Annexure - I

Faculty of Science

Ordinance, Curriculum & Syllabus

Master of Science (Physics)

(2019-20)

Shree Guru Gobind Singh Tricentenary University, Gurugram (Haryana)-122505, India

MASTER OF SCIENCE [M.Sc.]

COURSE ORDINANCE

1. PREAMBLE

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system.
Faculty of Science. Shree Guru Gobind Singh Tercentenary University, Gurugram with the aim to enhance academic standards in quality of higher education has adopted the UGC guide lines as such in all PG courses.

The grading system is considered to be better than the conventional marks system and in order to facilitate student mobility across institutions with in India and across countries the community grade point average (CGPA) has been introduced in all the PG courses. The guidelines as follows,

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

a. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   i. **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The

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University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

ii. **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

c. **Skill Enhancement Course:** The course based upon the content that leads to Knowledge enhancement.

2. GOALS:

i. Employment prospects for post graduates are very good. The scientific knowledge and mathematical and analytic skills acquired help to place across a wide range of industries including aerospace, pharmaceutical, dyes, fabrics, electronics, semiconductors, petroleum, communications, computing, education, commerce, civil services and many more.

ii. The course will build a rich knowledge base to provide a foundation for the continued study of science.

iii. The theoretical and experimental skills necessary to analyze and solve a range of advances problems, providing an excellent foundation for leadership.

iv. Post-graduation leads to abundance of research opportunities.

3. OBJECTIVES

The postgraduate training should enable the student to:

i. Practice efficiently various investigative procedures backed by scientific knowledge including basic sciences and skills.

ii. Get expertise in his/her field of interest

iii. Play the assigned role in the implementation of required practical skills.

iv. Be a motivated 'teacher' - defined as one keen to share knowledge and skills with a colleague or a junior or any learner continue to evince keen interest in continuing education irrespective of whether he/she is in a teaching institution or is practicing and use appropriate learning resources.

v. Exercise empathy and a caring attitude and maintain professional integrity, honesty and high ethical standards.

vi. The student is expected to know his subject in depth; however, emphasis should be on the analytical techniques. Knowledge of recent advances and basic sciences as applicable to his/her specialty should get high priority.

vii. Competence in skills commensurate with the specialty (actual hands-on training) must be ensured.

4. Duration and Nomenclature of the Course:

The duration of M.Sc (Physics /Chemistry /Mathematics /Forensic Science/Environmental Science course shall be of two academic years consisting of four (4) semesters (15-17 weeks) under Choice Based Credit System(CBCS). On successful completion of all the four semesters, the student will be awarded M.Sc.Degree in the concerned course. The student

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shall complete the course within a maximum period of 4 years from the date of admission to the first semester, failing which he/she will be disqualified from the course.

5. Admission to the Course:

i. Eligibility for Admission:

For admission to the 1st Semester of M.Sc. (Physics) course, the candidate must have passed B.Sc. (Pass) with Physics as one of the subjects/B.Sc. (Hons.) Physicswith 50% marks (45% marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC

For admission to the 1st Semester of M.Sc. (Chemistry) course, the candidate must have passed B.Sc. (Pass) with Chemistry as one of the subjects/B.Sc. (Hons.) Chemistry with 50% marks (45% marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC.

For admission to the 1st Semester of M.Sc. (Mathematics) course, the candidate must have passed B.Sc. (Pass) with Mathematics as one of the subjects/B.Sc. (Hons.) Mathematics /B.A (Pass) with Mathematics/ as one of the subjects/ B.A (Hons.) Mathematicswith 50% marks (45% marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC.

For admission to the 1st Semester of M.Sc. (Forensic Science) course, the candidate must be graduate with Physics, Chemistry & Mathematics, Physics, Chemistry & Biology OR Agricultural sciences OR BCA OR B.Pharm. OR B.Sc.(Nursing) OR Engineering sciences OR B.Sc.(Forensic Sciences) OR Medical sciences with 50% marks (45%marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC.

For admission to the 1st Semester of M.Sc. (Environmental Science) course, the candidate must have passed B.Sc(Non Medical/ Environmental Sciences/Life Sciences/Bio Sciences/ Agriculture) with 50% marks (45% marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC.

ii. Schedule of admission and payment of fees:

The admission schedule, along with last date for the submission of admission forms and payment of fees, shall be fixed by the Vice-Chancellor from time to time.

6. Mode of Selection of Candidates for Admission:

The admissions will be made as per the following criteria:

Sr.No.	Criteria	Condition
1	On the Basis of the Merit of the qualifying Examination.	If the no. of applicants is up to 3 times of the intake
2	On the Basis of the Merit of the Entrance Examination.	If the no. of applicants is more than 3 times of the intake

7. Syllabus:

The syllabus is based on Choice Based Credit System (CBCS) and is recommended by Board of Studies and approved by Academic Council from time to time.

8. Scheme of Examination, distribution of marks, credit system and Syllabus:

The Scheme of examination, distribution of marks in various papers along with the credit system and the syllabus of the course shall be as approved by Board of Studies/Academic Council from time to time.

9. Medium of Instruction and Examination:

The medium of the instruction and the examination shall be English only.

10. Attendance Requirements/Eligibility to Appear in Examination:

The student should fulfill the following criteria to be eligible for appearing in the End Term Semester Examinations:

i. He/she should bear a good moral character.

ii. He/she should be on the rolls of the Dept./Faculty of the University during the semester.

iii. He/she should have 75% of the attendance during the respective semester. Twenty five per cent (25%) of attendance relaxation shall account for illness and contingencies of serious and unavoidable nature.

iv. The Dean of the Faculty of his own or on the recommendation of the HOD shall have the power to give relaxation upto 5% on genuine grounds over the minimum 75% attendance.

v. Further, the Vice Chancellor of his own or on the recommendation of the Dean shall have the power to give further relaxation upto 5% on genuine grounds over the above mentioned minimum attendance.

vi. He/she should not be a defaulter in payment of any dues of the SGT University and no disciplinary action is pending against the student.

11. Exemption from Attendance / Shortage of attendance to be condoned:

The shortage of lecture to the maximum limit as under can be condoned by the competent authority:

Sr. No	Exemptable No. of Lecture	Ground of Exemption	Competent Authority
1	All periods of the days of blood donation	Voluntarily blood donation to the Blood Bank.	Dean of the Faculty
2	All periods of the day of Examination	For appearing in the supplementary examinations(Theory /Practical/Viva-voce)	-do-
3	10 days attendance during a semester	For participation in University or Inter-Collegiate Sports Tournaments/ Youth Festivals, NCC/NSS Camps/University Educational Excursions/ Mountaineering Courses	-do-

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4	15days attendance during a semester	For participation in Inter-University Sports Tournaments/ Youth Festivals	-do-

Provided:

i. that he/she has obtained prior approval of the Dean, Faculty of Science;

ii. that credit may be given only for the days on which lectures were delivered or tutorials or practical work done during the period of participation in the aforesaid events.

12. Attendance Shortage Warning:

Attendance shortage warning will be displayed on the Faculty's Notice Board and University Website by 10th day of every month.

13. Detained students

A student,who does not fulfill the criteria prescribed in Clauses10-11, will not be eligible for appearing in the End Term Semester Examination in that particular paper and will be deemed as Detained in that paper.Such student will repeat the course/paper alongwith the regular students of the subsequent batchto fulfill the prescribed conditions to appear in the "End Term" examination of the course/ paper.

14. Submission of Examination Forms and Payment of Examination Fee:

The Dean, Faculty of Science shall submit the examination admission forms of thosestudents who satisfy the eligibility criteria to appear in the examinations to the Controller of Examinations as per schedule of examination circulated by him from time to time.

15. University Examinations:

i. End Term Semester Examinations:

The examination for the 1st and 3rd semesters (Odd Semesters) shall ordinarily be held in the month of December and of the 2nd and 4th semesters (Even Semesters) in the month of May/June. The examination dates are fixed by the controller of examination with the approval of Vice Chancellor.

ii. Fail/ Reappear candidates:

Fail / re-appear candidate of the odd semesters (1st & 3rd) will take re-appear exams as an ex-student in the subsequent exams of the odd semesters(1st&3rd). Similarly, for the even semesters (2nd&4th), he/she will take re-appear exams. in the subsequent exams of the even semesters (2nd&4th). However, a candidate appearing in the 4th semester examination (Regular) may appear simultaneously in his/her re-appear paper(s) of lower semesters.

16. Improvement Examination:

The student may be permitted to improve his/her result subject to the following conditions:

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i. The student will be permitted to appear in improvement examination as an ex-student with regular batches.

ii. The student will be permitted to improve his/her CGPA in one or all papers in which he/she has obtained CGPA less than 'First Division' in aggregate.

iii. Only one chance per paper will be given. The chance must be availed within a year of initially passing of every semester examination.

iv. The candidate will be required to apply and allowed to appear only for theory examinations.

v. If the status/nature of the student's result does not improve by five (05) or more per cent, his/her improvement result will be declared "PRS" (Previous Result Stands).

vi. The candidate shall be allowed to appear in the improvement examination(s) along with regular candidates as and when the course is offered. No separate examination will be held for improvement of result. In case of change of syllabi, the student shall have to appear for improvement in accordance with the changed syllabi of the concerned course applicable to the regular students of that exam.

17. Setting of Question Papers:

i. The Head of the Department/Dean of the Faculty shall supply the panel of internal and external examiners duly approved by the Board of Studies to the Controller of Examinations. The paper(s) will be set by the examiner(s) nominated by the Vice-Chancellor from the panel of examiners.

ii. An examiner shall be allowed to set not more than two papers in a semester examination.

iii. The examiner(s) will set the question papers as per criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council of the University.

18. Evaluation Process – Theory and Practical:

Evaluation of Answer Books:

The answer books may be evaluated either by the paper setter or any other internal or external examiner to be nominated by the Controller of Examiners with the approval of the Vice-Chancellor from the panel of examiners approved by the Board of Studies.

Re-evaluation of Answer Books:

Re-evaluation/ rechecking of any paper is allowed. The students can apply for Re-evaluation/ Re-checking of any paper to the Controller of Examinations through the HoD/Dean of the Faculty within 10 days of the declaration of result by paying prescribed fee.

Practical Examinations - Appointment of Examiner:

a. The practical examinations shall be conducted by a Board of two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners.

Marks Distribution:

The distribution of marks in examination of the practical paper will be as per the criteria given below:

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a. Experimental performance = 60% marks

b. Viva-Voce = 30% marks

c. Laboratory work report = 10% marks

19. External Assessment (Summative Assessment):

Sixty per cent marks shall be assigned to each theory and practical paper as Summative Assessment. The distribution of marks in theory as well as practical papers will be in accordance to IQAC guidelines.

20. Internal Assessment(Formative Assessment):

i. (Theory Papers)

a. Based on 40 Marks:

1	Assignment	5 marks
2	Mid Term Test (10 Marks each)	20 marks
3	Synergy / Project	10 marks
4	Attendance	5 marks
	Marks distribution for Attendance in % age	
	95<=Attendance=100	5 marks
	90<=Attendance<95	4 marks
	85<=Attendance<90	3 marks
	80<=Attendance<85	2 marks
	75<=Attendance<80	1 marks

b. Based on 20 Marks:

1	Assignment	5 marks
2	Mid Term Test	10 marks
3	Attendance	5 marks
	Marks distribution for Attendance in % age	
	95<=Attendance=100	5 marks
	90<=Attendance<95	4 marks
	85<=Attendance<90	3 marks
	80<=Attendance<85	2 marks
	75<=Attendance<80	1 marks

ii. (Practical/Project/Dissertation)

i. Based on 40 Marks:

S.no.	40 Marks Internal		60 Marks External
1	Attendance	10 marks	
2	Practical/Project	10 marks	

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	File/Dissertation		30 marks for Practical examination (Conduction/ Demonstration)/Project File/Dissertation + 30 marks for Viva-Voce in End-term Examination by External Experts.
3	Internal Viva-Voce	20 marks	
	Marks distribution for Attendance in % age		
	97.5<=Attendance=100	10 marks	
	95<=Attendance<97.5	9 marks	
	92.5<=Attendance<95	8 marks	
	90<=Attendance<92.5	7 marks	
	87.5<=Attendance<90	6 marks	
	85<=Attendance<87.5	5 marks	
	82.5<=Attendance<85	4 marks	
	80<=Attendance<82.5	3 marks	
	77.5<=Attendance<80	2 marks	
	75<=Attendance<77.5	1 Marks	

ii. Based on 20 Marks:

s.no.	20 Marks Internal		30 Marks External
1	Attendance	5 marks	15 marks for Practical examination (Conduction/ Demonstration)/Project file/Dissertation + 15 marks for Viva-Voce in End-term Examination by External Experts.
2	Practical/Project File/Dissertation	5 marks	
3	Internal Viva-Voce	10 marks	
	Marks distribution for Attendance in % age		
	95<=Attendance=100	5 marks	
	90<=Attendance<95	4 marks	
	85<=Attendance<90	3 marks	
	80<=Attendance<85	2 marks	
	75<=Attendance<80	1 Marks	

iii. In case of ex-students, those appearing for re-appear / improvement examination in any semester, their previous Internal Assessment marks will be counted.If there is any change in Scheme of Examination, then Internal Assessment marks will be modified accordingly.

iv. The concerned teacher shall preserve records on the basis of which the Internal Assessment has been awarded and shall make the same available to the Controller of Examinations whenever required.

v. The Head of the Department/ Dean of the Faculty shall ensure:

a. That the internal assessment marks are displayed for information of the students at least seven (07) days before the commencement of the examinations of each semester

b. That the internal assessment marks are submitted to the Controller of Examinations at least seven (07) days before the commencement of the examinations of each semester.

21. Criteria for Promotion to Higher Semester:

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The student shall be promoted to 2nd and 4th semester automatically without any condition of passing minimum number of papers. For promotion from 2ndto 3rd Semester, the student shall have to clear at least 50% papers of 1st and 2nd semesters taken together.

22. Credit Based Grading System:

i. Key Definitions:

Programme	An educational programme leading to award of a Degree, Diploma or Certificate.
Course	Usually referred to as 'paper' is a component of a programme. All courses need not carry the same weight.
Credit	A unit by which the course work is measured. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours for practical work/field work per week. A Research Based Paper /Project is equal to 6 credits.
Credit Point	It is the product of grade point and number of credits for a course i.e. Credit Point = No. of credits in a course X "grade value" of the grade obtained in the course.
Grade Point	There are two types of GPAs as given hereunder:
Average (GPA)	Semester Grade Point Average (SGPA) Cumulative Grade Point Average (CGPA) Every student earns a distinct SGPA and a distinct CGPA at the end of each specified semester.
SGPA	SGPA is a measure for performance of student in a Semester. It is the Point Average ratio of sum of the product of number of credits with the grade points scored by the student in all the courses taken by him/her and the sum of the number of credits of all the Courses undergone by the student i.e. SGPA (Si) =∑(CixGi) /∑Ci
CGPA	CGPA is a measure of performance up to any Grade Gradespecified semester Point Average beginning from the first Semester. It is also calculated in the same (CGPA) manner as SPGA taking into account all the courses undergone by a student over all the semesters of programme i.e. CGPA = ∑(Cix Si) / ∑Ci
Grade Point	Itis a numerical weight allotted to each letter grade on a 10-point scale.
Letter Grades	It is an index of the performance of a student in a said course. The Grades are denoted by letters O, A+, A, B+, B, C, P, F and Ab.

ii. Credits, Semesters, Courses and total Credit Points:

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S.No	Course	Semesters	Core Courses	Discipline Specific elective Courses	Skill Enhancement Courses	Total Credits
1	M.Sc.(Physics)	4	72	16	12	100
2	M.Sc.(Chemistry)	4	74	12	14	100
3	M.Sc.(Mathematics)	4	78	12	10	100
5	M.Sc.(Forensic Sciences)	4	86	8	6	100
6	M.Sc.(Environmental Science)	4	60	24	16	100

Grading Table

Range of Percentage of Marks	Letter Grade	Grade Points	Range of Grade Points	Classification
90 and above	O (Outstanding)	10	9-10	Outstanding
80 & above but less than 90	A+ (Excellent)	9	8< 9	Excellent
70 & above but less than 80	A (Very Good)	8	7< 8	1st Div with Distinction
60 & above but less than 70	B+ (Good)	7	6< 7	1st Division
50 & above but less than 60	B (Above Average)	6	5<6	2nd Division
Above 40 but less than 50	C (Pass Average)	5	Above 4 <5	3rd Division
40	P(Pass)	4	4	Pass
Less than 40	F (Fail)	0	-	Fail

Formula for Calculating percentage of marks:

CGPA× 10 e.g. 6.53× 10 = 65.3

Formula for Grade Point calculation:

G = (Marks Obtained in Paper/Total marks of paper) x100.

Formula for Computation SGPA & CGPA

i. The SGPA is the ratio of sum of the product of the number of credits with the grad points scored by a student in all the courses taken by a students and the sum of the number of credits of all the courses taken by the students;

i.e SGPA (Si) = $\sum(Ci \times Gi) / \sum Ci$,

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where Ci is the no of credits of the ith course and Gi is the grad point Scored by the student in the ith course

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by the students over all the students over all the semesters of a programme , i.e

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded up to 2 decimal points and reported in the transcripts. Result–Cum-Detailed Marks Card/ Transcript: Based on the above recommendations on letter grades, grade points and SGPA and CGPA, the DMC/ Transcript for each semester and a consolidated transcript in dictating the performance in all semester may be issued

iv. **1. Illustration of Computation of SGPA and CGPA and Format for Transcripts**

Course	Credit	Grade Letter	Grade Point	Credit Points (Credit × ***Grad***)
Course 1	3	A	8	3×8 = 24
Course 2	4	B +	7	4×7 = 28
Course 3	3	B	6	3×6 = 18
Course 4	3	O	10	3×10 = 30
Course 5	3	C	5	3×5 = 15
Course 6	4	B	6	4×6 = 24
	20			**139**

Thus, SGPA = 139/20 = 6.95

Similarly, Suppose the SGPA for 2nd , 3rd and 4th semester are 7.85 , 5.6, and 6.0 with credits 22, 24 and 22, respectively, then for a two-year PG Programme, the CGPA will be computed as followed,

CGPA = (20× 6.95 + 22 × 7.85 + 24 × 5.6 + 22 × 6.0)/88 = 6.57

Course	Credits	Grade Letter	Grad Point Block	Range of Grad Points(Actual Grade Value as per marks obtained	Earned Credit Point(Credit × Actual ***Grade Value***)
Course 1	3	O	10	9.2	3×9.2=27.6
Course 2	3	A+	9	8.2	3×8.2=24.6
Course 3	4	A	8	7	4×7=28
Course 4	3	B+	7	6.7	3×6.7=27.6
Course 5	3	B	6	5.6	3×5.6=16.8
Course 6	4	C	5	4.7	4×4.7=18.8
	20				**135.9**

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Thus, SGPA= 135.9/20 = 6.79

Similarly suppose SGPA for 2nd , 3rd , and 4th semester are 7.85, 5.6 and 6.0 with credits 22, 24, and 22 respectively

CGPA = (20× 6.79 + 22 × 7.85 + 24 × 5.6 + 22 × 6.0)/88 = 6.53

Calculating percentage of marks

CGPA× 10 E.G.6.53× 10 = 65.3

23. Pass criteria:

The minimum percentage of marks to pass the examination in each subject/paper will be 40% each in theory paper, practical /field work/Research Project etc. examination & internal assessment. The student has to pass in summative and formative (Internal) assessment separately.

24. Declaration of Results:

i. The Controller of Examinations shall declare the results as early as possible after the conclusion of each examination, but before the start of teaching for the next academic session.

ii. Each successful student/ the student placed in reappear shall receive a copy of the Detailed Marks Certificate/ Grade Card Sheet of each semester examination.

iii. The student whose result is declared late without any fault on his/her part may attend classes for the next higher semester provisionally at his /her own risk and responsibility, subject to his /her passing the concerned semester examination. In case, the student fails to pass the concerned semester examination, his/her attendance/internal assessment in the next higher semester in which he / she was allowed to attend classes provisionally will stand cancelled.

25. Other Provisions:

i. Nothing in the Ordinance shall debar the University from amending the Ordinance and the same shall be applicable to all the students whether old or new.

ii. Any other provision not contained in the Ordinance shall be governed by the rules and regulations framed by the University from time to time.

iii. In case of any dispute, the Vice-Chancellor will be competent authority to interpret the rules and his interpretation shall be final.

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UNIVERSITYS' COMMON COURSE ORDINANCE POSTGRADUATE & UNDERGRADUATE PROGRAMS

1. Preamble:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning (online & offline) process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system.

Department of Physics, Faculty of Science, Shree Guru Gobind Singh Tricentenary University, Gurugram with the aim to enhance academic standards in quality of higher education has adopted the UGC guidelines in its Postgraduate (PG) program (M. Sc. Physics). The grading system is considered to be better than the conventional marks system and in order to facilitate student mobility across institutions within India and across countries the community grade point average (CGPA) has been introduced in this PG program. The guidelines are as follows:

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The CBCS provides an opportunity for the students to choose courses from the prescribed pool of courses comprising core, elective, skill and ability enhancement courses. The courses can be evaluated by a uniform grading system in the higher education system. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in the evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

a. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   i. **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

   ii. **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

c. **Skill Enhancement Course:** The course based upon the content that leads to Knowledge enhancement.

d. **Ability Enhancement Compulsory Course:** The course based upon the content that leads to the development of a professional of ability.

e. **Open Elective Course:** The course based upon the content that enhances interdisciplinary knowledge

2. Justification/Score of the Course:

The Master of Science (Physics) degree offers students a foundation in fundamental/applied physics, together with experience in forefront research. The student will take a suite of core Physics courses and also perform research in project work.

The aim of the programme is to train students with advanced knowledge and understanding physics with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently to meet higher level expectations of academia and research with sufficient transferrable skills, and to achieve holistic development and to prepare themselves to face the world outside in a dignified manner.

A Master in Physics opens up avenues that are vibrant and an interesting mix of money and intellect. There are endless possibilities for those who love the world of physics. One can definitely find out ways

and means by which you can find new avenues of work. It should be a combination of technical knowledge and what the job offers in terms of both monetary benefits and intellectual growth.

3. Duration of the Course:

Name of the Programme	Duration
Master of Science (Physics)	02 Years (4 Semesters)

4. Admission to the Course:

(a) Name of the Degree:

Master of Science (Physics)

(b) Eligibility for Admission:

Name of the Programme	Eligibility
1. Master of Science (Physics)	For admission to the 1st Semester of M.Sc. (Physics) program, the candidate must have passed B.Sc. (Pass) with Physics as one of the subjects/B.Sc. (Hons.) Physics with 50% marks (45% marks in case of SC/ST candidates of Haryana only) in aggregate or equivalent grade from any university recognized by UGC.

Migration/Lateral entry admission in second year/third semester of an academic programme, wherever permitted, shall be considered on the basis of merit in the qualifying examination and subject to the availability of seats in the academic programme where admission is desired. Student who ever granted lateral entry admission is required to pay the requisite fee as admissible to the fresh batch.

(c) Migration Admission :

A student of any other University/Institute/College, recognized by the concerned regulatory/statutory body like UGC etc., shall be eligible for migration (admission) to the University. Migration will be allowed, if the seat is available in that programme andcannot be claimed as a right by the candidate. Migration can only be allowed, if the student studied the programme in regular mode and is not having any backlog.

In addition to the Application Form for admission, student has to provide the following documents "

(i) Marksheets/result of all the examinations passed.

(ii) Detailed syllabi for all the courses studies till date.

(iii) The migration Certificate and Character Certificate stating that no disciplinary/academic action has been taken or pending.

(iv) All other relevant documents which are required for admission in the programme in which migration is sought.

Studies and Examinations passed by the candidate are recognized as equivalent to the corresponding examination of the University and he fulfills the minimum qualification and other eligibility laid down for admission to the programme to which he/she seeks migration in the University.

The migration case will be submitted to the University Equivalency Committee to verify all the relevant records and candidate will be admitted on the recommendations of the Committee only.

(d) **Student Exchange and Credit Transfer**

For a student exchange from or to a University, credit transfer from or to a University is possible only when there is an academic tie-up with the University and mutually agreed student exchange and credit transfer policy is approved by the Academic council. Student under the exchange programme shall not be considered as migrated.

The University may enter into collaboration with other Universities worldwide whereby students of those Universities can spent a semester or more at SGT University and study courses, accordingly to mutually agreed guidelines. Such students will be known as Associate Students of SGT University for the duration they spend at SGT University and will be governed for all academic matters of the University. Reciprocally, SGT University students may be permitted to spend a semester or more and study courses in collaborating Universities with or without transfer of credits.

(e) Schedule of admission and payment of fees:

The admission schedule, along with last date for the submission of admission forms and payment of fees, shall be fixed and notified by the Registrar with the approval of the Vice-Chancellor from time to time duly approved by the Academic Council/Board of Management of the University.

Students detained due to shortage of attendance and re-admitted will attend regular classes with alternative batch and will be required to pay the Tuition Fee and Examination Fee and make over the attendance criteria as prescribed in the Ordinance.

However, ex-students will be exempted from making up the deficiencies of the attendance criteria.

5. Mode of Selection of Candidates for Admission:

On the basis of the merit of the qualifying examination or as per the guidelines of the Statutory Bodies/Haryana Private Universities Act, 2006 as amended from time to time.

6. Medium of Instructions :

The medium of the instruction and the examination shall be English only.

7. University Examinations :

(a) **End Term Semester Examinations :**

The examination for all the Odd Semesters shall ordinarily be held in the month of November/December and of the Even Semesters in the month of May/June.

Fail/re-appear candidates of the Odd Semesters will re-appear in exams as an ex-student in the subsequent exams of the Odd Semesters. Similarly, for the Even Semesters he/she will re-appear in exams in the subsequent exams of the Even Semesters. However, candidates appearing in the Final Semester examination (Regular) may appear simultaneously in his/her re-appear paper(s) of lower semesters i.e. previous semesters as arranged by the Controller of Examinations.

(b) **Scheme of the Examinations/Distribution of Marks**:

The Scheme of examination, distribution of marks in various papers along with the credit system and the syllabus of the course shall be as prepared by the respective Board of Studies of the Faculty and duly approved by the Academic Council of the University from time to time.

(d) **Attendance Requirements/Eligibility to Appear in Examination:**

The student should fulfill the following criteria to be eligible for appearing in the End Term Semester Examination:

(i) He/she should have 75% attendance during the respective semester in each subject which is mandatory. Only 5% relaxation in the required attendance on account of illness and other contingencies by the Dean/Principal may be condoned. Further, the Vice Chancellor may also condone additional 5% of the required attendance in an extreme emergency case on merit basis. The relaxation of the attendance by the Dean/Principal/Vice Chancellor cannot be claimed as a matter of right by the students; it shall depend on facts and circumstances of individual case.

If a student does not meet the attendance criteria as mentioned above, he/she will not be permitted to appear in the End Term Examination. He/she can appear in the subsequent Odd/Even Semester examination after making up the deficiencies in the attendance.

(ii) He/she is not a defaulter in payment of any dues of the SGT University

(iii) No disciplinary action is pending against the student.

(iv) He/she should be on the rolls of the Faculty/College during the semester.

(v) The shortage of attendancecan be condoned by the competent authority as mentioned below in the table to the maximum limit and the same will be within the limit of the attendance criteria as mentioned in Point No. (i) above :

Sr. No	Exemptible attendance	Ground of Exemption	Dean of the Faculty is competent authority to condone shortage of lecture/ attendance.
1.	5%	For illness and contingencies of serious nature by the Dean & the Vice Chancellor	
2.	All periods of the day of donation	Voluntary blood donation to the Blood Bank.	
3.	All periods of the day of Examination.	For appearing in the supplementary examinations (Theory /Practical/Viva-voce	
4.	Maximum of 10 days attendance during a semester	For participation in University or Inter-Collegiate Sports Tournaments/ Youth Festivals, NCC/NSS Camps/University Educational Excursions, Mountaineering Courses	
5.	Maximum of 15 days attendance during a semester	For participation in Inter-University Sports Tournaments/Youth Festivals/Exhibition/ Symposium	

Provided that :

(i) He/she has obtained prior approval of the Dean of the Faculty.

(ii) Credit may be given only for the days on which lectures were delivered or tutorials or practical work done during the period of participation in the aforesaid events.

(e) **Attendance Shortage Warning :**

Attendance shortage warning will be regularly displayed on the Faculty's Notice Board every month and shall also be informed to the parents/guardians by the respective Course Coordinator.

In case, a student falls short of attendance during any semester, his result will be marked as "DETAINED" which can be removed subsequently after completing attendance requirement.

(e) **Submission of Examination Forms :**

All the students are required to submit their Examination Form through University ERP only before the last date as notified by the Controller of Examinations. The Examination Forms of the eligible students shall be validated by the Dean and will be forwarded to the Controller of Examinations within the prescribed date. In case, examination form is not submitted by scheduled last date, a late fee will be charged as prescribed by the University from time to time.

8. Setting of Question Papers:

The Dean of the Faculty shall supply the panel of internal and external examiners duly approved by the Board of Studies to the Controller of Examinations. The paper(s) will be set by the examiner(s) nominated by the Vice-Chancellor from the panel of examiners.

The question papers will be moderated by the Moderation Committee in the Chairmanship of Dean/Principal of the Faculty/College who is proficient in the subject in the office of the Controller of Examinations. The moderation will be done to see the difficulty level and that no question is out of syllabus and there is no mistake in the questions and the committee will amend/correct the paper accordingly.

The examiner(s) will set the question papers as per the criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council.

9. Appointment of Examiners:

The examiners will be appointed as per the following guidelines with the approval of the Vice Chancellor by taking due care that his/her own relative is not appearing in the examination :

(a) An internal/external examiner should be of the level of an Assistant Professor/consultant/equivalent or above in the respective subject in a University/Institution/College/Hospital.

(b) One external and one internal examiner will jointly conduct the practical examination.

(c) External examiners shall not be from the same University and should preferably be from outside the University.

(d) External examiners shall be rotated at an interval of 3 years.

10. Evaluation Process – Theory, Practical & Internal Assessment:

(a) Evaluation of Answer Books:

The answer books may be evaluated either by the paper setter or any other internal or external examiner to be nominated by the Controller of Examinations with the approval of the Vice-Chancellor from the panel of examiners approved by the Board of Studies.

(b) Re-evaluation of Answer Books:

The students can apply for Re-evaluation/Re-checking of any paper through the HOD/Dean of the Faculty by paying fee as per re-evaluation rules of the university.

(c) Internal/Formative Assessment:

Formative assessment in each theory paper shall have the following distribution:

(i) Attendance = 5 Marks

75 to 80	01
Above 80 to 85	02
Above 85 to 90	03

Above 90 to 95	04
Above 95 to 100	05

(ii) Midterm Class Tests (subjective & objective) = 20 marks

(iii) Assignment = 05 marks

(iv) Problems/Projects/Seminar/Case Study etc = 10 marks

The concerned teacher shall make continual assessment weekly over the content covered during the week and also shall have record of the same. It shall preferably be displayed monthly and finally cumulatively before the start of the semester examination.**In case, any student fails to clear the Internal Examination, the Vice Chancellor may relax and permit for Re-examination considering the request of the student on merit with the recommendations of the respective Deans.**

(i) In case of ex-students, those appearing for re-appear/improvement examination in any semester, their previous Internal Assessment marks will be counted.

(ii) The concerned teacher shall submit records to the HoD/Dean on the basis of which the Internal Assessment has been awarded and HoD/Dean shall make the same available to the Controller of Examinations whenever required.

(iii) That the internal assessment marks are submitted to the Controller of Examinations at least 7 (seven) days before the commencement of the end-term examinations of each semester.

(d) Practical Examinations:

(i) **Appointment of Examiners:**

The practical examinations shall be conducted by a Board of two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies.

(ii) **Distribution of Marks**: Practical examination for summative examination in all semesters will have the following distribution:

(aa) Summative assessment distribution (30 Marks):

Demonstration/conduction/presentation	=	20 marks
Viva Voce examination	=	10 marks

(ab) Formative assessment distribution (20 Marks):

Attendance = 5 marks

75 to 80	01
Above 80 to 85	02
Above 85 to 90	03
Above 90 to 95	04
Above 95 to 100	05

Laboratory work report	=	5 marks
Midterm oral examination/assessment	=	10 marks

(e) Project:

(i) Topic Selection and Appointment of Guide/Supervisor

Each student will be assigned a Teacher as Guide/ Supervisor from the Department. Topic of the Project will be approved by the Dean of the respective Faculty on the recommendations of the Teacher Guide/supervisor.

(ii) Evaluation:

The examination for Project shall be conducted by a Board of Two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies. Evaluation of the Project Report will be done by the External examiner or by Internal Examiner. The student will submit the project report in the form as specified by the department atleast before 15 days before the commencement of the examination, failing which it will be acceptable only with late fee of Rs. 2000/-
.

(f) Field Training

Evaluation of the field training will be for the marks as prescribed in the Scheme of Examinations of the respective course/program. The formative assessment of field training shall be based on the presentation, case reports and log sheets as well as on the basis of viva voce and reports adjudged by the joint board of external and/or internal examiners.

(g) Re-appearance for Improvement :

A student may re-appear in any theory paper prescribed for a semester after making the prescribed Examination Fee as notified by the University from time to time, on foregoing in writing his/her previous performance in the paper/s concerned. This can be done in the immediate subsequent semester examination only (for example, a student re-appearing in paper prescribed for 1stSemester examination may do so along with subsequent 3rdSemester examination and shall not be allowed to appear along with papers for 5thSemester.

A candidate who had cleared examination of Third Academic Year (Vth and VIth Semesters) may re-appear in any paper of Vth and VIth Semester only once at the immediate subsequent examinations on foregoing in writing her/her previous performance in the paper/s concerned, within the prescribed span period. Likewise will be applicable for the Fourth Academic Year also.

In the case of re-appearance in paper, the result will be prepared on the basis of candidate's current performance in the examination.

In the case of a candidate, who opts to re-appear in any paper/s under the aforesaid provisions,, on surrendering her/his earlier performance but fails to re-appear in the paper/s concerned, the marks previously secured by the candidate in the paper/s in

which he/she has failed to re-appear shall be taken into account while determining his/her result of the examination held currently.

11. Criteria for Promotion to Higher Semester(s):

(a) **For programs of the duration of 4 Academic Years (8 Semesters).**

The student will be promoted to the next semesters irrespective of the number of papers cleared/passed in the lower semesters. But he/she will not be allowed to appear in the examination of the 4th Semester unless he/she has cleared atleast 50% papers of 1st and 2nd semesters taken together and further the students will not be allowed to appear in the examination of the 6th semester unless he/she has cleared 1st and 2nd semesters and 50% papers of 3rd and 4th semesters taken together. Furthermore, the students will not be allowed to appear in the examination of the 8th semester unless he/she cleared 1st, 2nd, 3rd and 4th semesters and 50% papers of 5th and 6th semesters taken together.

(b) **For programs of the duration of 3 Academic Years (6 Semesters).**

The student will be promoted to the next semesters irrespective of the number of papers cleared/passed in the lower semesters. But he/she will not be allowed to appear in the examination of the 4th Semester unless he/she has cleared atleast 50% papers of 1st and 2nd semesters taken together and further the students will not be allowed to appear in the examination of the 6th semester unless he/she has cleared 1st and 2nd semesters and 50% papers of 3rd and 4th semesters taken together.

(c) **For program of the duration of 2 Academic Years (4 Semesters).**

The student will be promoted to the next semesters irrespective of the number of papers cleared/passed in the lower semesters. But he/she will not be allowed to appear in the examination of the 4th Semester unless he/she has cleared 50% subjects of 1st and 2nd semesters taken together.

12. Pass % criteria and grading system:

(a) The minimum percentage of marks to pass a course/paper will be as given below. Each Faculty is required to adopt any one scheme out of the below mentioned and incorporate the same in their respective Scheme of Examinations.

(i) The pass percentage for each component i.e. End Term Examination (Theory/Practical) and Internal Assessment is 40% separately (for the courses adopting Table No. 3).

(ii) The pass percentage for Internal Assessment will be 40% to be eligible to appear in End Term Examination, whereas overall pass percentage will be 50%in the End Term Examination (Theory/Practical) including Internal Assessment (For all other courses) (for the courses adopting Table No. 1).

(iii) The pass percentage for each component i.e. End Term Examination (Theory/Practical) and Internal Assessment is 40% separately (for the courses adopting Table No. 2).

(iv) To qualify for award of degree, a Grade Point of4.0, 5.0 and 6.0 **respectively and minimum numbers of credits required for that degree as defined in the Scheme of Examinations of the concerned course.**

(The Department of Physics, Faculty of science opt option – ii as Pass % criteria for M.Sc. Physics Programme)

(b) **Credit Based Grading System:-**

Key Definitions:

Programme: An educational programme leading to award of a Degree, diploma or certificate.

Course : Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight

Credit: A unit by which the course work is measured. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours for Practical Work/Field Work/ Research Based Paper /Project per week.

Credit Point: Itis the product of grade point and number of credits for a course i,e, Credit Point = No. of credit in a course **x** "grade value" of the grade obtained in the course.

Semester Grade Point Average (SGPA): The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student andthe sum of the number of credits of all the Courses undergone by a student, i.e. SGPA(Si) =∑ (Ci x Gi) /∑Ci

Cumulative Grade Point Average (CGPA):CGPA The is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of programme, i.e, CGPA =∑(Ci x Si) / ∑Ci

Grade Point :**It** is a numerical weight allotted to each letter grade on a l0-point scale with 7/6/5LETTER GRADES: **It** is an index of the performance of students in a said course.

Grades are denoted by letters 0, A+, A, B+, B, C, P and F etc.

Grade and its corresponding values. (For the courses where the pass marks are 50%)

[Faculty of Engineering & Technology, Law, Behavioural Sciences (Except B. Sc. (Clinical Psychology) & BA (Hons.) (Psychology), Fashion & Design, Mass Communication & Media Technology, Agricultural Sciences (Except M. Sc. programs), Education, Hotel & Tourism Management, Commerce & Management, Science, Allied Health Sciences, Physiotherapy]

Range of Percentage of Marks	Letter Grade	Grade Points	Range of Grade Points	Classification
90% and above	O (Outstanding)	10	9-10	Outstanding
80% and above but less than 90%	A+ (Excellent)	9	8<9	Excellent
70% and above but less than	A (Very Good)	8	7<8	1st Division with

80%				Distinction
60% and above but less than 70%	B+ (Good)	7	6<7	1st Division
Above 50% but less than 60%	B (Above Average)	6	>5<6	2nd Division
Minimum Pass Marks 50%	P (Pass Average)	5	5	Pass
Below minimum pass marks	F (Fail)	0	-	Fail

Grade and its corresponding values. (For the courses where the pass marks are 60%)

Faculty of Agricultural Sciences (M. Sc. programs)

Range of Percentage of Marks	Letter Grade	Grade Points	Range of Grade Points	Classification
90% and above	O (Outstanding)	10	9-10	Excellent
80% and above but less than 90%	A+ (Excellent)	9	8<9	1st Division with Distinction
70% and above but less than 80%	A (Very Good)	8	7<8	1st Division
Above 60% but less than 70%	B (Good)	7	>6<7	2nd Division
Minimum Pass Marks 60%	P (Pass)	6	6	Pass with 1st Division
Below minimum pass marks	F (Fail)	0	-	Fail

Grade and its corresponding values. (For the courses where the pass marks are 40%)

Faculty of Behavioural Sciences [B. Sc. (Clinical Psychology) & BA (Hons.) (Psychology)]

Range of Percentage of Marks	Letter Grade	Grade Points	Range of Grade Points	Classification
90% and above	O (Outstanding)	10	9-10	Outstanding
80% and above but less than 90%	A+ (Excellent)	9	8<9	Excellent
70% and above but less than 80%	A (Very Good)	8	7<8	1st Division with Distinction
60% and above but less than 70%	B+ (Good)	7	6<7	1st Division
50% and above but less than 60%	B (Above Average)	6	5<6	2nd Division
Above 40% but less than 50%	P (Pass Average)	5	>4<5	3rd Division
Minimum Pass Marks 40%	P (Pass Average)	4	4	Pass
Below minimum pass marks	F (Fail)	0	-	Fail

Semester Grade Point Average (SGPA):

SGPA (Si)=**Σ(Ci ×Gi)/ΣCi**

Where Ci is the number of credits of the ith course and Gi is the grade point scored as per marks obtained by the student in the ith course. Further, G is calculated as given below:

G=[Marks obtained in paper/Total marks of paper]×10 (The multiplication factor)

Cumulative Grade Point Average (CGPA):

CGPA= **Σ(Ci ×Si)/ΣCi**

Where Si is the SGPA of the ith Semester and Ci is the total number of credits in that Semester.

Formula for calculating percentage of marks;

CGPA×10 (The multiplication factor)

(c) **Grace Marks** :

Maximum 1% of total marks (Maximum to 5 marks) excluding internal assessment marks can be awarded to a student in one academic year.

13. Declaration of Results:

(a) After the semester/year examinations are over, the Controller of Examinations shall publish the results of those students who had appeared in the examinationspreferably within 45 days of last paper of course examination.

(b) Each successful student/ the student placed in reappear shall receive a copy of the Detailed Marks Certificate/ Grade Card Sheet of each semester examination.

(c) The successful students after the 4th, 6thor 8thsemester examination shall be equated in seven ascending letter grade (P to O) and grade points from 4 to 10 on the basis of final CGPA obtained by him/her in the 1st to 4th, 1st to 6th or 1st to 8th semester examinations.

14. Discharge of the students from the program

The student who does not clear all the papers with in the stipulated time frame span period i.e. duration of the program + 02 years will be discharged from the programme.

15. Re-admission

As per the chapter 2, Clause 2.4.5. of the First Ordinance of the University, if a student remains absent, without leave of absence, from his/her classes for a continuous period of seven working days without any valid reason, medical or otherwise, his/her name shall be struck off from the rolls of the University. However, the student may be re-admitted on payment of the prescribed fee by the University from time to time, if Dean/Principal is satisfied that re-admission of the student will not fall short of requisite percentage of the attendance.

If a student is re-admitted, all his previous records are revived under the current structure, regulations and scheduled of fees.

A student, who has been rusticated or expelled from University, cannot be re-admitted.

16. Simultaneously pursuing other degree

As per the guidelines of the University Grants Commission, students will not be permitted to pursue two degrees simultaneously. If at any time, it comes to the notice of the University, his/her degree will be cancelled without any prior notice.

17. Appearing for additional papers after award of degree

The student will be allowed to appear for additional papers available in that degree course after the completion of course within the span period subject to attendance requirement and internal assessment. A separate marksheet will be issued for such paper(s).

18. Other Provisions:

(a) Nothing in this Ordinance shall debar the University from amending the Ordinance and the same shall be applicable to all the students from the date of its implementation.

(b) Any other provision not contained in the Ordinance shall be governed by the rules and regulations framed by the University from time to time.

(c) In case of any interpretation, The Vice-Chancellor is empowered in this regard and his interpretation shall be the final.

(d) This ordinance will be effective from the AdmissionsSession 2019-20.

Name of the Faculty : Faculty of Science

Name of the Program : M. Sc. (Physics) SESSION : 2019-20

Sr. No.	Semester/ Year	Course Code	Nomenclature	Theory/ Practical	Core/ AECC/ SEC/ DSE/ GE	Lecture	Tutorial	Practical	Credits	Theory		Practical						Internal						Oral		Overall Pass Marks	Whether to be offered under CBCS (Yes/No)	Scheme of Examinations (Theory +Internal+ Practical+Oral/ Theory+Internal +Practical/ Theory+Practical
										Max	Pass	Experimental Performance	Viva-voce	Lab Work Report/ Dissertation Report	Max	Pass	Attendance	Midterm/ Internal Viva - Voce	Assignment	Practical File/Project File/Seminar	Max	Pass	Max	Pass			
1		17080101	Mathematical Physics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
2		17080102	Classical Mechanics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
3		17080103	Quantum Mechanics - I	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
4	I / I	17080104	Statistical Mechanics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
5		17080105	Laboratory Course - I	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
6		17080106	Laboratory Course - II	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
7		17080107	Professional Ethics and Human Values	Theory	SEC	2			2	30	12						5	10	5		20	8			20	NO	Theory+Internal
8		17080201	Solid State Physics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
9		17080202	Quantum Mechanics - II	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
10		17080203	Electrodynamics and Plasma Physics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
11	II / I	17080204	Electronic Devices	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
12		17080205	Laboratory Course - III	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
13		17080206	Laboratory Course - IV	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
14		17080207	Lasers and its Applications	Theory	SEC	2			2	30	12						5	10	5		20	8			20	NO	Theory+Internal
15		17080301	Computational Methods & Programming	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
16		17080302	Atomic and Molecular Physics	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
17		17080303	Laboratory Course - V	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
18		17080304	Laboratory Course - VI	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
19	III / II	17080305	The Physics of Energy	Theory	SEC	2			2	30	12						5	5	5	5	20	8			20	NO	Theory+Internal
20		17080306	Condensed Matter Physics - I	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
21		17080307	Electronics - I	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
22		17080308	Nuclear Physics - I	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
23		17080309	Spectroscopic Techniques - I	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
24		17080401	Physics of Nano Materials	Theory	Core	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
25		17080402	Laboratory Course - VII	Practical	Core			8	4			36	18	6	60	24	10	20		10	40	16			40	NO	Practical+Internal
26		17080403	Project	Practical	SEC			12	6				45	45	90	36	15	30		15	60	24			60	NO	Practical+Internal
27	IV / II	17080404	Condensed Matter Physics - II	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
28		17080405	Electronics - II	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
29		17080406	Nuclear Physics - II	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal
30		17080407	Spectroscopic Techniques - II	Theory	DSE	4			4	60	24						5	20	5	10	40	16			40	NO	Theory+Internal

25-12-2019

Name of the Faculty : Faculty of Science

Name of the Program : M. Sc. (Physics) SESSION : 2019-20

Sr. No.	Semester/ Year	Course Code	Nomenclature	Theory/ Practical	Core/ AECC/ SEC/ DSE/ GE	Lecture	Tutorial	Practical	Credits	Theory		Theory (Internal)						Practical					Practical (Internal)						Oral		Overall Pass Marks	Whether to be offered under CBCS (Yes/No)	Scheme of Examinations (Theory +Internal+ Practical+Oral/ Theory+Internal +Practical/ Theory+Practical
										Max	Pass	Attendance	Midterm	Assignment	Project/Seminar	Max	Pass	Demonstration/Presentation	Viva-voce	Max	Pass	Attendance	Lab Work	Midterm	Max	Pass	Max	Pass			
1	I / I	17080101	Mathematical Physics	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
2		17080102	Classical Mechanics	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
3		17080103	Quantum Mechanics - I	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
4		17080104	Statistical Mechanics	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
5		17080105	Laboratory Course - I	Practical	Core			8	4									36	24	60		10	10	20	40	16				50	NO	Practical+Internal
6		17080106	Laboratory Course - II	Practical	Core			8	4									36	24	60		10	10	20	40	16				50	NO	Practical+Internal
7		17080107	Professional Ethics and Human Values	Theory	SEC	2			2	30		5	5	5	5	20	8													20	NO	Theory+Internal
8	II / I	17080201	Solid State Physics	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
9		17080202	Quantum Mechanics - II	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
10		17080203	Electrodynamics and Plasma Physics	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
11		17080204	Electronic Devices	Theory	Core	4			4	60		5	20	5	10	40	16													50	NO	Theory+Internal
12		17080205	Laboratory Course - III	Practical	Core			8	4									36	24	60		10	10	20	40	16				50	NO	Practical+Internal
13		17080206	Laboratory Course - IV	Practical	Core			8	4									36	24	60		10	10	20	40	16				50	NO	Practical+Internal
14		17080207	Lasers and its Applications	Theory	SEC	2			2	30		5	5	5	5	20	8													20	NO	Theory+Internal

15		17080301	Computational Methods & Programming	Theory	Core	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
16		17080302	Atomic and Molecular Physics	Theory	Core	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
17		17080303	Laboratory Course - V	Practical	Core			8	4									36	24	60		10	10	20	40	16		50	NO	Practical+Internal
18		17080304	Laboratory Course - VI	Practical	Core			8	4									36	24	60		10	10	20	40	16		50	NO	Practical+Internal
19	III / II	17080305	The Physics of Energy	Theory	SEC	2			2	30		5	5	5	5	20	8											20	NO	Theory+Internal
20		17080306	Condensed Matter Physics - I	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
21		17080307	Electronics - I	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
22		17080308	Nuclear Physics - I	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
23		17080309	Spectroscopic Techniques - I	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
24		17080401	Physics of Nano Materials	Theory	Core	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
25		17080402	Laboratory Course - VII	Practical	Core			8	4									36	24	60		10	10	20	40	16		50	NO	Practical+Internal
26		17080403	Project	Practical	SEC			12	6									45	45	90		15	15	30	60	24		75	NO	Practical+Internal
27	IV / II	17080404	Condensed Matter Physics - II	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
28		17080405	Electronics - II	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
29		17080406	Nuclear Physics - II	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal
30		17080407	Spectroscopic Techniques - II	Theory	DSE	4			4	60		5	20	5	10	40	16											50	NO	Theory+Internal

M.Sc. (Physics)

Course Structure under Choice Based Credit System (CBCS): 2019-20

SEMESTER	COURSE CODE	COURSENAME	L	T	P	Contact hours/ week	Credits	Max. Marks	Formative Assessment	Summative Assessment
I		**Core Courses**								
	17080101	Mathematical Physics	4	0	0	4	4	100	40	60
	17080102	Classical Mechanics	4	0	0	4	4	100	40	60
	17080103	Quantum Mechanics-I	4	0	0	4	4	100	40	60
	17080104	Statistical Mechanics	4	0	0	4	4	100	40	60
	17080105	Laboratory Course-I	0	0	8	8	4	100	40	60
	17080106	Laboratory Course-II	0	0	8	8	4	100	40	60
		Skill Enhancement Course								
	17080107	Professional Ethics & Human Values	2	0	0	2	2	50	20	30
Total Credits			**18**	**0**	**16**	**34**	**26**	**650**	**260**	**390**
II		**Core Courses**								
	17080201	Solid State Physics	4	0	0	4	4	100	40	60
	17080202	Quantum Mechanics-II	4	0	0	4	4	100	40	60
	17080203	Electrodynamics and Plasma Physics	4	0	0	4	4	100	40	60
	17080204	Electronic Devices	4	0	0	4	4	100	40	60
	17080205	Laboratory Course-III	0	0	8	8	4	100	40	60
	17080206	Laboratory Course-IV	0	0	8	8	4	100	40	60
		Skill Enhancement Course								
	17080207	Laser and its applications	2	0	0	2	2	50	20	30
Total Credits			**18**	**0**	**16**	**34**	**26**	**650**	**260**	**390**
III		**Core Courses**								
	17080301	Computational Methods & Programming	4	0	0	4	4	100	40	60
	17080302	Atomic and Molecular Physics	4	0	0	4	4	100	40	60
	17080303	Laboratory Course-V	0	0	8	8	4	100	40	60
	17080304	Laboratory Course-VI	0	0	8	8	4	100	40	60
		Skill Enhancement Course								
	17080305	The Physics of Energy	2	0	0	2	2	50	20	30
		Discipline Specific Elective Courses (Choose any two of the following specialization)								
	17080306	Condensed Matter Physics-I	4	0	0	4	4	100	40	60
	17080307	Electronics - I	4	0	0	4	4	100	40	60
	17080308	Nuclear Physics-I	4	0	0	4	4	100	40	60
	17080309	Spectroscopic Techniques-I	4	0	0	4	4	100	40	60
Total Credits			**18**	**0**	**16**	**34**	**26**	**650**	**260**	**390**
IV		**Core Courses**								
	17080401	Physics of Nano Materials	4	0	0	4	4	100	40	60
	17080402	Laboratory Course-VII	0	0	8	8	4	100	40	60
		Skill Enhancement Course								
	17080403	Project	0	0	12	12	6	150	60	90
		Discipline Specific Elective Courses (Choose any two of the following specialization) **(Student opting specialized course in third semester has to be opt the advance paper of the same specialized course)**								
	17080404	Condensed Matter Physics-II	4	0	0	4	4	100	40	60
	17080405	Electronics-II	4	0	0	4	4	100	40	60
	17080406	Nuclear Physics-II	4	0	0	4	4	100	40	60
	17080407	Spectroscopic Techniques-II	4	0	0	4	4	100	40	60
Total Credits			**12**	**0**	**20**	**32**	**22**	**550**	**220**	**330**
Grand Total			**66**	**0**	**68**	**134**	**100**	**2500**	**1000**	**1500**

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Scheme of Studies M.Sc. (Physics): 2019-20

Category	Credits	%
Core Course	72	72
Discipline Specific Elective Course	16	16
Skill Enhancement Course (SEC)	12	12
Total	100	100

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CORE COURSES

Semester-I

1. Name of the Department: Physics						
2. Course Name	**Mathematical Physics**	**L**	**T**		**P**	
3. Course Code	17080101	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials** = 0	**Practical** = 0			
8. Course Description:						
The course will teach about a variety of mathematical methods which are used in solving problems in physics. These methods include solution of differential equations, tensors and matrices, and complex variables.						
9. Course Objectives:						
To impart knowledge about various mathematical tools employed to study physics problems.						
10. Course Outcomes (COs):						
Students will have understanding of 1. various techniques to solve differential equations 2. how to use special functions in various physics problems						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 12**	**Title of the unit: Vector spaces, tensors and matrices**				
Vector spaces: Introduction, definition of linear vector space , Linear independence, basis and dimension, scalar product, orthonormal basis, Gram-Schmidt orthogonalization process, Linear operators, Covariant and Contravariant tensors, Symmetric and skew-symmetric tensor, product of tensors Metric tensors, Matrices, orthogonal, Unitary and Hermition Matrices, eigen values & Eigen vectors, Matrix diagonalization.						
Unit - 2	**Number of lectures = 12**	**Title of the unit: Differential equations and special functions**				
First order equation, second order equation with variable coefficients, Ordinary point, singular point, series solution around an ordinary point and regular singular point, Solution of Legendre equation, Solution of Bassel's equation, Solution of Hermite&Lageurre equations, Definitions and properties of special functions: Bessel functions, Legendre polynomials, Hermite polynomials and Lageurre polynomials along with recurrence relations.						
Unit - 3	**Number of lectures = 14**	**Title of the unit: Complex variables**				
Function of complex variable, limit, continuity and differentiability of function of complex variables, Analytic function, Cauchy-Riemann conditions, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent's series, singular points, residues, evaluation of residues, Cauchy's residue theorem, Jordan's lemma, evaluation of real definite integrals.						
Unit - 4	**Number of lectures = 14**	**Title of the unit: Integral transforms**				
Fourier series, Dirichlet's conditions, Fourier series of arbitrary period, Half-wave expansions, development of the Fourier integral, Fourier integral theorem, Fourier transforms, Properties of Fourier transform, Convolution theorem, Fourier transform of Dirac delta function, Laplace transform, first and second shifting theorem, Laplace transforms of derivatives and integral of a function, convolution theorem, Inverse Laplace transform by partial fraction and by using convolution theorem, application of Laplace transform in solving differential equations.						
12. Brief Description of self learning / E-learning component						

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http://nptel.ac.in/courses/115103036/
http://web.mit.edu/al24406/www/mathmeth/DiffForms_SchulzSchulz_10Sep.pdf
https://www.youtube.com/watch?v=LYNOGk3ZjFM

13. Books Recommended

1. G. Arfken and H.J. Weber. Mathematical Methods for Physicists. San Diego: Academic Press.
2. A.W. Joshi. Matrices and Tensors in Physics. New Delhi: Wiley Eastern.
3. P.K. Chatopadhyay. Mathematical Physics. New Delhi: Wiley Eastern.
4. C. Harper. Introduction to Mathematical Physics. New Delhi: Prentice Hall of India.
5. M.L. Boas. Mathematical Methods in the Physical Sciences. New York: John Wiley.
6. L .Pipes and L.R. Horwell. Applied Mathematics for Engineers and Physicists.
7. Mary L. Boas. Mathematics for Physicists.
8. B.S. Rajput. Mathematical Physics.
9. A. K. Ghatak and I. C. Goyal. Mathematical Methods for Physicists.

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1. Name of the Department: Physics						
2. Course Name	**Classical Mechanics**	**L**	**T**		**P**	
3. Course Code	17080102	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE()**		**SEC()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Brief Syllabus:

The syllabus is divided into four units i.e. Lagrangian formulation and Hamilton's principle, rigid body motion, small oscillation and Hamilton equation, and canonical transformation and Hamilton-Jocobi theory.

9. Learning objectives:

The course aims to provide students with an understanding of the basics of Lagrangian formulation, Hamilton's principle and canonical transformation. It also gives the idea how to write Lagrangian and Hamiltonian for the rigid body motion.

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. understand the Lagrangian formulation and Hamilton's principle.
2. write Lagrangian and Hamiltonian for the rigid body motion.
3. describe the basic involved in the small oscillation and related Hamilton equation.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Lagrangian Formulation & Hamilton's Principle**

Mechanics of a system of particles, constraints of motion, generalized coordinates, D'Alembert's Principle Lagrange's velocity dependent forces (gyroscopic), dissipation function, Application of Lagrangian formulation Hamilton principle, Lagrange's equation from Hamilton principle, extension to non-holonomic systems.

Unit – 2	**Number of lectures = 14**	**Title of the unit: Rigid Body Motion**

Reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem , classification of orbits , the differential equation for orbits, Kepler's problem (inverse square law), scattering in central force field, The Euler's angles, rate of change of a vector, Coriolis force and its applications.

Unit – 3	**Number of lectures = 13**	**Title of the unit: Small Oscillations & Hamilton Equation**

Euler equation of motion, Torque free motion of rigid body, motion of a symmetrical top, Eigen value equation, Free vibrations, Normal coordinates, vibration of Tri-atomic Molecule, Legendre Transformation

Hamilton's equations of motion, Hamilton's equations from variation principle, Principle of least action.

Unit – 4	**Number of lectures = 11**	**Title of the unit: Canonical Transformation and Hamilton-Jacobi Theory**

Canonical transformation and its examples, Poisson's brackets, Equation of motion, Angular momentum,

Poisson's Brackets relations, infinitesimal canonical transformation, Conservation Theorems., Hamilton-Jacobi equation Hamilton's principal function, Harmonic Oscillator problem

Brief Description of self-learning / E-learning component:

To understand basic concepts in detail, students may get study materials on following links.
https://onlinecourses.nptel.ac.in/noc18_ph02
http://www.damtp.cam.ac.uk/user/tong/dynamics/clas.pdf

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12. Brief Description of self- learning / E-learning component.

To understand basic concepts in detail, students may get study materials on these links.

1. https://onlinecourses.nptel.ac.in/noc18_ph02
2. https://www.mooc-list.com/tags/nuclear-physics
3. www.nuclearonline.org/Courses.htm
4. https://study.com/directory/category/Physical_Sciences/Physics/Nuclear_Physics.html
5. https://www.class-central.com/tag/nuclear%20physics

13.Books Recommended

1. R. R. Roy and B. P. Nigam, "Nuclear Physics: Theory and Experiment", Wiley Eastern Limited, 1993.
2. M. K. Pal, "Theory of Nuclear Structure", Affiliated East-West Press, New Delhi.
3. Greiner and Maruhn, "Nuclear Models", Springer, 1996.\
4. W. E. Burcham, "Nuclear Physics : An Introduction", Longman Group Limited, London, 1973.
5. R. G. Sachs, "Nuclear Theory", Addison-Wesley Publishing Company, Cambridge, 1955.
6. K. S. Krane, "Introductory Nuclear Physics", Wiley India Pvt. Ltd., 2008

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1. Name of the Department: Physics						
2. Course Name	**Quantum Mechanics-I**	**L**	**T**		**P**	
3. Course Code	17080103	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials** = 0	**Practical** = 0			

8. Course Description:

This course will give an introduction to quantum mechanics, beginning with wave mechanics, angular momentum, time evolution, the simple harmonic oscillator, bra-ket notation. The students will also be made familiar with time independent perturbation theory applied to various problems.

9. Course Objectives:

To give exposure about the various tools employed to analyze the quantum mechanical problems.

10. Course Outcomes (COs):

Students will have understanding of:

1. Importance of quantum mechanics compared to classical mechanics at microscopic level.
2. Various tools to calculate Eigen values and total angular momentum of particles.

11. Unit wise detailed content

Unit-1	**Number of lectures** = 12	**Title of the unit: General formalism of quantum & Schroedinger equations with applications**

The Schrödinger equations, time dependent and time independent forms, probability current density, expectation values, Ehrenfest's theorem, Gaussian wave packet and its spreading., Exact statement and proof of the uncertainty principle, eigen values and Eigen functions, wave function in coordinate and momentum representations, Degeneracy and orthogonality. Application of Schrodinger equation for a particle in one dimensional Box, tunneling problem and linear harmonic oscillator

Unit – 2	**Number of lectures** = 12	**Title of the unit: Quantum operators**

Operator in quantum mechanics, Hermitian operator and Unitary operator change of basis, Eigen values and eigenvectors of operators, Dirac s Bra and Ket algebra, Linear harmonic oscillator, coherent states, Time development of states and operators, Heisenberg, Schroedinger and interactive pictures, Annihilation & creation operators, Matrix representation of an operator, Unitary transformations.

Unit – 3	**Number of lectures** = 14	**Title of the unit: Angular momentum**

The angular momentum operators and their representation in spherical polar coordinates, Solution of Schrodinger equation for spherically symmetric (central) potentials, spherical harmonics, Hydrogen atom. Commutators and various commutation relations. Eigen values and eigenvectors of L2 and Lz. Spin angular momentum, Eigen values and eigenvectors of J2 and Jz. Representation of general angular momentum operator,

Addition of angular momentum, C.G. coefficients, Stern-Gerlach experiment.

Unit – 4	**Number of lectures** = 14	**Title of the unit: Time independent perturbation theory**

Time independent perturbation theory, non degenerate case, first and second order perturbation, Degenerate case, First order Stark effect in hydrogen, The Variational Method: expectation value of the energy, application to the ground state of Harmonic oscillator, Hydrogen atom and Helium atom, Vander-Waals interactions.

12. Brief Description of self-learning / E-learning component

http://nptel.ac.in/courses/115106066/

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https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/
https://www.ks.uiuc.edu/Services/Class/PHYS480/qm_PDF/QM_Book.pdf

13. Books Recommended

1. Schiff. Quantum Mechanics. New Delhi: Tata McGraw-Hill.
2. B. Craseman and J.L. Powell. Quantum Mechanics. New Delhi: Narosa.
3. S. Gasiorowicz. Quantum Mechanics. New York: John Wiley.
4. J.J. Sakurai. Modern Quantum Mechanics. Addison Wesley.
5. P.M. Mathews and K. Venkatesan. Quantum Mechanics. New Delhi: Tata McGraw-Hill.
6. Ghatak and Loknathan. Quantum Mechanics.
7. M.P. Khanna. Quantum Mechanics. New Delhi: HarAnand.
8. V.K. Thankappan. Quantum Mechanics. New Delhi: New Age International.
9. N. Zettili. Quantum Mechanics: Concepts and Applications.

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1. Name of the Department: Physics						
2. Course Name	**Statistical Mechanics**	**L**	**T**		**P**	
3. Course Code	17080104	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			
8. Brief Syllabus:						
The course is intended to provide an understanding of the phase space and quantum space, canonical systems, in Bose-Einstein condensation, Ising model, random walk, Brownian motion and many more physical phenomenon which cannot be explained using classical mechanics principles.						
9. Learning objectives:						
The course aims to provide students with an understanding of the basics of phase space, ensembles, and different types of system like canonical, micro-canonical and grand-canonical system. To develop understanding of writing partition functions for these systems.						
10. Course Outcomes (COs):						
After the successful completion of the course, students would be able to 1. Understand phase space and canonical system. 2. Write partition functions for the canonical, micro-canonical and grand-canonical systems. 3. Describe the basic involved in Bose-Einstein condensation, Ising model, random walk and Brownian motion.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 12**	**Title of the unit: Basics of statistical mechanics**				
Phase space, Liouville's theorem, Ensemble and Ensemble average, The microscopic and macroscopic states, Concept of equal a priori probability, statistical equilibrium, micro canonical ensemble, Quantization of phase space, Classic limit, Symmetry of wave functions.						
Unit - 2	**Number of lectures = 12**	**Title of the unit: Canonical systems**				
The micro-canonical ensemble theory and its application to ideal gas of mono atomic particles; canonical ensemble and its thermodynamics, partition function; classical ideal gas in canonical ensemble theory, energy fluctuations; Equipartition and Virial theorems, a system of quantum harmonic oscillators as canonical ensemble, Statistics of paramagnetism, The grand canonical ensemble and significance of statistical quantities, classical ideal gas in grand canonical ensemble theory; density and energy fluctuations.						
Unit – 3	**Number of lectures = 14**	**Title of the unit: Quantum mechanical ensembles**				
Quantum states and phase space; an ideal gas in quantum mechanical ensembles; Ideal Bose system, basic concepts and thermodynamic behavior of an Ideal Bose gas; Bose-Einstein condensation; gas of photons (the radiation fields) and gas of photons (the Debye filed); Ideal Fermi systems; the thermodynamic behavior of an Ideal Fermi gas, discussion of heat capacity of a free electron gas at low temperatures; Pauli parameters, Boltzmann H-Theorem						
Unit – 4	**Number of lectures = 14**	**Title of the unit: Different models**				
A dynamical model of phase transitions, Critical indices, Ising model, Thermodynamic fluctuations, random walk, Brownian motion, introduction to non-equilibrium processes, diffusion equation.						
11. Brief Description of self-learning / E-learning component:						

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To understand basic concepts in detail, students may get study materials on following links.
https://onlinecourses.nptel.ac.in/noc18_ph02
https://www.cmi.ac.in/~kpnmurthy/StatisticalMechanics2017/book.pdf

12.Books Recommended

1. R.K. Patharia. Statistical Mechanics. 2nd ed. Oxford: Butterworth-Heinemann.
2. K. Huang. Statistical Mechanics. New Delhi: Wiley Eastern.
3. B.K. Agarwal and M. Eisner. Statistical Mechanics. New Delhi: Wiley Eastern.
4. C. Kittel. Elementary Statistical Physics. New York: John Wiley.
5. S.K. Sinha. Statistical Mechanics. New Delhi: Tata McGraw Hill.
6. Suresh Chandra. Textbook of Statistical Mechanics. New Delhi: CBS Publishers.

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1. Name of the Department: Physics						
2. Course Name	**Laboratory Course-I**	**L**	**T**		**P**	
3. Course Code	17080105	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 104**			

8. Course Description:

In this course student will gain the practical knowledge about the working of different semiconductor devices like photovoltaic cell, photo diode and determination of various parameters using various instruments.

9. Course Objectives:

1. To study the working principles of photovoltaic cell and photodiode
2. Determining e/m ratio, excitation potential and phase velocity

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiments.

11. List of Experiments

1. To determine Planck's constant using photovoltaic cell.
2. To measure the excitation potential of Argon using the Franck - Hertz method
3. To verify that atomic systems have discrete energy levels by bombarding electrons and observing the difference in energy levels.
4. To determine the value of e/m using Thomson method.
5. To Study the Photo-Diode Characteristics.
6. To determine the variation of refractive index of the material of prism and to verify Cauchy's dispersion formula.
7. To measure the numerical aperture and acceptance angle of an optical fibre.
8. To study the quantum tunneling effect with solid state device, e.g. tunneling current in backward diode or tunnel diode.
9. Creating Standing harmonic waves and study wavelength as a function of frequency and to find out the phase velocity
10. Creating standing harmonic waves and measure the linear mass density of the string

12. Book Recommended

1. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
2. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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1. Name of the Department: Physics						
2. Course Name	**Laboratory Course-II**	**L**	**T**		**P**	
3. Course Code	17080106	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 104**			

8. Course Description:

In this course student will gain the practical knowledge about the different functions of CRO, thermocouple, its calibration, pn junction diode etc

9. Course Objectives:

To determine various parameters like Boltzman constant, thermo emf, Curie temperature, velocity of sound in liquid etc.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiments.

11. List of Experiments

1. To study the characteristic of voltage doubler and voltage tripler.
2. To measure (i) the frequency of an a.c. signal and (ii) the phase difference between the two voltages using CRO.
3. To measure the Curie Temperature of a given ferroelectric material.
4. To measure the Curie Temperature of a given magnetic material.
5. To determine value of Boltzmann constant using V-I characteristic of PN diode.
6. Velocity of sound in liquids – ultrasonic interferometer meter
7. To study the thermocouple and plot the graph between thermo emf vs temperature.
8. Calibration of a thermocouple by potential meter
9. To find the dielectric constant of liquids
10. To calculate the time constant of a capacitor using RC circuit.

12. Book Recommended

3. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
4. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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Skill Enhancement Compulsory Courses

Semester - I

1. Name of the Department : Physics						
2. Course Name	Professional ethics and human value	**L**		**T**	**P**	
3. Course Code	17080107	2		0	0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 26		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

This course provides students with the knowledge of ethics in professional life. Some of the examples from history and day to day life will make the students more responsible towards their profession, society and family.

9. Course Objectives:

1. To develop ethical and human values in students
2. To develop the responsibility in students at professional and societal levels.

10. Course Outcomes (COs):

1. The students will understand the values of professional ethics and moral values deeply.
2. The students will be able to take strong decisions and perform their duties responsibly as on professional.

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Ethics and Human Values**

Definition, History and Development of Ethics, Universal declaration on Bioethics. Theories related to Bioethics: Utilitarian theory, Deontological theory and Communication theory.
Human Rights and Values : Autonomy, Consent, Equality, Confidentiality, Vulnerability and Personal Integrity
Environmental Ethics, Animal ethics

Unit – 2	**Number of lectures = 14**	**Title of the unit: Professional Ethics & Responsibility**

Need and Importance of professional ethics, Goals, Dignity of Labour, IRB & its functions, Authorship

Religious and Cultural Values, Importance of a Family, Guidance to youngsters, Gender Equality

Responsibilities towards Safety and Risk, Voluntary v/sIn voluntary Risk, Designing/Research for Safety – Risk, Benefit Analysis, Accidents. Disaster ethics,

Ethics in Media and Technology, Research Ethics, Intellectual Property Rights.

12. Brief Description of self learning / E-learning component

https://www.youtube.com/watch?v=cFOZplkRqsk&authuser=2

https://www.youtube.com/watch?v=HJk1Eodmf9A&authuser=2

https://www.youtube.com/watch?v=Fqt7m8LH5GY&authuser=2

https://youtu.be/2VYF_t51FyE

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https://youtu.be/2VYF_t51FyE

https://youtu.be/hjzA_rZG-bU

13. Books Recommended

1. Professional Ethics and Morals by Prof.A.R.Aryasri, DharanikotaSuyodhana – Maruthi Publications.
2. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
3. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013

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Semester-II

1. Name of the Department: Physics						
2. Course Name	**Solid State Physics**	**L**	**T**		**P**	
3. Course Code	17080201	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)	Physics at graduation level	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

This course will deepen your understanding of the different types of crystal structures and that will help you to analyze the electrical, mechanical, optical, and magnetic properties of the solids.

9. Course Objectives:

1. To study the basics of crystallography
2. To study the basic of origin of band gap in different types of solids.
3. To analyze the electrical and thermal properties of metals.
4. To understand the diamagnetic, paramagnetic and ferromagnetic properties of the materials
5. To get familiar with superconducting phenomenon and its applications.

10. Course Outcomes (COs):

After successful completion of the course, students will

1. have a basic knowledge of crystal systems and spatial symmetries
2. understand the concept of reciprocal space and be able to use it as a tool to know the significance of Brillouin zones
3. be able to calculate thermal and electrical properties in the free-electron model
4. know the fundamental principles of semiconductors, including pn-junctions, and be able to estimate the charge carrier mobility and density
5. know basic models of magnetism
6. be able to outline the importance of solid state physics in the modern society

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Crystal Structure**

Recapitulation of basic concepts: Bravais lattice, Primitive vectors, Primitive, conventional and Wigner-Seitz unit cells, Crystal structures and lattices with basis, Lattice planes and Miller indices, Simple crystal structures- Sodium chloride, Cesium chloride, Diamond, and Zinc-blende structures, Determination of crystal structure by diffraction, Reciprocal lattice and Brillouin zones (examples of sc, bcc and fcc lattices), Bragg and Laue formulations of X-ray diffraction by a crystal and their equivalence, Laue equations, Ewald construction, Brillouin interpretation, Crystal and atomic structure factors, Structure factor of the bcc and fcc lattices, Experimental methods of structure analysis: Types of probe beam, the Laue, rotating crystal and powder methods.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Lattice dynamics and thermal properties**

Classical theory of lattice vibration (harmonic approximation), Vibrations of crystals with monatomic basis- Dispersion relation, First Brillouin zone, Group velocity, Two atoms per primitive basis- acoustical and optical modes; Quantization of lattice vibration: Phonons, Phonon momentum, Inelastic scattering of neutrons by phonons; Thermal properties: Lattice (phonon) heat capacity, Normal modes, Density of states in one and three

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dimensions, Models of Debye and Einstein; Effects due to anharmonic crystal interactions, Thermal expansion.		
Unit - 3	**Number of lectures = 14**	**Title of the unit: Electronic properties of solids**
Free electron gas model in three dimensions: Density of states, Fermi energy, Effect of temperature, Heat capacity of the electron gas, Experimental heat capacity of metals, Thermal effective mass, Electrical conductivity and Ohm's law, Hall effect; Failure of the free electron gas model and Band theory of solids: Periodic potential and Block's theorem, Kronig-Penney model, Wave equation of electron in a periodic potential, Solution of the central equation, Approximate solution near a zone boundary, Periodic, extended and reduced zone schemes of energy band representation, Number of orbitals in an energy band, Classification into metals, semiconductors and insulators; Tight binding method and its application to SC and BCC structures.		
Unit - 4	**Number of lectures = 14**	**Title of the unit: Superconductivity**
Experimental survey: Superconductivity and its occurrence, Destruction of superconductivity by magnetic field, Meissner effect, Type I and type II superconductors, Entropy, Free energy, Heat capacity, Energy gap Microwave and infrared properties, Isotope effect; Theoretical survey: Thermodynamics of the superconducting transition, London equation, Coherence length, Salient features of the BCS theory of superconductivity, BCS ground state; Flux quantization in a superconducting ring; DC and AC Josephson effects; macroscopic long-range quantum interference, High T_c superconductors (introduction only).		
12.Brief Description of self-learning / E-learning component		
For understanding the basic concepts in detail, students may get the study materials from these E-learning links https://ocw.mit.edu/courses/physics/ https://nptel.ac.in/courses/115105099/ https://nptel.ac.in/courses/115104109/		
13.Books Recommended		
1. Introduction to Solid State Physics (7th edition) by Charles Kittel 2. Solid State Physics by Neil W. Ashcroft and N. David Mermin 3. Applied Solid State Physics by Rajnikant 4. Solid State Physics: An Introduction to Theory and Experiment by H. Ibach and H. Luth 5. Principles of the Theory of Solids (2nd edition) by J. M. Ziman 6. Solid State Physics by S.O. Pillai, "New Age International Publishers".		

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1. Name of the Department: Physics						
2. Course Name	Quantum Mechanics-II	**L**	**T**		**P**	
3. Course Code	17080202	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials** = 0	**Practical** = 0			
8. Course Description:						
The students will be made familiar with advanced topics such as approximation methods, scattering theory, many particle systems, etc.						
9. Course Objectives:						
To impart knowledge of advanced quantum mechanics for solving relevant physical problems.						
10. Course Outcomes (COs):						
Students will have understanding of: 1. approximation methods, scattering theory, etc. 2. Importance of relativistic quantum mechanics compared to non-relativistic quantum mechanics.						
11. Unit wise detailed content						
Unit-1	**Number of lectures** = 12	**Title of the unit: Approximation methods**				
WKB Approximation: WKB method for one-dimensional problems, Application to barrier penetration, WKB method for three dimensional problems, Time-dependent perturbation theory: General expression for the probability of transition from one state to another, harmonic perturbation, Fermi s golden rule, selection rule, adiabatic and sudden approximations.						
Unit - 2	**Number of lectures** = 14	**Title of the unit: Scattering theory**				
General considerations; kinematics, wave mechanical picture, scattering amplitude, differential and total cross-section, Green's function for scattering, partial wave analysis: asymptotic behaviour of partial waves, phase shifts, scattering amplitude in terms of phase shifts, cross-sections, optical theorem, phase shifts and its relation to potential effective range theory, application to low energy scattering; resonant scattering, Breit-Wigner formula for one level and two levels, non-resonant scattering-wave and p-wave resonances, exactly soluble problems; Square-well, Hard sphere, coulomb potential, Born approximation; its validity, Born series.						
Unit - 3	**Number of lectures** = 14	**Title of the unit: Many-particle system**				
Many-particle Schrodinger wave equation, identical particles: Physical meaning of identity, principle of indistinguishability and its consequences, exchange operator, Symmetric and anti-symmetric wave functions, connection between spin, symmetry and statistics, Fermions and bosons; Spin and total wave function for a system of two spin particles, Pauli exclusion principle and Slater determinant, Application to the electronic system of the helium atom (para- and orthohelium).						
Unit - 4	**Number of lectures** = 12	**Title of the unit: Relativistic quantum mechanics and radiation theory**				
Klein-Gordan Equation, Dirac Equation and its plane wave solution. transition probability for absorption, Transition probability for induced emission, electric dipole, forbidden transitions, selection rules.						
12. Brief Description of self learning / E-learning component						

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1. Name of the Department: Physics						
2. Course Name	**Electrodynamics & Plasma Physics**	**L**	**T**		**P**	
3. Course Code	17080203	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

This course aims to provide students with an introduction to the principles and behaviour of dynamical electric and magnetic systems, and a theoretical foundation in classical field theory. Plasma physics is an important subject for a large number of research areas. The primary learning outcome for this course is for the students to learn the basic principles and main equations of plasma physics, at an introductory level, with emphasis on topics of broad applicability.

9. Course Objectives:

To apprise the students regarding the concepts of electrodynamics and its use in various situations. To have a working understanding of the elements of Plasma Physics on topics including: Basic plasma properties; Motion of charged particles in magnetic field; Plasma waves and kinetic representation of plasmas.

10. Course Outcomes (COs):

1. Demonstrate and understanding of the use of scalar and vector potentials and of gauge invariance
2. Know and use methods of solution of Poisson/Laplace equation
3. Know and use principles of Lorentz covariant formalism
4. Know about radiation fields of moving charge
5. Gather basic understanding of Plasma state essential for higher studies.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Electrostatics**

Electric Field, Gauss Law, Differential form of Gauss Law, Electromagnetic scalar and vector potentials, Maxwell's equations in terms of scalar and vector potentials, Non uniqueness of Electromagnetic potentials and concept of Gauge. Lorentz gauge and coulomb gauge. Boundary value problem, Poisson and Laplace equations, Solution of Laplace equation in Rectangular coordinates, Green's Theorem, Dirichlet and Neumann boundary conditions, Formal solution of boundary value problem with Green's function, Electrostatic potential energy and energy density.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Method of Images**

The method of electrical images. Point charge near an infinite grounded conducting plane, Spherical conductor near point charge: When the sphere is at zero potential or earthed, insulated conducting sphere near a point charge, when the sphere is kept insulated and carries a total charge e, Point charge near a conducting sphere at fixed potential, Conducting sphere in a uniform electric field.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Electromagnetic Waves and Radiation by Moving Charges**

Wave equation, Reflection and Refraction of electromagnetic waves at a plane interface between dielectrics, Wave propagation in a non-conducting and conducting media, Fresnel relations, Brewster's angle, Wave guides:

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TE and TM modes in rectangular wave guides; Moving point charges, Retarded potentials, Lienard- Wiechart potentials for a point charge, The fields of moving charge particles, Total power radiated by a point charge: Larmor's formula and its relativistic generalization.

Unit - 4	Number of lectures = 12	Title of the unit: Plasma Physics

Elementary concepts, Derivation of moment Equations from Boltzmann Equation, Plasma Oscillation, Theory of simple oscillation, Electron oscillation in a plasma, Electronic oscillations when the motion of ions is also considered. Derivation of plasma oscillation using Maxwell's equation, Propagation of Electromagnetic waves in plasma containing a magnetic field Quasi neutrality of plasma, Debye shielding distance, Plasma production and heating of the plasma, Confinement of plasma, plasma instabilities.

12. Brief Description of self learning / E-learning component

http://nptel.ac.in/syllabus/95102023/

https://nptel.ac.in/courses/115102020/

https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-522-space-propulsion-spring-2015/lecture-notes/MIT16_522S15_Lecture8.pdf

13. Books Recommended

1. Classical Electrodynamics by J.D. Jackson.
2. Introduction to Electrodynamics by A. Z. Capri and P. V. Panat.
3. Electrodynamics by S. P. Puri.
4. Introduction to Electrodynamics by D. J. Griffiths.
5. Introduction to Plasma Physics by F. F. Chen.
6. Introduction to Plasma Theory by D. R Nicholson.

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1. Name of the Department: Physics						
2. Course Name	**Electronic Devices**	**L**	**T**		**P**	
3. Course Code	17080204	**4**	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)	Physics at graduation level	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The course is intended to provide an understanding of the electronic devices used in the current semiconductor industry. It caters to undergraduate and graduate students with a diverse background in Materials Science, and Physics. The course provides the students with the basic physics behind semiconductor materials, types of semiconductors, and the reason for the dominance of silicon in the electronics industry. The course also covers the basics of devices with emphasis on their electronic characteristics. Optical devices like LEDs, lasers, solar cells, and their properties will also be explained.

9. Course Objectives:

1. To study the basics of electronic components
2. To study the basic concept and characteristics of electronic devices and circuits.
3. To observe the characteristics of optical devices like LED, lasers and Solar cells
4. To get familiar with the different number systems and logic gates

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

1. Apply the concept of semiconductor physics
2. Apply the concepts of basic electronic devices to design various electronic circuits
3. Understand operation of diodes, transistors in order to design basic circuits
4. Analyze electronic circuits
5. Design small and large signal amplifier circuits for various practical applications

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Basic Semiconductor Devices**

p-n junction diode, Capacitance of p-n junctions, switching diodes, Clippers & Clampers, Photoconductors, photodiode, light emitting diodes and liquid crystal display, Junction Field Effect Transistor (JFET) : Basic structure & Operation, pinch off voltage, Single ended geometry of JFET, Volt Ampere characteristic, Transfer Characteristics, JFET as Switch and Amplifier. MOSFET: Enhancement MOSFET, Threshold Voltage, Depletion MOSFET, comparison of p & n Channel FET, SCR, 4 layer pnpn devices, Tunnel diode

Unit - 2	**Number of lectures = 12**	**Title of the unit: Optoelectronic Devices**

Radiative and non - radiative transitions, Solar Cell: basic characteristics, radiation effects and fill factor, Light dependent resistance (LDR), photodiodes, PIN diodes, metal semiconductor, avalanche photodiode, Light emitting diodes (LEDs), semiconductor diode lasers, Photo transistor.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Operational Amplifier**

Differential Amplifier: Circuit configuration, dual input balanced output different amplifier, Inverting and Non-inverting inputs, CMRR, Operational Amplifiers: Block diagram, open and close loop configuration, inverting & non-inverting amplifier, Op-amp with negative feedback Voltage series feedback, Effect of feedback on closed loop voltage gain, Input resistance, output resistance, band width, output offset voltage, Measurements of Op-amp parameters. Op-amp Application: D.C. and A.C. amplifier, summing, scaling and Averaging amplifier,

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Integrator, Differentiator, Electronic analog computation comparator.		
Unit - 4	**Number of lectures = 12**	**Title of the unit: Digital Circuits**
Various Number system and their arithmetic: binary number system, 2's compliment, Octal number system, hexadecimal number system, BCD codes, Excess-3 codes, Gray codes, Octal codes, Hexadecimal codes and ASCII codes: Digital (binary) operation of a system, Logic system, the OR gate, the AND gate, the NOT gate, the exclusive OR gate, De Morgan's laws, the NAND and NOR diode- transistor gates, Modified DTL gates, high threshold logic (HTL) gates, transistor-transistor logic (TTL) gates output stages, resistance transistor logic (RTL) logic, direct coupled transistor logic (DCTL) gates, emitter coupled logic (ECL) gates, Digital MOSFET circuits, complementary MOS (CMOS) logic gates, comparison of logic families, Karnaugh-map (K-map) up to four variables and its applications.		

12. Brief Description of self-learning / E-learning component

For understanding the basic concepts in detail, students may get the study materials from these E-learning links

https://ocw.mit.edu/courses/physics/

https://nptel.ac.in/courses/117107094/

https://www.youtube.com/watch?v=CeD2L6KbtVM

13. Books Recommended

1. J. Millman and C. C. Halkies, Integrated Electronics. Tata McGraw-Hill.
2. R. P. Jain. Modern Digital Electronics, Tata McGraw Hills.
3. Malvino and Leach, Digital Electronics.
4. S. M. Sze, Semiconductor Devices: Physics and Technology.
5. Ramakanth A. Gayakwad, Op-Amps & Linear Integrated Circuits. 2nd ed. 1991.
6. A.P. Malvino and Donald, Principal and Application in Electronics. Tata McGraw-Hill
7. Thomas L. Floyd. Digital Electronics. New Delhi: Person.
8. A.D. Helfrick and W.D. Cooper, Modern electronics Instrumentation and Measurements Techniques, New Delhi: PHI
9. J. D. Rayder, Fundamental of electronics.

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1. Name of the Department: Physics						
2. Course Name	Laboratory Course-III	**L**	**T**		**P**	
3. Course Code	17080205	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 104**			

8. Course Description:

In this course students will gain practical knowledge about various semiconductor and optoelectronic devices like JFET, MOSFET, LED etc and use of op amp for different arithmetic operations.

9. Course Objectives:

To study the characteristics of JFET, MOSFET, Solar cell

To use op amp for different arithmetic operations, square, ramp generator and Wein bridge oscillator

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiment procedure and results.

11. List of Experiments

1. To study the characteristics of Junction Field Effect Transistor.
2. To study the characteristics of Metal Oxide Semiconductor Field Effect Transistor
3. To study the characteristics of SCR and its application as a switching device.
4. To use Op-Amp for different Arithmetic Operations.
5. To use Op-Amp as Square, Ramp Generator and Wien Bridge Oscillator
6. To study the characteristics of a solar cell and calculate its fill factor.
7. To design an (i) inverting amplifier and (ii) non-inverting amplifier, of a given gain using operational amplifier.
8. To use Op-Amp as Full Wave Rectifier.
9. To study the characteristics of optoelectronics Devices (LED, photo-detector).
10. To design combinational Logic Circuits.

12. Book Recommended:

1. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
2. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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1. Name of the Department: Physics						
2. Course Name	**Laboratory Course-IV**	**L**	**T**		**P**	
3. Course Code	17080206	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures =		**Tutorials =**	**Practical = 104**			

8. Course Description:

Through this course student will gain practical knowledge about solid state practicals like two probe method, four probe, Hall effect, electrical analogues of crystal lattice. They will also get a basic idea about LASERs.

9. Course Objectives:

To calculate the energy gap of semiconductor, charge carrier concentration and type of semiconductor.

To determine the wavelength and thickness of wire using Lasers

To study the mono atomic and di-atomic lattice practically and compare it with theory.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiment procedure and results.

11. List of Experiments

1. Two probe method for resistivity measurement.
2. To study Hall effect in semiconductor to determine Hall voltage, concentration of charge carriers and the type of semiconductor etc.
3. To measure the band gap of Germanium using four probe method.
4. Wavelength measurement of LASER using diffraction grating.
5. To study conductivity of thin film by four probe method.
6. Study of dispersion relation for the mono-atomic lattice – comparison with theory.
7. Determination of cut-off frequency of the mono atomic lattice
8. Study of the dispersion relation for the di-atomic lattice – acoustical mode and optical mode energy gap. Comparison with theory.
9. To measure the thickness of thin wire and width of slit using He-Ne/Diode Lasers.
10. Determination of ionization potential of mercury

12. Book Recommended:

3. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
4. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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Semester - II

1. Name of the Department: Physics						
2. Course Name	**Lasers and its applications**	**L**	**T**		**P**	
3. Course Code	17080207	2	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**		**SEC (√)**	
5. Pre-requisite (if any)	Physics at graduation level	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 26	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course provides an introduction to the fundamental principles governing the operation and design of coherent light sources and applications of lasers.

9. Course Objectives:

To provide students a thorough understanding of the fundamentals of lasers: their unique properties, their operations and their applications.

10. Course Outcomes (COs):

It will equip the students with the knowledge of how a coherent light is generated and amplified, the techniques behind different lasers design, and applications of lasers in spectroscopy, chemistry, medicine, biology, military and other areas.

10. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Lasing principle and properties of Lasers**

Introduction to LASERs, Interaction of Light with matter, Einstein's concept of stimulated emission, Calculation of Einstein's coefficients, Population inversion, 3-level system and 4-level system, components of LASERs, Modes of LASER cavity and standing waves, Transverse modes of Laser Cavity. Continuous and pulsed Lasers. Properties of Laser: Directionality, Intensity, Coherence and Monochromaticity.

Unit - 2	**Number of lectures = 14**	**Title of the unit: Types of LASERs and applications**

Pulsing Techniques: Cavity dumping, Q – switching, Mode locking.
Types of Lasers: Solid State LASERs (Ruby LASER & Nd:YAG LASER), Atomic and Ionic Gas LASERs (He-Ne LASER & Argon LASER), Molecular Gas LASERs (CO_2 *LASER* & N_2 LASER), Chemical LASERs (Iodine LASER & Excimer LASER).
Some contemporary Laser applications: Medical, Defense and Transport usages, LIDAR technique, Internet of Thing sensors, rocket navigation, communication, LASER spectroscopy, barcode processing, printing.

11. Brief Description of self -learning / E-learning component

https://nptel.ac.in/courses/104104085/12
https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/laser-fundamentals-i/

12. Books Recommended

1. A.K. Katiyar, C.K. Pandey, Manisha Bajpai, Fundamentals of Laser Systems and Applications, Wiley.
2. Dr M N Avadhanulu, Dr P S Hemne, An Introduction to Lasers: Theory and Applications, S Chand.
3. K Thyagrajan, A Ghatak, Lasers: Fundamentals and Applications, Springer.

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Semester-III

1. Name of the Department: Physics						
2. Course Name	**Computational Methods & Programming**	**L**	**T**		**P**	
3. Course Code	17080301	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials** = 0	**Practical** = 0			

8. Course Description:

Many problems in physics need to be solved using computational techniquess. This course will teach students how to obtain solutions to system of linear equations, differential equations, etc using computational methods.

9. Course Objectives:

To impart the basic knowledge of computers and C programming. To give exposure about various computational techniques to solve physics using advance computer programming languages.

10. Course Outcomes (COs):

Students will have understanding of:

1. C language

2. various computational methods like bisection method, Euler, Newton-Raphson and Ranga-Kutta useful to Solve research problems.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Programming in C**

Keywords – constants, variables and data types – data input and output – control structures – if and switch statements – while, do-while and for statements – go to statement – functions – arrays – pointer – structures – array of structures – unions – file operations, Examples of writing C- programming of computational methods.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Roots of Equations**

Roots of quadratic equation - Limits for real roots of a polynomial equation – Bisection method, False position method and Newton Raphson method for finding roots of the equations.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Linear Algebra**

Eigen values and Eigen vector of matrix-inverse of a matrix- determinant – solution of linear systems of equations- Gauss elimination and pivotal condensation methods.

Unit - 4	**Number of lectures = 12**	**Title of the unit: Integration and differentiation**

Trapezoidal rule-Simpson's rule (one -third) solution of ordinary differential equation by Euler method and Runge-Kutta methods, Monte-Carlo Simulation and its applications

12. Brief Description of self learning / E-learning component

https://www.edx.org/course/programming-basics

https://www.edx.org/course/computational-methods-forpes-harvardx-423x-2

13. Books Recommended

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1. Name of the Department: Physics						
2. Course Name	**Atomic and Molecular Physics**	**L**	**T**		**P**	
3. Course Code	17080302	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

Atom and molecule are the fundamental unit for all matters in universe. Matter, whatever the states, is made of atoms. The properties of all matters are governed by the electronic structure of atom and molecule. They have individual properties like electronic, magnetic and optical properties, which are quite different from the collective properties of matter made of atoms and molecules. This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field.

9. Course Objectives:

1. Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum
2. Molecular spectroscopy
3. Theory of magnetic energy, Anomalous Zeeman's effect and Landue splitting factor.
4. Molecular Spectra of diatomic molecules Vibrational and Rotational energy levels.
5. To learn basics of NMR & ESR.

10. Course Outcomes (COs):

1. state and explain the key properties of many electron atoms and the importance of the Pauli exclusion principle.
2. explain the observed dependence of atomic spectral lines on externally applied electric and magnetic fields.
3. state and justify the selection rules for various optical spectroscopies in terms of the symmetries of molecular vibrations.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Atomic Physics**

Quantum states of one electron system, atomic orbitals, Space Quantisation and Stern-Gerlach experiment, Pauli's exclusion principle, spectrum of He atom and Heisenbeg resonance, L-S and J-J coupling: terms of equivalent and non-equivalent electron atom, Breit's Scheme, Normal and Anomalous Zeeman effect, Paschen-Back effect and Stark effect, Hyperfine Structure of Spectral lines: Isotope effects, Nuclear pin and Hyperfine splitting, Intensity Ratio and determination of Nuclear spin.

Unit - 2	**Number of lectures = 14**	**Title of the unit: Microwave, Infra-Red and Raman Spectroscopy**

Types of molecules, Diatomic Molecule as rigid rotator: its energy level, spectra and intensities of spectral lines, effect of isotopic substitution, Diatomic molecule as non-rigid rotator. Vibrating diatomic molecule: energy of a diatomic molecule, Simple Harmonic Oscillator, Anharmonic oscillator, Diatomic Vibrating Rotator. Experimental arrangement for Raman Spectra, Classical theory of Raman effect, Quantum theory of Raman effect, Raman Spectra and Molecular Structure.

Unit - 3	**Number of lectures = 12**	**Title of the unit: Electronic Spectra of Diatomic Molecules**

The Born-Oppenheimer Approximation, Vibrational Coarse Structure: Progressions, Intensity of Vibrational-Electronic Spectra: The Franck-Condon Principle, Dissociation Energy an Dissociation Products, Rotational Fine structure of Electronic-Vibration Transitions, The Fortrat parabola, predissociation. Electronic structure of

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1. Byron S. Gottfried. Schaum's outline of Theory and Problems of Programming with C. New Delhi: Tata McGraw-Hill,1991.
2. Suresh Chandra. Application of Numerical Techniques with C. New Delhi: Narosa Publishing House, 2006.
3. Brain W. Kernighan and Dennis. M. Ritchie. The C Programming Language. 2nd ed. New Delhi: Prentice-Hall of India, 1988.
4. E. Balagurusamy. Numerical Methods. New Delhi: Tata McGraw-Hill, 1999.
5. A.K. Ghattak, T.C. Goyal and S.J. Chua. Mathematical Physics. New Delhi: Macmillan, 1995.

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1. Name of the Department: Physics						
2. Course Name	Laboratory Course-V	**L**	**T**		**P**	
3. Course Code	17080303	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 104**			

8. Course Description:

Many problems in physics need to be solved using computational techniques. This course will give you the practical knowledge of how to obtain solutions to system of linear equations, differential equations, etc. using computational methods.

9. Course Objectives:

To impart the basic knowledge of computers and C programming. To give exposure about various computational techniques to solve physics using advance computer programming languages.

10. Course Outcomes (COs):

Students will have understanding of:

1. C language and MATLAB
2. various computational methods like bisection method, Euler, Newton-Raphson and Ranga-Kutta useful to solve research problems.

11. List of Experiments

1. To perform Matrix summation, subtraction and multiplication.
2. To find the root of algebraic equation using bisection method.
3. To find the root of algebraic equation Newton Raphson method.
4. To find the root of algebraic equation using Muller method.
5. To fit a straight line through given data using Least square method.
6. To fit the given data using polynomial fitting.
7. Interpolation and extrapolation using Lagrange method.
8. To perform Numerical differentiation using Newton's method.
9. MATLAB: Digital Signal Processing.
10. MATLAB: Solving Ordinary Differential Equations.
11. MATLAB – Matrix operations.

12. Book Recommended:

1. Ross L. Spencer and Michael Ware. Introduction to MATLAB. Brigham Young University,
2. Suresh Chandra. Applications of Numerical Techniques with C.: New Delhi: Narosa, 2006.
3. Vinay K. Lngle and John G. Proakis. Digital Signal Processing Using MATLAB. PWS Publishing, 1997.
4. Lez, Richard E. Woods, and Steven L. Eddins, Digital Image Processing Using MATLAB. Prentice-Hall, 2003.
5. Learning MATLAB – The MathWorks, Inc., 1999.

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1. Name of the Department: Physics						
2. Course Name	Laboratory Course-VI	**L**	**T**		**P**	
3. Course Code	17080304	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures =		**Tutorials =**	**Practical = 104**			

8. Course Description:

Through this course student will gain knowledge about magnetic properties of samples, particle counters and some spectroscopic terms.

9. Course Objectives:

To study the principle and working of GM counter

To determine Lande's g factor and to study Zeeman effect

To determine the hysteresis loss magnetic samples

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiment procedure and results.

11. List of Experiments

1. To study Quincke's method.
2. To study Curie temperature of magnetic materials.
3. Dielectric constant and Curie temperature of ferroelectric ceramics.
4. To determine the wavelength of LASER using Michelson interferometer.
5. To study the magnetic hysteresis (B-H curve) and calculate the retentivity, coercivity and saturation magnetization of a material using hysteresis loop.
6. To study the characteristics of G.M. Counter.
7. To find the end point energy of given source using G.M. Counter.
8. To find the absorption coefficient of given material using G.M. counter.
9. To Study Zeeman effect.
10. To find the value of Lande's g factor for an electron using Electron Spin Resonance.

12. Book Recommended:

5. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
6. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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http://nptel.ac.in/syllabus/95102023/

https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/

https://www.ks.uiuc.edu/Services/Class/PHYS480/qm_PDF/QM_Book.pdf

13. Books Recommended

1. Quantum Mechanics (3rd edition) by L. I. Schiff
2. Quantum Mechanics (2nd edition) by B. H. Bransden and Joachain
3. Introduction to Quantum Mechanics (2nd edition) by David J. Griffiths
4. Quantum Mechanics by A. K. Ghatak and S. Loknathan
5. A Textbook of Quantum Mechanics by P. M. Mathews and K. Venkatesan
6. Quantum Mechanics (3rd edition) by S. Gasiorowicz

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Semester – III

1. Name of the Department: Physics						
2. Course Name	The Physics of Energy	**L**	**T**		**P**	
3. Course Code	17080305	2	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**		**SEC (√)**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 26		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The course will focus on the physical principles underlying energy processes, assess it's use and potential for reduction for transport, industry and buildings. The application of these principles for harvesting energy from various sources will also be discussed.

9. Course Objectives:

To teach students the fundamental laws and physical processes that governs the sources, extraction, storage, and uses of energy.

10. Course Outcomes (COs):

Students will have enhanced their abilities to:

1. Understand how physical principles influence energy use.
2. Understand how to solve the problem of energy demand using various alternatives.

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Energy and its uses**

Energy Literacy and the Challenge: Mechanical energy and transport, Electromagnetic energy, Heat and thermal energy, energy quantization in quantum, Entropy and temperature, Energy in chemical systems and processes Heat engines, Phase change energy conversion. Nuclear binding and Nuclear fission and fusion power. Energy storage, Energy conservation. Electricity generation and transmission: the grid, Climate change.

Unit – 2	**Number of lectures = 14**	**Title of the unit: Sources of energy**

Nuclear reactors and radiation, Bioenergy, Fossil fuels and Carbon footprint, Alternative Energy Harvesting: Solar energy global uptake, types of Solar absorption, Solar-thermal electricity, &Photovoltaics, Ocean energy flow & Ocean thermal energy conversion, Wind energy, Hydro, Geothermal energy.

12. Brief Description of self learning / E-learning component

https://www.edx.org/course/solar-energy-delftx-et3034x-0

https://www.edx.org/course/sustainable-energy-design-renewable-delftx-energyx-0

https://www.edx.org/course/understanding-nuclear-energy-delftx-nuclear01x-0

https://www.edx.org/course/energy-principles-and-renewable-energy-2

13. Books Recommended

1. R. L. Jaffe and W. Taylor . The Physics of Energy. Cambridge University Press
2. S P Sukhatme and J K Nayak. Solar Energy. McGraw-Hill Education
3. P. Rez. The Simple Physics of Energy Use. Oxford University Press
4. G.D. Rai. Non-conventional Energy Sources. Khanna Publisher

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Discipline Specific Elective Courses

Semester-III

1. Name of the Department: Physics						
2. Course Name	**Condensed Matter Physics-I**	**L**	**T**	**P**		
3. Course Code	17080306	4	0	0		
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

It includes Semiconductor crystals and Fermi surfaces & metals, Optical properties of solids, Dielectrics and Ferroelectrics and Magnetism

9. Course Objectives:

The aim of Condensed Matter Physics-I is to expose students to topics like electron dynamics in semiconductors and metals, Fermi surface and its determination, optical properties of solids, dielectrics and ferroelectrics, and quantum-mechanical origin of magnetism. Theoretical formulation of these properties has been brought in direct contact with relevant experiments.

10. Course Outcomes (COs):

The students should be able to learn how above mentioned properties can be deduced using the fundamental principles of mechanics (classical/quantum) and statistical mechanics.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Semiconductor crystals and Fermi surfaces & metals**

Semiconductor crystals: Band gap, Direct and indirect absorption processes, Motion of electrons in an energy band, Holes, Effective mass, Physical interpretation of effective mass, Effective masses in semiconductors;

Fermi surfaces and metals: Fermi surface and its construction for square lattice (free electrons and nearly free electrons), Electron orbits, Hole orbits, Open orbits; Wigner-Seitz method for energy bands, Cohesive energy; Experimental determination of Fermi surface: Quantization of orbits in a magnetic field, De Hass-van Alphen effect.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Optical properties of solids**

Dielectric function of the free electron gas, Plasma optics, Dispersion relation for em waves, Transverse optical modes in a plasma, Transparency of alkalis in the ultraviolet, Longitudinal plasma oscillations,

Plasmons and their measurement; Electrostatic screening, Screened coulomb potential, Mott metal-insulator transition, Screening and phonons in metals; Optical reflectance, Kramers-Kronig relations, Electronic interband transitions, Excitons: Frenkel and Mott-Wannierexcitons; Raman effect in crystals, Electron spectroscopy with X-rays.

Unit - 3	**Number of lectures = 12**	**Title of the unit: Dielectrics and Ferroelectrics**

Polarization, Macroscopic electric field, Dielectric susceptibility, Local electric field at an atom, Dielectric constant and polarizability, Clausius-Mossotti relation, Electronic polarizability, Classical theory of electronic polarizability. Structural phase transitions; Ferroelectric crystals and their classification; Landau theory of the phase transition; Anti-ferroelectricity, Ferroelectric domains; Piezoelectricity, Ferroelasticity.

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Unit - 4	Number of lectures = 14	Title of the unit: Magnetism
Diamagnetism and Paramagnetism: Langevin's classical theory of diamagnetism, Quantum theory of diamagnetism, Langevin's classical theory of paramagnetism, Weiss theory of paramagnetism,Quantum theory of paramagnetism, Ferromagnetism and antiferromagnetism: Weiss theory of ferromagnetism, Quantum theory of ferromagnetism, The Heisenberg model, Ferromagnetic domains, Bloch wall. Antiferromagnetism and the two sub-lattice model.		

12. Books Recommended

1. Introduction to Solid State Physics (7th edition) by Charles Kittel
2. Solid State Physics by Neil W. Ashcroft and N. David Mermin
3. Solid State Physics by S.O. Pillai, "New Age International Publishers".
4. Solid State Physics: An Introduction to Theory and Experiment by H. Ibach and H. Luth
5. Principles of the Theory of Solids (2nd edition) by J. M. Ziman
6. Fundamentals of Solid State Physics by Saxena, Gupta, Saxena and Mandal.
7. Elements of Solid State Physics (4th Edition) by J P Srivastava

13. Brief Description of self learning / E-learning component

For understanding the basic concepts in detail, students may get the study materials from these E-learning links

https://nptel.ac.in/courses/113104005/75
http://web.mit.edu/course/6/6.732/www/6.732-pt2.pdf
https://unlcms.unl.edu/cas/physics/tsymbal/teaching/SSP-927/Section%2013_Optical_Properties_of_Solids.pdf

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1. Name of the Department: Physics						
2. Course Name	Electronics-I	**L**	**T**		**P**	
3. Course Code	17080307	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**		**SEC ()**	
5. Pre-requisite (if any)	Physics at graduation level	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

This course will deepen your understanding of the different types of operational amplifier, modulation and de-modulation techniques, logic gates and microprocessors.

9. Course Objectives:

1. To study the working principle and characteristics of operational amplifier.
2. To study the basic of amplitude and frequency modulation and its related electronic circuits.
3. To understand the different types of logic circuits and its various application.
4. To study the basics of A/D and D/A convertors.
5. To study the architecture, control logic unit and arithmetic logic unit of different types of microprocessor.

10. Course Outcomes (COs):

After successful completion of the course, students will

1. have a basic knowledge of operational amplifier and its uses.
2. understand the concept of working of different types of logic gates.
3. be able to design the electronic circuits using different types of logic gates.
4. know the fundamental principles modulation and de-modulation techniques.
5. know basic microcomputer and microprocessors.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Operational Amplifier**

Differential Amplifier, Inverting & non-inverting Amplifiers, Negative and Positive Feedback. Band width,Voltage follower. CMRR, DC, AC, Summing, Scaling & Instrumentation Amplifier, Integrator & Differentiator, Comparator, Oscillator principal and Types, Frequency response and Frequency stability, Phase shift Oscillator.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Modulation Communication**

PLL using IC, Active Filters., Amplitude Modulation, De-modulation of AM waves, Frequency Modulation

Transmitter (Block Diagram) and its characteristics feature, Super heterodyne receiver, Digital communication and Delta modulation, Pulse Code Modulation, Pulse width modulation,Block diagram od Radar & Radar range equation.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Digital Electronics**

Q.M. Method, Logic gates, Decoder and De-multiplexer, Multiplexer & Encoder, Flip flops RS, JK, MSJK & D type. Analog computation, time & amplitude scaling, ROM and RAM, D/A Convertor, weighted resister, R-2R adder, A/D Convertors; Quantization and encoding, parallel comparator. A/D convertor using, Voltage to frequency & voltage to time conversion, Sample and Hold circuit, solution of ordinary differential equation using analog computation.

Unit - 4	**Number of lectures = 12**	**Title of the unit: Micro-processor**

Microcomputer systems and Hardware., Microprocessor architecture and Microprocessor system, Instruction and timing diagram, Introduction to 8085 basic instructions, Arithmetic operation, logic operation, branch operation, 16 bit arithmetic instructions., Arithmetic operation related to memory, Rotate and compare instructions, Stack and subroutines, programming of 8085 using instructions, Introduction to Microcontroller

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diatomic molecules.		
Unit - 4	**Number of lectures = 12**	**Title of the unit: Resonance Spectroscopy**
NMR: Basicprinciples, NMR instrumentation, Relaxation process: spin-spin and spin-lattice relaxation times, magnetic dipole coupling, chemical shift: measurement and factors affecting chemical shift. **ESR:** Basicprinciples, instrumentation, intensity of ESR lines, hyperfine interaction (Electron – Nucleus coupling), g – factor and factors affecting ESR lines, zero field splitting.		
12. Brief Description of self learning / E-learning component		
For understanding the basic concepts in detail, students may get the study materials from these E-learning links https://ocw.mit.edu/courses/physics/ https://nptel.ac.in/courses/104104085/ https://nptel.ac.in/courses/115105100/56		
13. Books Recommended		
1. Collin N Banwell and Elaine M McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw- Hill. 2. Raj Kumar, Atomic, Molecular Spectra: Laser, KedarNath Ram Nath 3. H Kaur, Spectroscopy, PragatiPrakashan 4. Atomic spectra & atomic structure, Gerhard Hertzberg: Dover publication, New York. 5. Molecular structure & spectroscopy, G. Aruldhas; Prentice – Hall of India, New Delhi.		

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1. Name of the Department: Physics						
2. Course Name	Nuclear Physics – I	**L**	**T**		**P**	
3. Course Code	17080308	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE(√)**		**ASE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The syllabus is divided into four units i.e. Introduction to nuclear physics, Two nucleons problems, Nuclear model –I and Nuclear Model –II.

9. Course Objectives:

The course aims to provide students with an understanding of the basics of nuclear physics two nucleons problem and nuclear models to explain the structure of nucleus.

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. Understand the basics of nuclear physics
2. Describe the two nucleons problem.
3. Explain the Nuclear models and their relative success and failures.

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Introduction to nuclear physics**

The atomic nucleus, nuclear radius, nuclear size, semi-empirical formula, nuclear binding energy, nuclear angular momentum and parity, nuclear electromagnetic moments, nuclear exited states, the deuteron, the nuclear many body problem, fundamental forces, elementary particles (leptons, quarks, elementary vector bosons), conservation laws and symmetric, accelerators and detectors, projectiles and targets, energies, nuclear interactions. Particle detectors, scattering of nucleons, low energy of n-p scattering.

Unit – 2	**Number of lectures = 14**	**Title of the unit: The Two Nucleon Problem**

Qualitative features and phenomenological potentials, Exchange forces, generalized Pauli principle. The ground state of deuteron, Range-depth relationship for square well potential., Neutron-Proton scattering at low energies (below 10 Mev), Concept of scattering length and its interpretation, Spin dependence of neutron-proton scattering, Effective range theory of n-p scattering, Coherent scattering of neutrons on ortho and para hydrogen, Magnetic moment and its importance in the determination of exact ground state of deuteron.

Unit – 3	**Number of lectures = 13**	**Title of the unit: Nuclear Models – I**

Liquid drop model, Outlines of Bohr and Wheeler theory of nuclear fission, Concept of magic numbers The properties of magic nucleus, Nuclear Shell Model, Predictions of shell closure on the basis of harmonic oscillator potential, Need of introducing spin-orbit coupling to reproduce magic numbers. Extreme single particle model and its predictions regarding ground state spin parity, Magnetic moment, Electric quadrupole moments.

Unit – 4	**Number of lectures = 13**	**Title of the unit: Nuclear Models – II**

Nuclear surface deformations, General parameterization, Types of multipole deformations, Quadrupole deformations, Symmetries in collective space, Surface vibrations, Vibrations of a classical liquid drop, The Harmonic quadrupole oscillator, The collective angular momentum operator, The collective quadrupole operator, Quadrupole vibrational spectrum, Rotating nuclei, The rigid rotor, The symmetric rotor, The asymmetric rotor.

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12. Brief Description of self-learning / E-learning component
For understanding the basic concepts in detail, students may get the study materials from these E-learning links https://ocw.mit.edu/courses/physics/ https://nptel.ac.in/courses/108108111/3 https://nptel.ac.in/courses/117103066/7
13. Books Recommended
1. J. Millman and C. C. Halkies, Integrated Electronics. Tata McGraw-Hill. 2. R. P. Jain. Modern Digital Electronics, Tata McGraw Hills. 3. Malvino and Leach, Digital Electronics. 4. S. M. Sze, Semiconductor Devices: Physics and Technology. 5. Ramakanth A. Gayakwad, Op-Amps & Linear Integrated Circuits. 2nd ed. 1991. 6. A.P. Malvino and Donald, Principal and Application in Electronics. Tata McGraw-Hill 7. Thomas L. Floyd. Digital Electronics. New Delhi: Person. 8. A.D. Helfrick and W.D. Cooper, Modern electronics Instrumentation and Measurements Techniques, New Delhi: PHI 9. J. D. Rayder, Fundamental of electronics.

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1. Name of the Department: Physics						
2. Course Name	Spectroscopic Techniques – I	**L**	**T**		**P**	
3. Course Code	17080309	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE(√)**		**SEC()**	
5. Prereq uisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**			**Practical = 0**	
8. Course Description:						

This course includes basics of spectroscopy, UV/Visible spectroscopy, nonlinear phenomenon and applications of Laser spectroscopy.

9. Course Objectives:

To understand the basics of spectroscopy and topics of current research interest such as laser cooling and trapping and Bose-Einstein condensation in atomic vapors.

10. Course Outcomes (COs):

This course;

1. will give basic knowledge on spectroscopic techniques that use lasers
2. provide knowledge on the techniques and instrumentation for laser spectroscopy.
3. includes laboratory exercises that illustrate the concepts and phenomena that are characteristic of lasers
4. provide a degree of experimental skill in the spectroscopic applications.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Basics of Spectroscopy and UV/Visible spectroscopy**

Basics of Spectroscopy, Energy of electromagnetic radiation, Quantization of energy, Mechanisms of interaction of electromagnetic radiation with matter, Absorption peaks and line widths. UV/Visible Absorption Spectroscopy, Instrumentation, Beer Lambert law, Deviations from Beer Lambert's law. Applications: Quantification of compounds, Quality control, Chemical kinetics, Detectors in liquid chromatography instruments.

Unit – 2	**Number of lectures = 12**	**Title of the unit: Non-Linear Phenomenon and related spectroscopy**

Non-linear phenomena and generation of short pulses, laser system for spectroscopy, instrumentation for detection of optical signals and time-resolved measurements , absorption spectroscopy, fluorescence spectroscopy , Raman spectroscopy, non-linear spectroscopy, time-resolved spectroscopy, ultra-fast laser spectroscopy.

Unit – 3	**Number of lectures = 14**	**Title of the unit: Applications of Laser Spectroscopy**

Cooling and Trapping of Atoms, Principles of Doppler Cooling, Polarization Gradient Cooling Qualitative Description of Ion Traps, Optical Traps and Magneto-Optical Traps, Bose Condensation, Applications of Laser.

Unit – 4	**Number of lectures = 12**	**Title of the unit: Non Conventional Spectroscopic Techniques**

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Two-photon spectroscopy, Saturation Spectroscopy, CARS, Experimental techniques of MPI spectroscopy, Optogalvanic spectroscopy and Supersonic Beam Spectroscopy with emphasis on measurement of molecular parameters.

12. Brief Description of self- learning / E-learning component:

For basic conceptual understanding and detail study, students may get the study material from the following links.

1. https://nptel.ac.in/courses/102103044/pdf/mod2.pdf
2. https://www.photonics.com/.../**Lasers**_Understanding_the_**Basics**
3. https://en.wikipedia.org/wiki/List_of_**laser_applications**
4. www.bgu.ac.il/~glevi/website/Guides/**Lasers**.pdf
5. **ieee**xplore.**ieee**.org/document/8048469/

13. Books Recommended

1. Laud: Laser and nonlinear optics
2. Ghosh: Laser Cooling and Trapping.
3. Demtroder: Laser Spectroscopy and Instrumentation
4. Svelto: Principles of Lasers
5. Sengupta: Frontiers in Atomic, Molecular and Optical Physics.
6. Laser Spectroscopy : W. Demtroder.
7. High Resolution Spectroscopy : J. M. Hollas.
8. Spectrophysics : A. Thorpe.

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Semester-IV

1. Name of the Department: Physics						
2. Course Name	Physics of Nanomaterials	**L**	**T**		**P**	
3. Course Code	17080401	**4**	0		0	
4. Type of Course (use tick mark)		Core (√)	DSE ()		SEC ()	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	EverySem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

It includes Fundamental of Nanomaterials, Nanofabrication Techniques, Characterization of Nanomaterials and Nanomaterials and Devices

9. Course Objectives:

The course aims to provide students with an understanding of the basics of nanomaterials, techniques used in fabrication of nanomaterials, characterization of different types of nanomaterials. It also gives the idea how to design electric devices, magnetic and gas sensors etc. using nanomaterials.

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. understand the fundamentals of nanomaterials.
2. understand different fabrication as well as characterization techniques of nanomaterials.
3. describe the basic involved in the design of devices based on nanotechnology.

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit:** Fundamental of Nanomaterials

Definition of nanotechnology, Nanomaterials, Novel combination of properties of materials of nanoscale, Device miniaturization, Functional enhancement, Nanoparticles as super atoms, Size dependence on melting point, Size dependence on vapour pressure, Nucleation, Size dependence on Chemical reactivity, Intermolecular interactions, Size dependence on Surface tension of solid surfaces, Wetting-dewetting of rough and chemically inhomogeneous surfaces, Quantum confinement & energy levels, Band structure, Density of states in 0D, 1D, 2D & 3D materials, Quantum dots, wires, & wells.

Unit - 2	**Number of lectures = 14**	**Title of the unit:** Nanofabrication Techniques

Top down and bottom up approaches to nanofabrication, Nucleation & growth mechanism, Optical & electron beam lithography, Dip pen lithography, Focussed ion beam technique, Thin films deposition, Evaporation, Sputtering, Electrode position and sol Gel Technique, Plasma assisted chemical vapour deposition, Molecular beam epitaxy, Atomic layer deposition, Self-assembly of monolayers, Langmuir Blodgett films, Thermodynamics of self-organization, Crystallization and super molecular interactions,.

Unit - 3	**Number of lectures = 12**	**Title of the unit:** Characterization of Nanomaterials

X-ray diffraction techniques, Scanning transmission electron microscopy, SEM, TEM, Contact &Non-contact methods of surface characterization, Atomic force microscopy, Ellipsometry, Surface plasma resonance techniques, Electron spectroscopy techniques like AES, XPS, SIMS

Unit - 4	**Number of lectures = 14**	**Title of the unit:** Nanomaterials and Devices

Carbon based nanomaterials, Small and Large Fullerenes and Other Buckyballs, Carbon nanotubes and their Electronic structure, Graphene, Metal matrix composites, Polymers- electroactive material blends,

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Semiconductor Nanoparticles, Nanowires, Nanoribbon and nanospring, Quantum computing, Ballistic transport, Coulomb blockade, Single electron devices, Molecular electronic devices, Coupled quantum dots, Spintronics, Ultra-sensitive magnetic sensors, Spin dependent transistors, Photonic devices, Mechanical and Fluidic devices, Chemical and bio-chemical sensors, Energy conversion devices

12. Brief Description of self-learning / E-learning component:

To understand basic concepts in detail, students may get study materials on following links.
https://onlinecourses.nptel.ac.in/noc18_ph02
https://ocw.mit.edu/courses/physics/
https://www.mooc-list.com/

13. Books Recommended

1. John H. Davies. The Physics of Low Dimensional Semiconductors. Cambridge University Press.
2. J.J. Ramsden. Nanotechnology- An Introduction. William Andrew Elsevier.
3. Ning Xi and King W. Chiu Lai. Nano-optoelectronics Sensors and Devices. William Andrew Elsevier.
4. V.V. Mitin, V.A. Kochetp and M.A. Stroscio. Quantum Heterostructures: Microelectronics and Optoelectronics. Cambridge University Press.
5. G. Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications. Imperial College Press.
6. C.P. Poole and F.J. Owens. Introduction to Nanotechnology. New York: John Wiley. M. Wilson, K. Kannangara, M. Simmons and B. Raguse. Nanotechnology. Overseas Press.

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1. Name of the Department: Physics						
2. Course Name	**Laboratory Course-VII**	**L**	**T**		**P**	
3. Course Code	17080402	0	0		8	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 104**			

8. Course Description:

Through this course students will gain practical knowledge about circuit design and working of flip flops, UJT, coder – decoder, DAC, ADC etc.

9. Course Objectives:

To study JK, SR flip flop, multiplexer, demultiplexer, decoder, phase shifter and UJT.

To study the working of DAC and ADC.

To determine the range and energy of alpha particles

To determine energy using Compton scattering

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

Correlate the theoretical concepts and identify its practical applications through experiment procedure and results.

11. List of Experiments

1. To study SR and JK flip flop circuits using logic gates.
2. To study the UJT Characteristics.
3. To study the use of Digital Comparator.
4. To study use of multiplexer, de-multiplexer, decoder and phase shifter.
5. To measure input offset voltage, input bias current, input offset current and CMRR of Op-Amp.
6. To study the working of DAC and measure resolution and setting time of DAC.
7. To study working of ADC and measure resolution and conversion time of ADC.
8. To determine the range and energy of alpha particles using Spark Counter
9. Energy determination using Compton scattering
10. Cross section determination using Compton scattering

12. Book Recommended:

7. R. A. Dunlup. Experimental Physics: Modern Methods. New Delhi: Oxford University Press.
8. B. K. Jones. Electronics for Experimentation and Research. Prentice-Hall.

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Discipline Specific Elective Courses

Semester-IV

1. Name of the Department: Physics						
2. Course Name	**Condensed Matter-II**	**L**	**T**		**P**	
3. Course Code	17080404	**4**	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**		**SEC ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	EverySem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
It includes Electron Transport Phenomenon, Nanostructures and Electron Transport, Beyond the independent electron approximation and Many-particle physics						
9. Course Objectives:						
The aim of second course on Condensed Matter Physics is to prepare students for undertaking somewhat advanced studies in Condensed Matter Physics.						
10. Course Outcomes (COs):						
It emphasizes on the consequences of going beyond the independent electron approximation and an exposure to the language of second quantization- the language in use in condensed matter theory research. Importantly, it also includes an introduction to the emerging field of Nano-structures and electron transport phenomenon in such systems.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 12**	**Title of the unit: Electron Transport Phenomenon**				
Motion of electrons in bands and the effective mass tensor (semi-classical treatment), Currents in bands and holes, Scattering of electrons in bands (elastic, inelastic and electron-electron scatterings), The Boltzmann equation, Relaxation time ansatzand linearized Boltzmann equation; Electrical conductivity of metals, Temperature dependence of resistivity and Matthiesen's rule; Thermoelectric effects, Thermopower, Seebeck effect, Peltier effect, The Wiedemann-Franz law.						
Unit – 2	**Number of lectures = 14**	**Title of the unit: Nanostructures and Electron Transport**				
Nanostructures; Imaging techniques (principle): Electron microscopy (TEM, SEM), Optical microscopy, Scanning tunneling microscopy, Atomic force microscopy; Electronic structure of 1D systems: 1D subbands, Van Hove singularities; 1D metals- Coulomb interactions and lattice couplings; Electrical transport in 1D:Conductance quantization and the Landauer formula, Two barriers in series- Resonant tunneling, Incoherent addition and Ohm's law, Coherence-Localization; Electronic structure of 0D systems (Quantum dots):Quantized energy levels, Semiconductor and metallic dots, Optical spectra, Discrete charge states andcharging energy; Electrical transport in 0D- Coulomb blockade phenomenon.						
Unit – 3	**Number of lectures = 12**	**Title of the unit: Beyond the independent electron approximation**				
The basic Hamiltonian in a solid: Electronic and ionic parts, One-electron model, The adiabatic approximation; The Hartree equations, Exchange: The Hartree-Fock approximation, Hartree-Fock theory of free electrons-Ground state energy, exchange energy, correlation energy (only concept); Screening in a free electron gas: The Dielectric function, Thomas-Fermi theory of screening, Calculation of Lindhard response function, Lindhard						

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theory of screening, Friedel oscillations, Frequency dependent Lindhard screening (no derivation).		
Unit – 4	**Number of lectures = 14**	**Title of the unit: Many-particle physics: Second quantization formulation**
Many-particle Schrodinger wave equation in first quantization, The single-particle states as basis states, Normalized symmetric and anti-symmetric wave functions; Second quantization: Transformation of Schrodinger equation to occupation number representation (both for bosons and fermions), Many-particle Hilbert space and creation and destruction operators; Field operators, Second-quantized from of number density operator; Application to degenerate electron gas: First and second-quantized Hamiltonian operators, rs parameter, Ground-state energy in first-order perturbation theory, Contact with the Hartree-Fock result, Exchange energy.		
12. Books Recommended		
1. Solid State Physics: An Introduction to Principles of Materials Science (4th Ed.) by H. IbachandH. Luth 2. Introduction to Solid State Physics (8th Ed.) by Charles Kittel 3. Solid State Physics by Neil W. Ashcroft and N. David Mermin 4. The Wave Mechanics of Electrons in Metals by Stanley Raimes 5. Quantum Theory of Many-particle Systems by A. L. Fetter and J. D. Walecka 6. Many-body Quantum Theory in Condensed Matter Physics by H. Bruus and K. Flensberg 7. Solid State Physics by S.O. Pillai, "New Age International Publishers".		
10. **Brief Description of self-learning / E-learning component:**		
To understand basic concepts in detail, students may get study materials on following links. **https://www.slideshare.net/prithusayak/characterization-techniques-of-nanoparticles** **https://nptel.ac.in/courses/102104069/15** **https://nptel.ac.in/courses/113107075/19**		

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1. Name of the Department: Physics						
2. Course Name	**Electronics-II**	**L**	**T**		**P**	
3. Course Code	17080405	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**		**SEC ()**	
5. Pre-requisite (if any)	Physics at graduation level	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

This course will deepen your understanding of the different processes to grow the single crystal silicon which will help you to fabricate the different types of integrated circuits (ICs) for the particular applications. It also help you to understand the techniques for making contact between semiconductor and metals.

9. Course Objectives:

1. To study the basics of different processes to grow the single crystal silicon
2. To study the basics of ion-implantation and diffusion.
3. To understand the formation of different electronic circuits using IC.
4. To understand the design of combinational logic circuits using IC
5. To get familiar with different types of clean rooms.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

1. have a basic knowledge of crystal growth and silicon wafer production
2. understand the science behind the different types of transistors
3. understand the techniques for making contact between semiconductor and metals
4. know the working principle of adders, subtractor, counters and shift registers

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: IC Fabrication – I**

Silicon planar process, Crystal growth, Wafer production, Thermal oxidation, high pressure oxidation, Concentration enhanced oxidation, chlorine oxidation, Lithography & pattern transfer, Etching process, factors affecting the etching process, HF-HNO_3 system, dopant addition, Ion implantation, diffusion, Diffusion in concentration gradient, Fick's Laws, diffusivity variation, Segregation, CVD, epitaxial and non-epitaxial films.

Unit – 2	**Number of lectures = 12**	**Title of the unit: IC Fabrication – II**

Monolithic IC technology, BJT Fabrication, PNP transistor, Multi-emitter Schottky transistor, Superbeta transistor fabrication, Fabrication of FET/NMOS enhancement, FET/NMOS depletion transistor, Fabrication of CMOS devices, Monolithic diodes, Clean rooms & their classifications.

Unit – 3	**Number of lectures = 14**	**Title of the unit: MOS systems and SPICE**

Metal semiconductor contacts, Ideal MS contacts, Schottky barriers and ohmic contacts, Oxide and interface charges, Origin of oxide charges, MOS structure, Effect of bias voltage Capacitance of MOS system, Introduction to electrical computer simulation, SPICE and its evaluations, Electrical circuit specifications, The SPICE DC analysis.

Unit – 4	**Number of lectures = 14**	**Title of the unit: COMBINATIONAL LOGIC DESIGN USING IC**

Adders and their use as Substractors, Ripple counters, Sequential logic design, Shift registers, Application of shift registers as delay line, Serial to parallel converter, parallel to serial converter, Ring counter, twisted ring counter, Sequence generator, Synchoronous counter design, up-down counter, Asynchronous versus synchronous sequential circuits, Applications of Asynchronous sequential circuits, Asynchronous sequential machine modes, Asynchronous sequential circuit design.

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12. Brief Description of self learning / E-learning component
For understanding the basic concepts in detail, students may get the study materials from these E-learning links **https://ocw.mit.edu/courses/physics/** **https://nptel.ac.in/courses/117107094/** **https://www.youtube.com/watch?v=CeD2L6KbtVM**
13. Books Recommended
1. Integrated electronics – Millman&Halkias 2. Microprocessor and Interfacing – D. V Hall 3. Micropressor Architecture Prog. &Appls. – S. Goankar, Wiley-Estern 4. Micro Electronics – Millman&Grabel 5. Digital Computer Electronics – AP. Malvino. 6. Advanced Electronic Communication system by Kennedy 7. Modern digital electronics by R. P. Jain

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1. Name of the Department: Physics						
2. Course Name	**Nuclear Physics – II**	**L**	**T**		**P**	
3. Course Code	17080406	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE(√)**		**ASE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The syllabus is divided into four units i.e. particles Identification, basic electronics behind nuclear techniques, ion accelerators &ion beam interactions in solids and Nuclear stability and nuclear reactors.

9. Course Objectives:

The course aims to provide students with an understanding of the particles identification, basic electronics behind nuclear techniques, the working principles of ion accelerators & ion beam interactions in solids & basic features involved in nuclear stability and Nuclear reactors.

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. Describe the particle Identification.
2. Explain the Nuclear Electronics, techniques, circuits and analyzers.
3. Explain the working principles of ion accelerators & ion beam interactions in solids.
4. Describe the basic features involved in nuclear stability and Nuclear reactors.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Particles Identification**

Basic principle of ΔE-E detector telescopes, Short range charged particles ΔE-E telescope, Methods of particle identification using semiconductor and gaseous detectors, ΔE-E time of flight spectroscopy, Event by event particle identification system for heavy ion induced reaction analysis; neutron-gamma discrimination;

Modem Gas Detectors: Basic principle and operation of split anode ionization chamber, Position sensitive ionization chamber, Position sensitive proportional counter, Multi-wire proportional counter.

Unit – 2	**Number of lectures = 14**	**Title of the unit: Nuclear Electronics**

Types of preamplifiers: basic idea of voltage sensitive , Current sensitive pre-amplifiers, Details of charge sensitive preamplifier and its applications; Amplifier Pulse Shaping Circuits, RC, Gaussian, delay-line,Bipolar and zero cross-over timing circuits, Pole zero cancellation and base line restorer, Coincidence Techniques: basic idea of coincidence circuit its resolving time, Basic principle of slow coincidence, slow fast coincidence

Sum coincidence techniques; Single Channel Analyzer; Multi-Channel Analyzer; CAMAC Based Data Acquisition System.

Unit – 3	**Number of lectures = 13**	**Title of the unit: Ion Accelerators and Ion Beam Interaction in Solids**

Ion Accelerators: Ion sources- basic features of RF ion source, Direct extraction negative ions source (Duo plasmatron) , Source of negative ions by Cs sputtering (SNICS); Basic principle and working of Tandom accelerator and Pelletron accelerator and its applications; Ion Beam Interaction in Soilds: Basic ion bombardment processes in Solids- general phenomenon, ion penetration and stopping, Ion range parameters, channelling,

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components of an ion implanter, 8.Energy deposition during radiation damage, sputtering process and ion beam mixing.

Unit – 4	Number of lectures = 11	Title of the unit: Nuclear Reactors

Nuclear stability, fission, prompt and delayed neutrons , fissile and fertile materials- characteristics and production , Classification of neutrons on the basis of their energy, four factor formula , control of reactors using natural uranium, principle of breeder **Unit** reactors

12. **Brief Description of self-learning / E-learning component:**

To understand basic concepts in detail, students may get study materials on following links.

1. https://onlinecourses.nptel.ac.in/noc18_ph02
2. https://www.mooc-list.com/tags/nuclear-physics
3. www.nuclearonline.org/Courses.htm
4. https://study.com/directory/category/Physical_Sciences/Physics/Nuclear_Physics.html
5. https://www.class-central.com/tag/nuclear%20physics

13. Books Recommended

1. R. R. Roy and B. P. Nigam, "Nuclear Physics: Theory and Experiment", Wiley Eastern Limited, 1993.
2. M. K. Pal, "Theory of Nuclear Structure", Affiliated East-West Press, New Delhi.
3. Greiner and Maruhn, "Nuclear Models", Springer, 1996
4. W. E. Burcham, "Nuclear Physics : An Introduction", Longman Group Limited, London, 1973.
5. R. G. Sachs, " Nuclear Theory", Addison-Wesley Publishing Company, Cambridge, 1955.
6. K. S. Krane, "Introductory Nuclear Physics", Wiley India Pvt. Ltd., 2008

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1. Name of the Department: Physics							
2. Course Name	**Spectroscopic Techniques - II**	**L**	**T**		**P**		
3. Course Code	17080407	4	0		0		
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**		**SEC ()**		
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical							
Lectures = 52		**Tutorials = 0**	**Practical = 0**				
8. Course Description:							
Whenever a new molecule is synthesized it is essential to determine its structure using spectroscopic techniques. This course is all about practical applications of spectroscopic methods for the determination of structure of molecules.							
9. Course Objectives:							
1. Comparing between different spectroscopic techniques 2. To learn basics of NMR, ESR, Mossbauer and laser spectroscopy							
10. Course Outcomes (COs):							
1. Identify the basic components of spectroscopic instrumentation. 2. Demonstrate an understanding of the processes responsible for NMR chemical shifts and splitting patterns. 3. Elucidate the structures of molecules from spectral data.							
11. Unit wise detailed content							
Unit-1	**Number of lectures = 14**	**Title of the unit: Laser Spectroscopy**					
Lasers as spectroscopic light sources, spectral characteristics of laser emission, single and multi-mode lasers, Laser tenability, Fluorescence and Raman Spectroscopy with Lasers, Non-linear spectroscopy.							
Unit - 2	**Number of lectures = 12**	**Title of the unit: Time resolved spectroscopy**					
Ultra short pulses and life time measurements with lasers, pump and probe technique, coherent spectroscopy. Optical coupling, trapping of atoms and ions using lasers. Laser cooling.							
Unit - 3	**Number of lectures = 12**	**Title of the unit: Nuclear Magnetic and Electron Spin Resonance Spectroscopy**					
General theory of high resolution NMR spectroscopy, experimental technique, analyses of NMR spectra, spin-spin coupling, chemical shift, Electron Spin Resonance Spectroscopy: Experimental methods, ESR spectrum, hyperfine structure, anisotropic systems, the triplet state.							
Unit - 4	**Number of lectures = 14**	**Title of the unit: Mossbauer and X-ray Photoelectron Spectroscopy**					
Mossbauer Spectroscopy: the Mossbauer effect, experimental methods, hyperfine interactions, molecular and							

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electronic structures, **X-ray Photoelectron spectroscopy:** Experimental technique, XPS spectra and its interpretations, other derivative forms of XPS like ESCA, EDAX etc., chemical shift, stoichiometric analyses, electronic structure.
12. Brief Description of self learning / E-learning component
For understanding the basic concepts in detail, students may get the study materials from these E-learning links https://ocw.mit.edu/courses/physics/
13. Books Recommended
1. Laser Spectroscopy by W. Demtroder (3rd Ed., Springer, 2003) 2. Modern Spectroscopy by J.M. Hollas (4th Ed., John Wiley, 2004) 3. Electron paramagnetic Resonance by J.A. Well and J.R. Bolton (2nd Ed., Wiley, 2007) 4. Electronic and Photoelectron Spectroscopy by A.M. Ellis, M. Feher and T.G. Wright (Cambridge Univ. Press, 2005) 5. Introduction to Spectroscopy by D.L.Pavia, G.M. Lampman and G.S. Kriz (Thomson learning, 2001)

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