell Fundamentals**		
5.1	P-N junction I-V relation: quantitative analysis	1	6
5.2	P-N junction under illumination – generation of photo voltage (PV) – light generated current	2	6,7
5.3	I-V equation for solar cell – solar cell characteristics.	2	6
5.4	Design of Solar Cells: upper limits of solar cell parameters - short circuit current – open circuit voltage	2	7
5.5	Fill factor – efficiency – losses in solar cell	1	7
5.6	Model of solar cell – effect of series and shunt resistance	1	7
5.7	Solar radiation and temperature on solar cell efficiency – solar cell design	2	7
5.8	Design of high short circuit current – choice of junction	2	7

	depth and orientation – minimisation of optical losses and recombination		
5.9	Design for high open circuit voltage – design for high fill factor	2	7
5.10	Base resistance – emitter resistance – analytical techniques	1	7
5.11	Solar simulator: I-V measurement – quantum efficiency measurement	1	6,7
5.12	Minority carrier life time and diffusion length measurement.	1	7

Text Book:

1. Laser fundamental-W. T. Silfvast, Cambridge University Press (1996).
2. Lasers-Theory, and Applications –K. Thyagarajan and A. K. Ghatak, McMillian (2002).
3. Solar Photovoltaic: Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI, 2nd Edn. (Chap 4 & 5)

Reference Books:

1. Laser Electronics – J. T. Vardeyan, PHI, 1989.
2. Solid State laser Engineering, W. Koechner, Springer Verlag, 2006.
3. Quantum Electronics- A. Yariv, John Wiley.
4. Laser Physics – Tarasov, MIR Pub, 1985.
5. Fibre optics and optoelectronics – R. P. Khare, Oxford University Press, 2004.
6. Optical Fibre Communications-John M. Senior,PHI(1994).
7. Lasers principles and applications, J. F. B. Hawkes and Wilson, PHI.

Course	Details				
Code	AP1923302				
Title	**PHOTONICS I**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/III				
Type	Elective				
Credits	3	**Hrs/Week**	3	**Total hours**	54

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive Level	PSO No.
1	Review of basic concepts of semiconductors	R	5
2	Understand the optical process in semiconductors	U	5
3	Understand and familiarize display devices	U	5
4	Understand modulation of light	U	5
5	Explain different opto electric effects	An	5
6	Understand basic concepts of photonics at nanoscale	U	5
7	Familiarize the latest developments in photonics and its application.	Ap	3

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Module	Course Description	Hrs	CO.No.
1.0	**Properties of Semiconductors**		
1.1	Optical processes in semiconductors	1	1
1.2	Direct and indirect band gap semiconductors	2	1
1.3	Electron- Hole pair formation and recombination	1	2
1.4	Absorption in semiconductors	2	2
1.5	Effect of electric field on absorption	2	2
1.6	Absorption in quantum wells	2	2
1.7	Radiation in semiconductors	1	2
2.0	**Display Devices**		
2.1	Photoluminescence –Cathodo luminescence-Electro luminescence	2	3
2.2	LED –Device configuration and efficiency	2	3
2.3	Hetero junction, surface emitting LEDs	2	3
2.4	Edge emitting, stripe geometry LEDs	2	3
2.5	Performance and characteristics	1	3
2.6	Plasma display	1	3
2.7	Liquid crystal – Properties	1	3
2.8	Numeric displays	1	3
3.0	**Optoelectronic Modulators**		

3.1	Modulation of light	2	4
3.2	Birefringence	1	4
3.3	Electro optic effect	1	5
3.4	Pockels electro optic modulator	2	5
3.5	Kerr modulator	1	5
3.6	Magneto optic effect	1	5
3.7	Optical isolator	1	5
3.8	Acousto optic effect – Acousto optic modulator	1	5
3.9	Self electro optic device	1	5
4.0	**Fundamentals of Nanophotonics**		
4.1	Photons and electrons: similarities and differences	1	6
4.2	Free space propagation -Confinement of photons and electrons	1	6
4.3	Propagation through a classically forbidden zone :Tunneling	2	6
4.4	Localization under periodic potential : Band gap	1	6
4.5	Cooperative effects for photons and electrons	1	6
4.6	Nanoscale optical interactions- axial and lateral nanoscopic localization	2	6
4.7	Quantum confined materials; quantum wells, quantum wires, quantum dots, quantum rings	2	6
4.8	Quantum confined stark effect	1	6
4.9	Super lattices	1	6
5.0	**Photonic materials-Applications**		
5.1	Photonic crystals	1	7
5.2	Features of photonic crystals	1	7
5.3	Photonic crystal sensors	1	7
5.4	Nanolithography(basic idea)	1	7
5.5	Two photon Lithography	2	7
5.6	Sunscreen nanoparticles, self-cleaning glass	1	7
5.7	Fluorescent quantum dots, Nanobarcodes,	1	7

Text Books

1. Optical Fibre Communications – John M. Senior, PHI (1994).
2. Nanophotonics-Paras N. Prasad; Wiley (2016)

ReferenceBooks:

1. Fibre Optics and Optoelectronics – R.P. Khare, Oxford University Press (2004).
2. FibreOptic Communication – D.C. Agarwal, Wheeler Publications (1993).
3. Optical Fibre Communication System – J. Gowar, PHI (1995).
4. Fibre Optic Communication – Joseph Palais, PHI (1998).
5. Understanding FibreOptics – J. Hecht, Pearson Edu. Inc (2006).
6. Optoelectronic Devices and Systems – S.C. Gupta, PHI (2005).

Course	Details				
Code	AP1924305				
Title	**PHOTONICS – II**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/IV				
Type	Elective				
Credits	4	**Hrs/Week**	4	**Total hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Discuss the features of fibre optic communication system	U	1,3
2	Differentiate between the different system design considerations	U	1,4
3	Explain about the different optical amplifiers and detectors	An	2,3
4	Explain the different fibre cables and connections	U	1,3,4
5	Distinguishthe different fibre splices	An	2,4
6	Discuss about frequency multiplication	U	2,4
7	Elucidate the different nonlinear effects in materials.	Ap	3,4.7

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO .No.
1.0	**Fibre Optic Communication**		
1.1	Fibre optic communication system	2	1
1.2	Advantages of fibre optic system	2	1
1.3	System design considerations for point to point links	2	2
1.4	Digital systems	1	2
1.5	Link power budget	1	2
1.6	Rise time budget	1	2
1.7	Line coding	2	2
1.8	Analog systems	1	2
1.9	System Architecture -Point to point links	2	2
1.10	Distribution networks	2	2
1.11	Local area networks	2	2
2.0	**Optical Amplifiers and Detectors**		
2.1	Qualitative ideas of semiconductor optical amplifiers	2	3
2.2	Erbium doped fibre amplifiers and Raman amplifiers	2	3
2.3	Optical detection principle-Absorption coefficient- Quantum efficiency-Responsivity	2	3
2.4	Long wavelength cutoff	1	3
2.5	PN photo diode	1	3
2.6	PIN photo diode	1	3
2.7	Avalanche photo diode	1	3

2.8	Photo transistor	1	3
2.9	Photo conducting detectors	1	3
2.10	Photomultiplier- CCD	2	3
2.11	Photo voltaic effect and solar cells	2	3
2.12	Noise- Thermal noise- Dark current noise- Quantum noise	2	3
3.0	**Fibre Cables and Connections**		
3.1	Fibre material requirements	1	4
3.2	Fibre fabrication methods- Liquid –Phase (Melting) Methods	1	4
3.3	Vapour-phase deposition methods- OVPO method- VAD method- MCVD method- PCVD method	1	4
3.4	Fibre optic cables	2	4
3.5	Fibre connections and related losses	1	4
3.6	Loss due to Fresnel reflection- fibre to fibre misalignment losses- loss due to other factors	2	4
3.7	Connection losses due to intrinsic parameters-	2	4
4.0	**Fibre Splices**		
4.1	Fibre splices	1	5
4.2	Fusion splices- Mechanical splices	2	5
4.3	Multiple splices	1	5
4.4	Fibre optic connectors	2	5
4.5	Butt-jointed connectors- Expanded beam connectors- multi fibre connectors.	2	5
5.0	**Frequency Multiplication and other Nonlinear Effects**		
5.1	Wave propagation in an anisotropic crystal	1	6
5.2	Polarization response of materials to light	2	6
5.3	Second harmonic generation- Sum and difference frequency generation	2	6
5.4	Parametric oscillation	2	6
5.5	Third harmonic generation	2	6
5.6	Self focusing- Nonlinear optical materials	2	7
5.7	Phase matching- Active phase matching	2	7
5.8	Saturable absorption- Optical bistability	2	7
5.9	Two photon absorption	1	7
5.10	Stimulated Raman scattering- Harmonic generation in gases.	2	7

Reference Books:

1. Fibre Optic Communication, D.C. Agarwal, Wheeler Publications (1993).
2. Optical Fibre Communication System, J. Gowar, PHI (1995).
3. Fibre Optic Communication, Joseph Palais, PHI (1998).
4. Understanding Fibre Optics, J. Hecht, Pearson Edu. Inc.(2006).
5. Optoelectronic Devices and Systems, S. C. Gupta, PHI (2005).

Course	Details				
Code	AP1924306				
Title	**FIBRE OPTICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/IV				
Type	Elective				
Credits	3	**Hrs/Week**	3	**Total hours**	54

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Recall Some of the basic concepts of Optical fibre	R	1,5
2	Understand the concept of modes in optical fibre	U	2,3
3	Evaluate and classify different optical fibres	E	2,3
4	Understand transmission characteristics of optical fibres	U	1,5
5	Examine different measurement techniques for optical fibre	An	3,5
6	Analyze the characteristics of various fibres	An	5
7	Solve problems related to optical fibre and its characteristics	Ap	3,6
8	Understand various optical sensors	U	5

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Optical Waveguides**		
1.1	Ray theory of transmission -	1	1
1.2	Total internal reflection -Acceptance angle - Numerical aperture	1	1
1.3	Skew Rays.	1	1
1.4	EM Theory for Optical propagation	2	1
1.5	Modes in a planar waveguide	2	1,2
1.6	Phase velocity and group velocity	1	1,2
1.7	Evanescent field	1	1,2
1.8	Modes – Mode coupling (elementary idea)	2	1,2
1.9	Classification of fibres – Step index fibre – Graded index fibre	3	1,3
1.10	Single mode fibre– Number of modes and cut off parameters	2	1,3
2.0	**Transmission Characteristics of Optical Fibres**		
2.1	Attenuation	1	4,6,7
2.2	Absorption losses	2	4,6,7
2.3	Linear scattering losses	1	4,6,7

2.4	Nonlinear scattering losses	1	4,6,7
2.5	Wavelengths for Communication	1	4,6,7
2.6	Fibre bend loss	2	4,6,7
3.0	**Transmission Characteristics of Optical Fibres II**		
3.1	Dispersion effects in fibres	1	4,6,7
3.2	Intra modal dispersion	2	4,6,7
3.3	Inter modal dispersion	3	4,6,7
3.4	Over all fibre dispersion	2	4,6,7
4.0	**Optical Fibre Measurements**		
4.1	Attenuation measurements	2	1,5,7
4.2	Dispersion measurements	2	1,5,7
4.3	Refractive index profile measurements	2	1,5,7
4.4	Cut off wavelength measurements	2	1,5,7
4.5	Numerical aperture measurements	2	1,5,7
4.6	Diameter measurements	2	1,5,7
4.7	Field measurements	2	1,5,7
5.0	**Optical sensor system**		
5.1	Intensity modulated sensors	1	8
5.2	Phase modulated sensors	1	8
5.3	Interferometric sensor	2	8
5.4	Polarization modulated sensors	2	8
5.5	Spectrally modulated sensors	2	8

Text Books :

1. Optical Fibre Communications – John M. Senior, PHI (1994).

Reference Books:

1. Fibre Optics and Optoelectronics – R.P. Khare, Oxford University Press (2004).
2. Fibre Optic Communication – D.C. Agarwal, Wheeler Publications (1993).
3. Optical Fibre Communication System – J. Gowar, PHI (1995).
4. Fibre Optic Communication – Joseph Palais, PHI (1998).
5. Understanding Fibre Optics – J. Hecht, Pearson Edu. Inc (2006).
6. Optoelectronic Devices and Systems – S.C. Gupta, PHI (2005).

Course	Details				
Code	AP1924603				
Title	**COMPUTATIONAL PHYSICS-PRACTICAL**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/ IV				
Type	Elective				
Credits	4	**Hours/week**	10	**Total hours**	180

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Solve different problems in physics through graphical representation and construct C++ programs to implement it.	Ap	1,2,3
2	Use numerical methods to solve differential equations, integration and differentiation and write C++ programs to execute it.	Ap	4,5,6
3	Plot signals and graphs discussed in various physical problems using functions in Matlab programming language.	Ap	1,2,3
4	Construct Matlab program to solve mathematical problems related to matrices, differential equations and integral equations.	Ap	4,5,6

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

(Minimum of 12 experiments should be done and recorded)

Section	Description	CO.No.
1.1	Describe the motion of a spherical body in a viscous medium using graphical representation method by constructing program in C++	1
1.2	Construct C++ program to describe the projectile motion of a body.	1
1.3	Study the damped and forced Simple harmonic motion using graphical representation methods and write C++ program to implement it.	1
1.4	Construct C++ program to analyse the formation of Standing waves.	1
1.5	Construct C++ program to analyse electric field due to a point charge and equipotential surface	1
1.6	Analyse LCR circuits with AC and DC sources with the aid of C++ program	1
1.7	Construct C++ program for solving a system of linear equations using Gauss elimination method	2
1.8	Finding the roots of a nonlinear equation using Bi section method	2

	and using C++ as programming language	
1.9	Construct C++ program to solve differential equation using RK method	2
1.10	Construct C++ program to solve differential equation using Euler method	2
1.11	Construct C++ program to perform numerical integration using Simpson’s rule	2
1.12	Construct C++ program to perform numerical integration using Monte Carlo method	2
1.13	Programming in Matlab - Matrix operations	3
1.14	Programming in Matlab - Digital signal processing	3
1.15	Programming in Matlab - Solving ordinary differential equations	4
1.16	Programming in Matlab - Plot unit impulse,step,ramp and random noise	3
1.17	Programming in Matlab - Generation of waveforms(Sinusoidal,square,triangular,exponential)	3
1.18	Programming in Matlab - Linear Convolution	3
1.19	Programming in Matlab - Circular Convolution	3
1.20	Programming in Matlab - Linear Convolution using Circular Convolution	3
1.21	Programming in Matlab - Random Sequence Generator	4
1.22	Programming in Matlab - Amplitude Modulation	3
1.23	Programming in Matlab - Frequency Modulation	3
1.24	Programming in Matlab - Pulse width Modulation	3
1.25	Programming in Matlab - Inverse Discrete Fourier Transform	4
1.26	Programming in Matlab - Discrete Fourier Transform	4

2. Bunch B: Optronics

Course	Details					
Code	AP1923303					
Title	**SOLAR THERMAL ENERGY COLLECTION AND STORAGE**					
Degree	M.Sc.					
Branch(s)	Applied					
Year/Semester	II/III					
Type	Elective					
Credits	3	Hours/week:	3	Total:	54	

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Discuss the structure of Sun and solar radiation	U	1
2	List the thermal applications of Solar energy	U	1,3
3	Explain the different surfaces for Solar energy conversions	An	2,3
4	Analyze the characteristics and performance of flat plate collectors	An	2,4
5	Understanding various concentrating collectors	U	1,4

PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	Solar Energy and Solar Radiation		
1.1	Structure of the Sun	1	1
1.2	Solar radiation outside the earth’s atmosphere	1	1
1.3	Solar radiation at the earth's surface	1	1
1.4	Instruments for measuring solar radiation and sunshine	1	1
1.5	Solar radiation geometry	1	1
1.6	Solar radiation on titled surfaces	1	1
2.0	**Thermal Applications of Solar Energy**		
2.1	An Overview Devices for thermal collection and storage	1	2
2.2	Thermal applications, water heating	1	2
2.3	Space heating	1	2
2.4	Space cooling and refrigeration	1	2
2.5	Power generation, distillation	1	2
2.6	Drying and cooking	1	2
3.0	**Selective Surfaces for Solar Energy Conversion**		
3.1	Introduction	1	3
3.2	Heat balance	1	3
3.3	Physical characteristics	1	3

3.4	Use of selective solar energy collectors	1	3
3.5	Anti-reflection coatings	1	3
3.6	Solar reflector materials	1	3
3.7	Type of selective coatings - preparations of selective coatings	1	3
4.0	**Flat Plate Collectors**		
4.1	Performance analysis of fluid flat plate collectors	2	4
4.2	Transmissivity of cover system	2	4
4.3	Transmissivity- absorptivity product	2	4
4.4	Overall loss coefficient and heat transfer correlation	2	4
4.5	Collector efficiency factor	2	4
4.6	Collector heat removal factor	2	4
4.7	Effects of various parameters on performance	2	4
4.8	Testing procedures performance analysis of conventional air heater	2	4
4.9	Other types of air heaters	1	4
4.10	Testing procedures	1	4
5.0	**Concentrating Collectors**		
5.1	Parameters characterizing solar concentrators	2	5
5.2	Types of concentrating collectors - cylindrical	2	5
5.3	Parabolic concentrators	2	5
5.4	Performance analysis of cylindrical parabolic concentrators	2	5
5.5	Parametric study of cylindrical concentrating collectors	2	5
5.6	Compound parabolic collector (CPC)	2	5
5.7	CPC geometry	2	5
5.8	Performance analysis	2	5
5.9	Central receiver collector (basic ideas)	1	5

Text Books:

1. Solar Energy - Principles of Thermal Collection and Storage, S.P. Sukhatme, 2nd Edn. TMH
2. Solar Energy Utilization, G.D. Rai, Khanna Publ., 1997

	Details				
Code	AP1923304				
Title	**BIO PHOTONICS**				
Degree	M Sc				
Branch(s)	Applied Physics				
Year/Semester	II/III				
Type	Elective				
Credits	4	Hrs/Week	4	Total hours	72

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Understand fundamentals of optics and photonics together with basic concept of light tissue interaction	U	1,2
2	Understand the principles and applications of bio-imaging and bio sensors	U	1,2
3	Apply the principle of photonics to biology and biomedicine	Ap	3
4	Apply the principles of biophotonics in particular in the areas of imaging and diagnostics	Ap	4,6
5	Evaluate bioimaging techniques such as confocal and super resolution microscopies	E	1,3,6
6	Evaluate the therapeutic application of biophotonics including laser activated therapies	E	5
7	Analyze the interaction of optical radiation with biological materials	An	3,6

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Photobiology**		
1.1	Interaction of light with cells with cells and tissues,	2	1
1.2	Photo-process in Biopolymers- human eye and vision,	2	1
1.3	Photosynthesis; Photo-excitation, free space propagation,	3	1
1.4	Optical fibre delivery system	2	1
1.5	Articulated arm delivery	2	1
1.6	Hollow tube wave-guides	2	1
1.7	Optical coherence Tomogaphy	2	1
1.8	Fluorescence	1	1
1.9	Resonance energy transfer imaging	1	1
2.0	**Bioimaging**		
2.1	Transmission microscopy	2	2
2.2	Kohler illumination,	2	2
2.3	Microscopy based on phase contrast	2	2
2.4	Dark-field and differential interference contrast microscopy	2	2
2.5	Fluorescence	2	2,3

2.6	Confocal and multi-photon microscopy	2	2,3
3.0	**Optical Biosensors**		
3.1	Florescence and energy transfer sensing	2	2
3.2	Molecular beacons and optical geometries of biosensing,	3	2
3.3	Biosensors based on fibre optics, planer waveguides,	2	2
3.4	Flow Cytometry: basis, flurochromes for flow cytometry.	3	2
3.5	DNA analysis	2	2
4.0	**Laser activated therapy**		
4.1	Photodynamic therapy, photo-sensitizers for photodynamic therapy	3	5,6
4.2	Applications of photodynamic therapy	3	5,6
4.3	Two photon photodynamic therapy	2	5,6
4.4	Tissue engineering using light; contouring and restructuring of tissues using laser	3	5,6
4.5	Laser tissue regeneration	2	5,6
4.6	Femto-second laser surgery	2	5,6
5.0	**Laser tweezers and laser scissors**		
5.1	Design of Laser tweezers and laser scissors,	3	7
5.2	Optical trapping using non Gaussian optical beam,	2	7
5.3	Manipulation of single DNA molecules,	2	7
5.4	Molecular motors, laser for Genomics and Proteomics,	3	7
5.5	Semi conductor Quantum dots for bioimaging,	2	7
5.6	Metallic nanoparticles and nanorods for biosensing,	2	7
5.7	Photonics and biomaterials: bacteria as bio-synthesizes for photonic polymers.	3	7

References :

1. Introduction to Biophotonics, P.N. Prasad Wiley Interscience (2003)

2. Biomedical Photonics Handbook T. VoDinh (CRC Press) (2002)

3. Optical Imaging Techniques in Cell Biology Guy Fox, Taylor & Francis Group, C.R.0 (2007).

4. An Introduction to Biomedical Optics- R. Splinter & B. A. Hooper, Taylor & Francis Group, C.R.0 (2007).

Course	Details				
Code	AP1924307				
Title	**APPLIED OPTICS**				
Degree	M.Sc.				
Branch(s)	Applied Physics				
Year/Semester	II/IV				
Type	Elective				
Credits	3	Hrs/Week	3	Total hours	54

CO No.	*Expected Course Outcomes* *Upon completion of this course, the students will be able to*:	Cognitive Level	PSO No.
1	Analyse the theories of Semiconductors and LEDs	An	1,3
2	Discuss the basic principle and working of Optical Fiber	U	1,4
3	Describe the Characteristics of optical wave guide	U	1,4
4	Explain different optical devises and its working	U	1,3
5	Describe the physical construction, working and operation of semiconductor devices	U	1,3
6	Solve problems related to semiconductor, fibre optics and nonlinear optics	Ap	1, 2
7	Understand the principles of NLO	U	5

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Semiconductor Science and Light Emitting Diodes**		
1.1	Semiconductor energy bands -basics	1	1,7
1.2	Extrinsic semiconductors – compensation doping – degenerate and non-degenerate semiconductors	1	1,7
1.3	Energy band diagrams in applied field – direct and indirect bandgap semiconductors	1	1,7
1.4	P-N junction principles – open circuit- forward and reverse bias – recombination life time	1	1,7
1.5	Light emitting diodes – principles – device structures,	2	1,7
1.6	Heterojunction high intensity LEDs – double heterostructure –	1	1,7
1.7	LED characteristics and LEDs for optical fibre communications – surface and edge emitting LEDs	1	1,7
2.0	**Fibre Optics**		
2.1	Symmetric planar dielectric slab waveguide – waveguide condition	1	2,7
2.2	Single and multimode waveguides TE and TM modes	1	2,7
2.3	Modal and waveguide dispersion in the planar waveguide	1	2,7
2.4	Dispersion diagram – intermodal dispersion – intra-modal dispersion – dispersion in single mode fibers	2	2,7
2.5	Material dispersion – waveguide dispersion – chromatic dispersion	1	2,7
2.6	Profile and polarization dispersion – dispersion flattened fibers - bit rate and dispersion	2	2,7
2.7	Optical and electrical bandwidth – graded index optical fiber	1	2,7

2.8	Light absorption and scattering – attenuation in optical fibers	1	2,7
3.0	**Optical Devices**		
3.1	Principle of p-n junction photodiode - Ramo's theorem and external photocurrent	2	4,5
3.2	Absorption coefficient and photodiode materials - quantum efficiency and responsivity	3	4,5
3.3	PIN-photodiode – avalanche photodiode – phototransistor	2	4,5
3.4	Photoconductive detectors and photoconductive gain - noise in photo-detectors – noise in avalanche photodiode	3	4,5
3.5	Solar energy spectrum - photovoltaic device principles – I-V characteristics -	3	4,5
3.6	Series resistance and equivalent circuit - temperature effects	2	4,5
3.7	Solar cell materials, device and efficiencies	3	4,5
4.0	**Optoelectronic Modulators**		
4.1	Optical polarization	1	5,6
4.2	Birefringence	1	5,6
4.3	Retardation plates	1	5,6
4.4	Electro-optic Modulators, Pockels effect	2	5,6
4.5	Kerr effect	1	5,6
4.6	Magneto-optic effect	2	5,6
4.7	Acousto-optic effect	1	5,6
4.8	Raman Nath and Bragg-types	1	5,6
5.0	**Nonlinear optics**		
5.1	Wave propagation in an anisotropic crystal, polarization response of materials to light	2	7
5.2	Second order nonlinear optical processes, second harmonic generation	1	7
5.3	Sum and frequency generation, optical parametric oscillation	1	7
5.4	Third order nonlinear optical processes, third harmonic generation	1	7
5.5	Intensity dependent refractive index, self-focusing	1	7
5.6	Nonlinear optical materials, phase matching - angle tuning	1	7
5.7	Saturable absorption,two photon absorption.	1	7

Text Books:

1. Optoelectronics and Photonics: Principles and Practices, S.O. Kasap,Pearson 2nd Edition (2012)
2. Fiber optics and Optoelectronics, R.P. Khare, Oxford UniversityPress, (2004)
3. Optoelectronics: An Introduction, J. Wilson and J.F.B. Hawkes,PHI, (2000)
4. Laser Fundamentals, William T. Silfvast, CUP 2nd Edn. (2009),

Reference **Books:**

1. Semiconductor Optoelectronic Devices: Pallab Bhattacharya, Pearson(2008)
2. Optoelectronics: An introduction to Materials and Devices, JaspritSingh,McGraw Hill International Edn., (1996).
3. Optical Waves in Crystals: Propagation and Control of Laser Radiation, A.Yariv and P. Yeh, John Wiley and Sons Pub. (2003)

Course	Details				
Code	AP1924308				
Title	**OPTICAL INSTRUMENTATION**				
Degree	M.Sc.				
Branch(s)	Applied				
Year/Semester	II/ IV				
Type	Elective				
Credits	4	**Hours/week**	4	**Total hours**	72

CO No.	**Expected Course Outcomes** *Upon completion of this course, the students will be able to:*	Cognitive Level	PSO No.
1	Apply the methods involved in photometry.	Ap	1,6
4	Explain the different methods of interferometry.	An	1,6
6	Apply the concepts of interferometry.	Ap	2,3
7	Analyze different spectrometers.	Ap	3,4
9	Understand different types of cameras.	Ap	2,3,5

PSO – Programme Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hrs	CO.No.
1.0	**Module 1**		
1.1	Photometry and Radiometry -quantities and units	1	1
1.2	Colourimetry- chromaticity coordinates	1	1
1.4	UCS chromaticity coordinates, UCS diagrams	2	1
1.5	RGB colur mixing and colourpurity,colour temperature	2	1
1.6	CCT, Visual basis of colourimetry	2	1
1.7	Human eye and colourdeficiency,colour vision model	2	1
2.0	**Module 2**		
2.1	Double beam Interferometry	1	2
2.2	Interference in a plane parallel plate and in a plate of varying thickness	2	2
2.3	Fizeau fringes	1	2
2.4	Mach-Zehnder Interferometer, Sagnac Interferometer	2	2
2.5	Interferometric measurements of rotation ,Channeled Spectra	1	2
2.6	Achromatic fringes, Fringes of equal thickness, Fringes of equal inclination, Fringes of equal chromatic order	3	2
2.7	Pohl Interferometer	1	2
2.8	Speed of light and Michelson Morley experiment	1	2
3.0	**Module 3**		
3.1	Multiple beam Interferometry	2	3
3.2	Multiple beam fringes of equal inclination, visibility and Intensity distribution.	2	3
3.3	Fabry Perot Interferometer and Fabry Perot etalon, resolving	3	3

	power and expression for finesse		
3.4	Non-reflecting films, Highly reflecting films and Interference filters	2	3
3.5	Broad band reflectors, band pass filters, dichoric beam splitters and cold mirrors.	2	3
3.6	Wave front shearing interferometers, Twyman- Green interferometer	2	3
3.7	Scanning Fabry- Perot Interferometer-central spot scanning, Spherical Fabry-Perot Interferometers	3	3
4.0	**Module 4**		
4.1	Theory of concave grating	2	4
4.2	Mountings for gratings-various mounting techniques	2	4
4.3	Grating spectrographs, resolution and dispersive power of spectrographs	2	4
4.4	Single beam and double beam monochromators	2	4
4.5	UV-VIS-NIR and IR Spectrometers	3	4
4.6	FTIR Spectrophotometer	2	4
4.7	Atomic Absorption Spectrophotometer, Fluorometer	3	4
5.0	**Module 5**		
5.1	Adaptive optics-Wavefront sensor	2	5
5.2	Guided star systems, MEMS and Deformable mirror and wavefront corrections	2	5
5.3	Adaptive optics and vision optics Imaging systems	2	5
5.4	Different types of projectors, LCD projectors	2	5
5.5	Endoscopes, Head up displays, 3D projection systems Camera	2	5
5.6	High speed camera, video camera	2	5
5.7	Remote sensing and its applications	2	5
5.8	Radars and Lidars	2	5
5.9	Phase contrast microscopes	2	5

Text Books:

1. Optical Interferometry- P. Hariharan, Academic press (1985)
2. Optics Eugene Hecht, Pearson Education Inc., 4th Edition, (2004)
3. Basics of Interferometry - P. Hariharan, Academic Press (1985)
4. Handbook of Applied Photometry - C De Cusatis, AIP. (1997)
5. Light Emitting Diodes- E Fred Scheubert, Cambridge University Press (2003)

Reference Books:

1. Optical Measurement Techniques and Applications- P.K.Rastogi,ArtechHouse(1997)
2. Principles of Adaptive Optics: - R. K. Tyson, Academic press (1998)
3. Wave Optics and Applications - R. S. Sirohi, Orient Longman, (1993)
4. Geometrical and Physical Optics- R. S. Longhrust, Orient Longman, 3rd Edition, (1991)
5. Introduction to Optics and Optical Imaging - C. Scott, S. Chand Co, (1998)

6. Principles of Optics Max Born and Emil Wolf, Cambridge University Press, (1999)
7. Light Ditch Burn, ELBS, Blackie and Sons, 2nd Edition, (1963)
8. Handbook of Optics - Vol I and Vol II - Michael Bags (ED), Mc Graw Hills (1995)
9. Fundamentals of Optics Jenkins and White, Mc Graw Hill Int.editions, 4th Edition, (1981).

Course	**Details**				
Code	AP1923702				
Title	**OPTRONICS PRACTICAL**				
Degree	M.Sc.				
Branch(s)	Applied				
Year/Semester	II/ III				
Type	Elective				
Credits	4	Hours/week	4	Total hours	180

CO No.	***Expected Course Outcomes*** *Upon completion of this course, the students will be able to*:	**Cognitive Level**	**PSO No.**
1	Understand the concept of diffraction and interference of laser beam using appropriate equations	U	1
2	Determination of physical properties of materials by Laser experiments.	Ap	5
3	Study of Laser based instrumentation and performance analysis	Ap	6
4	Experimental study of various losses of optical fibers	An	4

*PSO-Program Specific outcome; CO-Course Outcome,

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create.

Section	Description	CO.No.
1.1	Estimation of beam power and width of a Laser beam	1
1.2	Wavelength of Laser light by counting the number of diffraction fringes	1
1.3	Wavelength of Laser light using diffraction grating - graphical approach.	1
1.4	Laser light attenuation in an optical fiber cable	4
1.5	Thomas Young's double slit experiment	1
1.6	Diffraction of Laser light through a circular aperture - Airy's disc	1
1.7	Diffraction of Laser light through a rectangular slit	1
1.8	Measurement of refractive index of liquids using Laser light	2
1.9	Measurement of refractive index of solids using Laser light	2
1.10	Study of diffraction of Laser light through graduation marks	1
1.11	Diffraction halos using Laser light	1
1.12	LDR characteristics	3
1.13	Measurement of wavelength using Michelson interferometer and digital ring counter	1
1.14	Determination of Laser light wavelength using Lloyd's mirror	1
1.15	Spatial and temporal coherence of Laser light using Michelson interferometer	3
1.16	Study Evanescent field of an optical fibre using a laser beam	3
1.17	Characteristics of a phototransistor	3
1.18	Measure the intensity of plane-polarised light as a function of the position of the analyser use ofquarter wave plate	3
1.19	Measure the intensity of plane-polarised light as a function of the position of the analyser use of half wave plate	3
1.20	Power launching and the testing of optic power loss between two plastic optical fibers in ST connectors	4
1.21	Study the angular misalignment loss of the given plastic optical fibre	4

Reference Books:

1.Francis A Jenkis and Harvey E White, Fundamentals of Optics, Macgraw-Hill (2011)
2.David Attwood, University of California, Berkely, Spatial and Temporal Coherence; Coherent Undulator Radiation
3.Jeethendra Kumar P K, Laboratory experiments series edited by Dr. Sharma P.

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