KADI SARVA VISHWAVIDYALAYA
GANDHINAGAR

Syllabus for M.Sc. Physics

(*2 Years Full Time:*

***4 Semesters Program*)**

(For 2017-19 Batch and onwards)

LDRP Campus, Sector-15, Nr. KH-5 Circle,
Gandhinagar - 382015

About the Trust

"Sarva Vishwavidyalaya Kelavani Mandal" the trust which has been in existence for more than eight decades is a well reputed prestigious educational trust in North Gujarat. The alumni of SVKM has managed and nurtured the trust to its present eminence.

The trust was formed in 1919, and commenced its activities with a school and student residential "Ashram" at Kadi in 1921 through the generous donation from the society and through the visionary efforts of "Chhaganbha" who is the establisher of the Mandal.

The trust has setup as many as 30 different educational institutions, ranging from Primary schools to postgraduate courses.Engaged in the right pursuit of contributing to the noble cause of education the trust, which started with a school and a handful of students, has today to its credit two mega campuses at Kadi and Gandhinagar. More than 50,000 young students are being groomed at these campuses.

Having provided primary, secondary and higher secondary for almost seven decades, the trust has started imparting higher education and being sensitive to the needs of environment, has added technology, management and computer oriented courses to prepare youth of the region to take up the challenges of the future.

Be it quality of students, quality of faculty or quality of infrastructure at **Sarva VishwavidhyalayaKelavaniMandal**, nothing would be less par excellence. With the co-operation from its Alumni settled across the globe, the trust is committed to attain higher and higher standards of quality education to serve the coming generation.

About Kadi Sarva Vishwavidyalaya(KSV)

Kadi Sarva Vishwavidyalaya (KSV) is a University established vide Gujarat State Government Act 21 of 2007 in May 2007 and approved by UGC (Ref.: F. 9-18/2008(cpp-1) March 19,2009).

The University has been setup by **Sarva Vidyalaya Kelavani Mandal**, a trust with more than 95 years of philanthropic existence to achieve the following objectives:

- To provide need based education and develop courses of contemporary relevance.
- To be a University of excellence by providing research based activities which would foster higher economic growth.
- To provide education to all irrespective of caste, creed, religion etc

MASTER OF SCIENCE (PHYSICS)

(1) Learning outcomes (objectives and aim)

This program leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding of the fundamental and advanced content in Physics which will be determined by his /her particular choice of courses, according to his/her particular needs and interests.

Cognitive skills:

When one has completed this degree he/she will be able to:

- Understand how to solve some problems using the methods taught
- Assimilate complex Physical ideas, concepts and arguments
- Develop abstract and research based Physical thinking
- Develop physical and scientific intuition.

Practical and/or professional skills and Key Skills:

When one has completed this degree he / she will be able to demonstrate the following skills:

- The ability to advance own knowledge and understanding through independent learning
- Communicate clearly knowledge, ideas, concepts and conclusions about Physics
- Develop problem-solving skills and apply them independently to problems in pure, applied and applicable Physics
- Communicate effectively in writing about the subject
- Improve his/her own learning and performance.

(2) Duration of the course:

The CBCS pattern M.Sc. program with multidisciplinary approach in Physics is offered on a fulltime basis. The duration of the course is of two academic years consisting of four semesters each of 15 weeks duration.

(3) Teaching and learning methods:

All relevant material is provided and taught in the course texts through the study of set books. Various Modern resources will be provided to enhance his/her skill. One will build up knowledge gradually, with sufficient in text examples to support one’s understanding. He/ She will be able to assess his/her own progress and understanding by using the in- text problems and exercised at the end of each unit. Opportunity to engage with what is taught is provided by means of the assignment questions and understanding will be reinforced by personal feedback from the teacher in the form of comments based on the answers to one’s assignments, seminars, unit tests and project.

(4) Course of study:

The curriculum has seven major components:

1. Core/Principal/Fundamental Physics courses
2. Pure Physics Courses
3. Applied Physics Courses
4. Applicable/Application Oriented Physics Courses (disciplinary)
5. Soft Skill Based Courses (Inter-disciplinary)
6. Choice Based Coursed (Disciplinary/Inter disciplinary)
7. Cognitive Skill- Work Based Courses

There are several courses prescribed in the following classification to be studied to acquire M.Sc. Degree in Physics.

(I) **Principal /Core/Compulsory Courses (HARD CORE):**

–Semester I to IV

All Basic/Core courses carry 4 credits in 4 hours per week teaching and in semester I & II any four while in semester III & IV any three core courses to be selected/offered from the list of MPCT Group (various groups are listed in detail syllabus) with no repetitions i.e. there are total 14 Physics Core Courses to be selected from semester- I to semester IV.

(II) **Elective Disciplinary Courses (SOFT CORE):**

–Semester III to IV

All elective courses carry 4 credits in 4 Hours per week teaching. During the span of the program, 1 Physics Elective Course is offered in semester III as well as in semester IV. Each elective course contains two options covering Pure and Applied Physics Group.

(III) **Cognitive Skills Work Practical/Project/Dissertation Work for Research Problem**

This is also described in detail syllabus at the end.

(5) A**ssessment and examination method**:

A candidate understands of principals and concepts will be assessed through Internal Assessment (IA) and University Exam (UE) pattern as follow:

- **Internal Assessment (IA) :**

The Internal Assessment (IA) will be evaluated as:

1. Mid Sem Exam: 40 Marks / 2 = 20 Marks
2. Report Submission / Attendance = 5 Marks
3. Seminar/ Quiz/ Assignments = 5 Marks

- **University Examination (UE) :**

There shall be four semester examinations, one at the end of each semester in each academic year. A candidate who does not pass the examination in any course (s) in a semester will be permitted to appear in such failed course (s) also, with subsequent semester examinations: University Examination (UE) only.

Classifications of IA & UE for different courses of different credits are:
1. Courses of 4 Credits = 70 (UE) + 30 (IA) = 100 marks. (Theory)
2. Courses of 4 Credits = 100 (UE) = 100 marks. (Practical)
3. Courses of 4 Credits = 100 (UE) = 100 marks. (Project)

(6) Rules and regulations

1. Candidates for admission to the Master of Science (Physics) must have a Bachelor's degree with Physics as principle subject of minimum three year duration.
2. The duration of the course will be full time two academic years. The examination for the Master of Science (Physics) course will be conducted under the semester system. For this purpose the academic year will be divided into two semesters. No candidate will be allowed to join any other fulltime course simultaneously.
3. No candidates will be admitted to any semester examination for Master of Science (Physics) unless it is certified by the HOD, M.Sc. (Physics) that he/she has attended the courses of study to the satisfaction of the HOD, M.Sc. (Physics). For granting the terms, minimum attendance of 70% of the theory and practical sessions will be required out of the total number of lectures and practical sessions conducted in the terms.
4. Candidates desirous of appearing at any semester examination of the M.Sc. (Physics) course must forward their application in the prescribed form to the Registrar, through the HOD, M.Sc. (Physics) on or before the date prescribed for the purpose under the relevant intimation of the University.

5. For any Semester, the maximum marks in any subject(s) for the internal and external assessments shall be shown in the teaching and examination scheme for each individual subjects. For the purpose of internal assessment, tests, quizzes, assignment or any other suitable methods of continuous evaluation may be used by the department. If a student keeps term and does not appear for examinations as well as if he/she fail to reappear in the re-test (block test) examination in the same academic session, his/her internal in the relevant subject(s) would be considered as ABSENT (INCOMLETE grade "I"). The department will submit the internal marks of all subject(s) as per the notification of the University.

6. No candidate will be permitted to reappear at any semester examination, which he/she has already passed.

7. To obtain the Degree of Master of Science (Physics), student should clear all the four semester examinations within a period of four years from the date of his/her Registration. Failing which, he/she shall be required to register himself/herself as a fresh candidate and keep the attendance and appear and pass in the four semester examinations afresh from first semester onwards in order to obtain the Degree of Master of Science (Physics).

8. There shall be an Examination at the end of each of the four semesters to be known as First semester Examination, Second semester Examination, Third semester Examination and Fourth semester Examination respectively, at which a student shall appear in that portion of papers practical and Viva- Voce if any, for which he/she has kept the semester in accordance with the regulations in this behalf.

A candidate, whose term is not granted for whatsoever reason, shall be required to keep attendance for that semester or terms when the relevant papers are actually taught at the department.

9. No candidates will be allowed to reappear in a subject/course in which he/she has already passed. He /She can reappear only for the examination i.e. Internal or University examination in which he/she has failed. His/ Her marks in the examination passed will be carried forwarded.

(7) Rules for grading

1. Theory Subjects and Practical Subjects are allotted credits as per the hours allocated to them per week. (For Theory: 4 hr/week = 4 Credit = 100 Marks and For Practical and Project: 9 hr/week = 4 or 5 Credit = 100 Marks).

2. To pass a subject in any Semester a candidate must obtain a minimum of 40% of marks under each head of the subject and minimum of 40% in the individual subject head.

3. If a candidate fails in any heads of a subject, he has to appear for that particular head to pass. (That is, for example if candidate fails in midterm exam of a subject, he has to reappear for midterm of that subject.)

4. The performance of each candidate in all the subjects will be evaluated on 7-point scale in term of grades as follow:

Grading Scheme				
Sr. No.	**Grades**	**Percentage according to Grade**	**Grade Points**	**Qualitative Meaning Of Grade**
1	A +	90-100	10	Outstanding
2	A	80-89	9	Excellent
3	A-	70-79	8	Very Good
4	B +	60-69	7	Good
5	B	50-59	6	Average
6	B-	40-49	5	Fair
7	F	Less Than 40	0	Fail
8	I	Incomplete		

Award of class:

The class awarded to a student with his/her M.Sc. (Physics) course is decided by his/her final CPI as per the following table:

Distinction	CPI not less than 7.50
First Class	CPI less than 7.50, but not less than 6.50
Second Class	CPI less than 6.50, but not less than 5.50
Pass Class	CPI less than 5.50, but not less than 5.00

Semester Performance Index (SPI)

- The performance of a student in a semester is expressed in terms of the Semester Performance Index (SPI).
- The Semester Performance Index (SPI) is the weighted average of course grade points obtained by the student in the courses taken in the semester. The weights assigned to course grade points are the credits carried by the respective courses.

$$\text{SPI} = \frac{g1\ c1 + g2\ c2 + \ldots\ldots}{c1 + c2 + \ldots\ldots}$$

- Where g1, g2 …… are the grade points obtained by the student in the semester, for courses carrying credits c1, c2 …… respectively.

Cumulative Performance Index (CPI)

The cumulative performance of a student is expressed in terms of the Cumulative Performance Index (CPI). This index is defined as the weight age average of course grade points obtained by the students for all courses taken since his admission to the program, where the weights are defined in the same way as above.

If a student repeats a course, only the grade points obtained in the latest attempt are counted towards the Cumulative Performance Index.

(8) For any Semester the maximum marks for the internal and external assessments shall be shown in the teaching and examination scheme. The Continuous Internal Assessment (CIA) will be done by the course teaches and this will be evaluated on the basis of Seminars of equal weight age in each course as well as through quiz, assignments, written test and other physics aptitude tests.

(9) Semester Passing Scheme:

- For each semester examination, a candidate will be considered as pass/clear if he/ she has secured "B-" OR above grade in the Internal as well as in the University Examination separately in each course of theory, practical and Project work.

- For each semester examination, a candidate will be considered as fail if he/she has secured “F” grade in any or all of the subject(s).
- If the candidate does not fulfill the subject requirements, he/she will be given I-grade and the candidate will have to complete the course requirement before the commencement of the next semester-end examination. If the candidate does not clear I grade in any subject, he/she will be considered fail – F grade. Candidate has to clear his / her ‘F’ grade or ‘I’ grade, if any, in the next examination.

(10) Semester Promotion Scheme

A candidate will be promoted to the subsequent Semester according to following scheme:

- A candidate would be granted admission to the Second Semester irrespective of the result of First Semester. He/ She will be permitted to pursue his/her study of the Second Semester, provided his/her term for the first semester is granted and applied for the university examination.
- A candidate would be granted admission to the Third Semester if and only if he/she has cleared all the subjects of First Semester and irrespective of the result of Second Semester. He/ She will be permitted to pursue his/her study of the Third Semester, provided his/her term for second semester is granted and applied for the university examination.
- A candidate would be granted admission to the Fourth Semester if and only if he/she has cleared all the subjects of Second Semester. He/ She will be permitted to pursue his/her study of the Fourth Semester, provided his/her term for third semester is granted and applied for the university examination.
- The final degree would be awarded to the student on successful completion of all the Semester.

(11) Following criteria would be followed for awarding the mark statement of any Semester:

- The Grade (Mark) sheet will contain separate grades internal and University Examination for each of compulsory papers (subjects), Practical work, Project Work and overall grade for all the subjects combined.

- It will also contain percentage and the class obtained. The percentage will be calculated on the basis of cumulative performance index (CPI) obtained by candidate.
- CPI will be shown in each semester's Grade (mark) sheet for each end-semester examination.

(12) Subject wise Grade and grade points will be calculated based on the Grading Scheme defined. For example:-

FOR SEMESTER-I

Subjects	Total Marks (Int+Ext)	Marks secured (Int+Ext)	In percentage	Grade	Points as per grade	Subject wise credit points	Product of credit points and grade Points (Total credits)
A	100	75	75.00	A-	8	4	32
B	100	64	64.00	B+	7	4	28
C	100	82	82.00	A	9	4	36
D	100	54	54.00	B	6	4	24
E	150	73	49.00	B-	5	6	30
F	100	80	80.00	A	9	4	36
G	100	72	72.00	A-	8	4	32
Total						30	218

SPI: 218 / 30 = 7.27 ,**CPI** = 7.27

FOR SEMESTER-II

Subjects	Total Marks (Int+Ext)	Marks secured (Int+Ext)	In percentage	Grade	Points as per grade	Subject wise credit points	Product of credit points and grade Points (Total credits)
A	100	82	82.00	A	9	4	36
B	100	76	76.00	A-	8	4	32
C	100	71	71.00	A-	8	4	32
D	100	65	65.00	B+	7	4	28
E	150	45	30.00	F	0	6	0
F	100	52	52.00	B	6	4	24
G	100	44	44.00	B-	5	4	20
Total						30	172

SPI: 172 / 30 = 5.73,**CPI**: 6.50 (As Follow)

Semester	Points of sem (SPI)
Sem-I	7.27
Sem-II	5.73
Total SPI	13.00
CPI (SPI/2)	6.50

In this case, the candidate is failing in one subject i.e. Project-II, and he/she has secured 5.23 SPI for semester II and 7.27 CPI for semester I and II both. Whenever the candidate clears the subject i.e. Project-II in the next semester examination, the total credits for that subject will be add to CPI of the candidate.

To calculate the final grade of the course, CPI will be calculated as follows:–

SEMESTER	POINTS OF SEM (SPI)
SEM-I	6.79
SEM-II	5.30
SEM-III	8.33
SEM-IV	5.56
Total SPI	25.98
CPI	**6.50**

CPI: 6.50

Class of M.Sc. Physics Course will be now – **'First'** as it falls in that range.

(13) Career scope

There are numbers of opportunities in various fields after successfully completing the program. Physics is the basic need of any natural sciences so this course has significant role in the society.

- Physics finds a wide application in industry, atomic and space organizations, forensic science, meteorology, electronics, design & development engineering, research laboratories.
- It also has considerable commercial and military value.
- Physicists are mainly involved in (R&D) research and development in specialized branches such as elementary particle physics, astrophysics, nuclear physics, biotechnology, etc.
- National laboratories and organizations like BARC, DRDO, SSPL, ISRO, Space Application Centers (SAC), National Atmospheric Research laboratory of department of space, Inter university accelerator centers (IUAC), Indira Gandhi Centre for atomic research (IGCAR) Kalpakkam, Raja Ramanna

Centre for advanced Technology (RRCAT) Indore, Variable Energy Cyclotron Centre (VECC) Calcutta, Uranium Corporation of India Limited, Nuclear Power Corporation of India Limited, Nuclear fuel complex, Heavy Water Board, Atomic mineral directorate; PRL Ahmedabad, IPR Gandhinagar, IUCAA, Saha Institute of Nuclear Physics Calcutta, ARIES, Uttrakhand, Indian Institute of Geomagnetism, Centre for Liquid Crystal Research (CLCR), UGC DAE CSR; Constituent laboratories & institutes of CSIR like National Physical Laboratory (NPL), National Geophysical Research Institute, Regional Research Laboratories, National Institute of Science, Technology and Development Studies (NISTADS), Institute of Materials & Mineral Technology (IMMT), National Institute of Science Communication and Information Resources (NISCAIR), etc. provides enormous career opportunities as scientist/director/research fellow/research associate/research assistant/technician. Etc. in these laboratories and institutes.

- Agricultural research services with soil physics & agricultural physics as specialization.
- A growing number of physicists specialize in biophysics, chemical physics, radio physics, astrophysics and related sciences.
- Besides going in for research, one could also teach in colleges/universities for which the minimum requirement is M. Sc Physics and qualifying the UGC-CSIR NET/Ph.D. for lectureship and JRF.
- M. Sc followed by a B. Ed will enable to teach at the high school level.
- M. Sc Physics students are also eligible for pursuing M. Tech (in a host of engineering/technology disciplines including aeronautical, automobile, instrumentation, electronics & communication, or computer science at leading institutions including the IITs after taking the GATE (Graduate Aptitude Test in Engineering).
- Postgraduate diplomas in leather, sugar, plastics, processing, packaging or environment technology are some other options one could look at.
- Moreover, the skills developed while studying Physics, particularly the ability to research, evaluate and communicate information, will hold in good position in any field to train for - be it management, information technology, or aviation.

- Civil Services as well as the Indian Forest Service Exams with Physics as one of the papers in the Mains examination.
- Software field especially game developer (motion specialist) has more prospectuses.

(14) Semester Promotion Scheme

Promotion to	**Conditions for Promotion**
Semester-II	Term of semester-I is granted
Semester-III	Term of semester-I and semester-II both are granted
Semester-IV	Pass in all subjects of semester-I; and Term of semester-II and semester-III both are granted

The final degree would be awarded to the student on the successful completion of all the semesters.

(15) Course structure

Semester - I

Sr. No.	Subject Title	Subject Code	Teaching Scheme Hours per Week		Examination Scheme		Total Marks	Credit
			L	Pr.	Internal Assessment (IA) Marks	University Exam (UE) Marks		
1	Classical Mechanics	MPCT101	4	-	30	70	**100**	**4**
2	Quantum Mechanics -I	MPCT102	4	-	30	70	**100**	**4**
3	Mathematical Methods - I	MPCT103	4	-	30	70	**100**	**4**
4	Electronics-I	MPCT104	4	-	30	70	**100**	**4**
5	Practical-I	MPCT105	-	9	-	100	**100**	**4**
6	Project - I	MPCT106	-	9	-	100	**100**	**4**
			16	18	120	480	**600**	**24**
Total Contact hours per week = 34					**Total Marks = 600**			

L=Theory Lecture Pr. = Practical/Project

Semester - II

Sr. No.	Subject Title	Subject Code	Teaching Scheme Hours per Week		Examination Scheme		Total Marks	Credit
			L	Pr.	Internal Assessment (IA) Marks	University Exam (UE) Marks		
1	Solid State Physics	MPCT201	4	-	30	70	**100**	**4**
2	Quantum Mechanics - II	MPCT202	4	-	30	70	**100**	**4**
3	Mathematical Methods-II	MPCT203	4	-	30	70	**100**	**4**
4	Electronics-II	MPCT204	4	-	30	70	**100**	**4**
5	Practical - II	MPCT205	-	9	-	100	**100**	**4**
6	Project - II	MPCT206	-	9	-	100	**100**	**4**
			16	18	120	480	**600**	**24**
Total Contact hours per week = 34					**Total Marks = 600**			

L = Theory Lecture Pr. = Practical/Project

Semester - III

Sr. No.	Subject Title	Subject Code	Teaching Scheme Hours per Week		Examination Scheme		Total Marks	Credit
			L	Pr.	Internal Assessment (IA) Marks	University Exam (UE) Marks		
1	Atomic and Molecular Physics	MPCT301	4	-	30	70	**100**	**4**
2	Nuclear and Particle Physics	MPCT302	4	-	30	70	**100**	**4**
3	Electrodynamics	MPCT303	4	-	30	70	**100**	**4**
4	Elective-I	MPET304	4	-	30	70	**100**	**4**
5	Practical – III	MPCT305	-	9	-	100	**100**	**5**
6	Project-III	MPCT306	-	9	-	100	**100**	**5**
			16	18	120	480	**600**	**26**
Total Contact hours per week = 34					**Total Marks = 600**			

L=Theory Lecture Pr. = Practical/Project

Semester - IV

Sr. No.	Subject Title	Subject Code	Teaching Scheme Hours per Week		Examination Scheme		Total Marks	Credit
			L	Pr.	Internal Assessment (IA) Marks	University Exam (UE) Marks		
1	Statistical Mechanics	MPCT401	4	-	30	70	**100**	**4**
2	Plasma Physics	MPCT402	4	-	30	70	**100**	**4**
3	Statistical Methods	MPCT403	4	-	30	70	**100**	**4**
4	Elective-II	MPET404	4	-	30	70	**100**	**4**
5	Practical – IV	MPCT405	-	9	-	100	**100**	**5**
6	Project- IV	MPCT406	-	9	-	100	**100**	**5**
			16	18	120	480	**600**	**26**
Total Contact hours per week = 34					**Total Marks = 600**			

L=Theory Lecture Pr. = Practical/Project

List of courses in various groups offered in Semester – I to IV.

M.Sc. Physics Core Subjects – MPCT (Semester – I to IV)

1. Classical Mechanics
2. Quantum Mechanics - I
3. Mathematical Methods – I
4. Electronics - I
5. Solid State Physics
6. Quantum Mechanics – II
7. Mathematical Methods – II
8. Electronics - II
9. Atomic and Molecular Physics
10. Nuclear and Particle Physics
11. Electrodynamics
12. Statistical Mechanics
13. Plasma Physics
14. Statistical Methods

M.Sc. Physics Elective - I Subjects - MPET (Semester - III)

1. Astronomy and Astrophysics - I (MPET – 304A)
2. Applied Electronics - I (MPET – 304B)

M.Sc. Physics Elective - II Subjects - MPET (Semester - IV)

1 Astronomy and Astrophysics - II (MPET – 404A)

2. Applied Electronics - II (MPET – 404B)

Soft Skill & Cognitive Skills Subjects (Semester – I to IV)

1. Physics Practical - I, II ,III and IV
2. Project - I, II , III and IV

DETAIL SYLLABUS

SEMESTER - I

Name of Course: Classical Mechanics

<table>
<tr><th rowspan="3">Subject Title</th><th rowspan="3">Subject Code</th><th colspan="2">Teaching Scheme Hours per Week</th><th rowspan="3">Total Teaching Hours per semester</th><th colspan="4">Examination Scheme</th><th rowspan="3">Total Marks</th><th rowspan="3">Credit</th></tr>
<tr><th rowspan="2">L</th><th rowspan="2">Pr.</th><th colspan="2">Internal Assessment (IA)</th><th colspan="2">University Exam (UE)</th></tr>
<tr><th>Max. Marks</th><th>Hrs</th><th>Max. Marks</th><th>Hrs.</th></tr>
<tr><td>Classical Mechanics</td><td>MPCT101</td><td>4</td><td>-</td><td>60</td><td>30</td><td>1.5</td><td>70</td><td>3</td><td>100</td><td>4</td></tr>
</table>

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of classical Mechanics.
- To gain skill in problem solving and critical thinking.
- To understand various different forms and methods - Newtonian mechanics, Lagrangian Mechanics and Hamiltonian Mechanics which are used according to which provides the answer most easily and conveniently

Learning Outcomes

After studying this subject, student will be able to

- To explain most of the phenomena we encounter in day-to-day activities.
- In machines and parts of machines, in sports, in simple processes like using simple machines, processes like designing a mechanical system.
- In very complex applications like launching rockets and satellites too, the principles of classical mechanics play a very important role. The laws have been cast into various different forms and methods - Newtonian mechanics, Lagrangian Mechanics and Hamiltonian Mechanics these methods are used according to which provides the answer most easily and conveniently.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Mechanics of a particle (conservation of linear and angular momentum, energy conservation); Mechanics of a system of particles (conservation of linear and angular momentum, energy conservation); Constraints (Holonomic, Non holonomic, Rheonomous and Scleronomous); Generalized coordinates; D'Alembert's principle and Lagrange's equations of motion; Velocity-dependent potentials and the dissipation function; Simple applications of the Lagrangian formulation-single particle in space, Atwood's machine, bead sliding rotating wire, one dimensional harmonic oscillator, planetary motion (Kepler's problem), spherical pendulum, other related problems. Illustrative Examples

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Advantages of Hamiltonian formulation over Lagrangian; Hamilton's principle; proof of Hamilton's principle; Hamilton's equations; Hamilton's canonical equations of motion; Ignorable or cyclic coordinates and spherical pendulum; Routhian function and Kepler's problem; applications of Hamiltonian formulation- a simple pendulum with moving support, charged particle in an electromagnetic field, one dimensional harmonic oscillator, other related problems. Illustrative Examples

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Canonical Transformation and the Hamilton-Jacobi Theory: Gauge transformation, Canonical transformation, condition for transformations to be Canonical, Illustration of canonical transformations, Poisson brackets, canonical equations in terms of Poisson bracket notation, infinitesimal transformation, Relation between infinitesimal transformation and Poisson brackets. The Hamilton Jacobi equations, Illustrative Examples

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Theory of small oscillations: General case of coupled oscillations, Eigen vectors and Eigen frequencies, Orthogonality of Eigen vectors, Normal coordinates Small oscillations of particles on string. Illustrative Examples

Text Book:

1. Introduction to Classical Mechanics, R.Takwale & P.Puranik, Tata McGraw Hill Publication, New Delhi

Reference Books:

1. Classical Mechanics, 3/e, Herbert Goldstein, Charles P. Poole& John Safko, Pearson Education, Chennai
2. Classical Mechanics, G. Aruldas, Prentice Hall of India, New Delhi
3. Classical Mechanics,1/e, N. C. Rana & P. S. Joag, Tata McGraw Hill Publication, New Delhi
4. Classical Mechanics,1/e , S.N. Biswas, Books& Allied (NCBA) Publisher, New Delhi
5. Classical Mechanics, V. B. Bhatia, Narosa Publishing House, New Delhi
6. Mechanics, L. D. Landau &E. M. Lifshitz, Pergamon Press, Oxford

Name of Course: Quantum Mechanics-I

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hour per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Quantum Mechanics-I	MPCT102	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of quantum Mechanics.
- To gain skill in problem solving and critical thinking.
- To describe the behavior of matter and energy at atomic and sub-atomic scale.

Learning Outcomes

After studying this subject, student will be able to

- Explain the structure of the atom and the structure of the nucleus.
- Predict the existence of antimatter, and explains radioactivity
- Explains the photoelectric effect, whereby electrons are emitted from matter as a result of absorbing energy from light - this occurs in human vision, and has practical applications in digital cameras.
- Used in night vision goggles and 'scanning tunneling microscopes' (which create images of surfaces where individual atoms can be seen)

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Quantum Mechanics in Three Dimensions: Schrodinger Equation in Spherical Coordinates, Separation of Variables, The Angular Equation, Associated Legendre Function, Legendre Polynomials, Rodrigues Formula, Spherical Harmonics, The Radial Equation, Infinite Square Well, Spherical Bessel Function, Spherical Neumann Function; The Hydrogen Atom, The Radial Wave function, The Ground State Energy, The Ground State Wave Function, Associated Laguerre Polynomial, Laguerre Polynomial, Radial Wave Functions and their Normalization, Construction of higher order wavefunctions using Radial wave functions, The Spectrum of Hydrogen, Illustrative Examples.

Unit:2 **(Lecture Hours: 15/Weightage: 25%)**

Time Independent Perturbation Theory: Non- Degenerate Perturbation Theory, First Order Correction, Second Order Correction, First Order Theory, Second Order Energies; Degenerate Perturbation Theory, Two Fold Degeneracy, Removal of Degeneracy; Effect of Electric field on the energy levels of an atom – Stark Effect, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

The Variation Principle: Upper bound on the Ground State Energy, Ground State Energy of One Dimensional Simple Harmonic Oscillator, Ground State Energy of a Delta Function Potential, Ground State Energy of One Dimensional Infinite Square Well using Triangular Wave Function; The Ground State of Helium; The Hydrogen Molecule Ion, Overlap Integral, Exchange Integral, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

The WKB Approximation: The WKB Method, One Dimensional Schrodinger Equation – The Classical Region; Tunneling, Gamow's Theory of alpha Decay; The Connection Formulas, The Patching Region, The Overlap Region, Airy's Equation, Airy Functions and their properties, Illustrative Examples

Text Book:

1. Introduction to Quantum Mechanics by David J Griffiths (2^{nd} Edition), Pearson

Reference Books:

1. A text book of Quantum Mechanics, by P.M. Mathews and K. Venkatesan (TMH)
2. Quantum Mechanics - by L.I. Schiff
3. Quantum Mechanics by A.K. Ghatak and L.S. Kothari
4. Quantum Mechanics by V. K. Thankapan
5. Quantum Mechanics by Ghatak & Loknathan; McMillan India Publication
6. Lectures on quantum field theory by Ashok Das (World Scientific).

Name of Course: Mathematical Methods - I

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Mathematical Methods -I	MPCT103	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of Mathematical Physics
- To gain skill in problem solving and critical thinking.
- To understand the applications of mathematical methods in physics.

Learning Outcomes

After studying this subject, student will be able to

- Use ordinary differential equations, symplectic geometry etc to understand dynamical systems and Hamiltonian mechanics belong to mathematical physics.
- Expand and elucidate physical theories.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Linear Algebra:

Introduction, Matrices; Row Reduction, Determinants; Cramer's Rule, Vectors, Lines and Planes, Matrix Operations, Linear Combinations, Linear Functions, Linear Operators, Linear Dependence and Independence, Special Matrices and Formulas, Linear Vector Spaces, Eigenvalues and Eigenvectors; Diagonalizing Matrices, Applications of Diagonalization. Illustrative Problems

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Vector Analysis:

Introduction, Applications of Vector Multiplication, Triple Products, Differentiation of Vectors, Fields, Directional Derivative; Gradient, Some Other Expressions Involving ∇, Line Integrals, Green's Theorem in the Plane, The Divergence and the Divergence Theorem, The Curl and Stokes' Theorem, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Infinite and Power Series:

The Geometric Series, Definitions and Notation, Applications of Series, Convergent and Divergent Series, Testing Series for Convergence; The Preliminary Test.

Power Series; Interval of Convergence, Theorems About Power Series, Expanding Functions in Power Series, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Partial Differentiation:

Introduction and Notation, Power Series in Two Variables, Total Differentials, Approximations using Differentials, Chain Rule or Differentiating a Function of a Function, Implicit Differentiation, Application of Partial Differentiation to Maximum and Minimum Problems, Maximum and Minimum Problems with Constraints; Lagrange Multipliers, Endpoint or Boundary Point Problems, Change of Variables, Differentiation of Integrals; Leibniz' Rule, Illustrtive Examples.

Text Book:

1. Mathematical Methods in Physical Sciences by M. L. Boas, Second Edition, John Wiley & Sons.

Reference Books:

1. Mathematical Methods for Physicists by G. Arfken, Weber, and Harris Academic Press, 6th Ed.
2. A. Joshi, Matrices and Tensors in Physics, Wiley India
3. Mathematical Physics by P. K. Chattopadhyay, Wiley Eastern Limited.
4. Vector Analysis, Murray Spiegel (Schuam Series).
5. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics, McMillan
6. S. D. Joglekar, Mathematical Physics: The Basics, Universities Press 2005
7. S. D. Joglekar, Mathematical Physics: Advanced Topics, CRC Press 2007

Name of Course: Electronics -I

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Electronics –I	MPCT104	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of Analog and Digital Electronics
- To gain skill in problem solving and critical thinking.
- To understand the application of Analog and Digital Electronics in day to day life.

Learning Outcomes

After studying this subject, student will be able to

- Understand physical interpretation of Analog and Digital Electronics.
- Understand the application of Analog and Digital Electronics in computer, Aircraft technology and electronics, Satellites and electronics, Television, Internet technology etc.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Application of PN junction Diode, Special Purpose diode, Light Dependent Resistor, photodiode, photo-transistor and photo - detectors, Optocouplers, PNP and NPN transistors, conduction through transistor leakage current, relationship between α and β, Transistor configuration & characteristics for CB,CE,CC, Load line and biasing methods of transistor, Transistor as an amplifier ,Cascade amplifiers.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Introduction of power amplifier, Difference between Voltage and Power amplifiers, ,Terms used in power amplifiers ,Classification of Power Amplifiers, Class-A power amplifiers (Direct –coupled with resistive load), Transformer coupled class –A amplifier, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. Illustrative Examples

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Difference between BJT and JFET ,Basic of JFET, Principle and working of JFET, n-channel and p-channel ,JFET Parameters of JFET – rd, gm, µ ,JFET configurations: common source, drain and gate, Application of FETs,Types of MOSFET: Depletion type MOSFET,enhancement type MOSFET ,JFET and MOSFET as amplifiers

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Operational amplifiers, Characteristic and specification of OPAMP- IC 741, Op-Amp parameters: Input and output offset voltage, Input offset current, Input bias current, CMRR, slew rate, frequency response , Inverting and non-inverting amplifier with derivation of voltage gain , Summing and differential amplifier, integrator, differentiator, comparator, V-I converter Schmitt trigger, Comparator, Illustrative Examples

Reference Books:

1. Integrated Electronics: Analog And Digital Circuits and Systems by J. Millman And C. C. Halkias, 50/e, Tata McGraw - Hill Education, New Delhi.
2. Electronics Devices and Circuit by J. Millman And C. C. Halkias, 32/e, Tata McGraw - Hill Education, New Delhi.
3. Electronics Devices and Circuit by J. B. Gupta, 5/e, S. K. Kataria& Sons-New Delhi
4. Principles of Electronics by V. K. Mehta & Rohit Mehta, 11/e, S. Chand-New Delhi.
5. Op-amps and Linear Integrated Circuits by Ramakant A. Gayakwad, 4/e, Prentice Hall of India-New Delhi
6. Hand Book of Electronics by Gupta and Kumar, Pragiti Prakashan Meerut.
7. Digital Logic and Computer Design by M. Morris Mano, 4/e, Pearson Education, Chennai

SEMESTER - II

Name of Course: Solid State Physics

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Solid State Physics	MPCT201	4	-	60	30	1.5	70	3	100	4

Rationale

Modern technology relies to a large extent on solid-state and other condensed matter devices and systems. Rapid technological advances have occurred as a result of our increased understanding of the properties of condensed matter. This course offers students the opportunity to learn the fundamentals of solid state physics as an introduction to the wider area of condensed matter physics. This knowledge is essential for persons conducting research and development on condensed matter technology, working in technical positions in industrial and government laboratories, or pursuing graduate studies in condensed matter physics.

Learning Outcomes:

A course objective is to introduce to the student the physical properties of solids including the electrical, magnetic, optical, thermal and mechanical properties. A second objective is to relate and guide the study of the classical, semi-classical, and quantum theories forming the basis for our understanding of condensed matter. The structure, symmetry, and bonding in solids determine in part the properties of solids and an objective of this course is the development of student understanding of these impacts. Students will also learn about the technological applications of condensed matter physics through examples highlighted in this course.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Reciprocal Lattice and Determination of Crystal Structure:

Reciprocal Lattice, Bragg's Law, Laue's Method, Construction of Reciprocal Lattice, Relationship between the a,b,c and a*,b*,c*, Analysis of X-ray diffraction patterns from crystals, Measurement of diffraction pattern of crystals, Determination of Lattice Parameters.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Lattice Vibrations:

The balls and spring model of a harmonic crystal, Normal modes of one dimensional monoatomic chain, Normal modes of one dimensional diatomic chain, The Reststrahlen Band, General theory of harmonic approximation, Normal modes of real crystals, Quantization of lattice vibrations, Measurement of Phonon dispersion by inelastic neutron scattering.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Free electron theory of Metals:

The Drude Model: Electrical and Thermal Conductivity, Lorentz Modification, The Fermi-Dirac Distribution function, The Sommmerfeld model, The electron heat capacity, The Sommerfeld theory of electrical conduction in metals, Thermoelectric Power.

Band Theory of Solids: Metals, Semi Conductors and Insulators.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Diamagnetism and Paramagnetism: Langevin's Theory of dia and para magnetism, Theory of Atomic Magnetic Moment, Quantum Theory of Magnetic Susceptibility, Electron Spin Resonance (ESR) and Nuclear Magnetic Resonance (NMR)

Superconductivity: Phenomena without observable Quantization: Zero resistance and Persistent currents, Meissner Effect, London Equations, Type I and II superconductors, Thermodynamic Properties.

Text Book:

1. Elements of Solid State Physics, 2nd Edition, J P Shrivastava, PHI

Reference Books

1. Kittel: Solid State Physics
2. Verma and Srivastava: Crystallography for Solid State Physics
3. Azaroff: Introduction to Solids
4. Azaroff: X-Ray Crystallography
5. M. Ali Omar: Elementary Solid State Physics
6. S O Pillai: Solid State Physics
7. Dekker: Solid State Physics

Name of Course: Quantum Mechanics – II

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Quantum Mechanics-II	MPCT202	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To study and be able to apply the conceptual structure of quantum Mechanics.
- To gain skill in problem solving and critical thinking.
- To describe the behavior of matter and energy at atomic and sub-atomic scale.

Learning Outcomes

After studying this subject, student will be able to

- Explain the structure of the atom and the structure of the nucleus.
- Predict the existence of antimatter, and explains radioactivity
- Explain the photoelectric effect, whereby electrons are emitted from matter as a result of absorbing energy from light - this occurs in human vision, and has practical applications in digital cameras.
- Used in night vision goggles and 'scanning tunneling microscopes (which create images of surfaces where individual atoms can be seen)

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Angular Momentum: Commutator Relations of Angular momentum with position and momentum, The Ladder Operators – The Rising and Lowering Operators, The Generalized Uncertainty Principle, Eigenvalues of Angular Momentum, The ‘ladder’ of Angular Momentum States, Eignefunctions of Angular Momentum – The Spherical Harmonics. Illustrative Examples

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Spin, Spin ½, Pauli Spin Matrices, Eigenvalues, Eigenvectors, Normalization, Expectation Values, Uncertainties and The Uncertainty Principle for Spin, Addition of Angular Momenta, Singlet State, Triplet State, Clebsch-Gordon Coefficients, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Scattering Theory: The Classical Scattering Theory, Hard Sphere Scattering, Rutherford Scattering; Partial Wave Analysis, Formalism, Spherical Hankel Functions, Partial Wave Amplitude, Rayleigh’s formula, Quantum Hard Sphere Scattering; Phase Shifts, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

The Born Approximation, Integral form of Schrodinger Equation, Helmholtz equation, The Greens Function, Cauchy's Integral Formula, The first Born approximation, Spherically symmetric potential, Yukawa Scattering, Rutherford Scattering, The Born Series, Illustrative Examples.

Text Book:

1. Introduction to Quantum Mechanics by David J Griffiths (2^{nd} Edition), Pearson

Reference Books:

1. A text book of Quantum Mechanics, by P.M. Mathews and K. Venkatesan (TMH)
2. Quantum Mechanics - by L.I. Schiff
3. Quantum Mechanics by A.K. Ghatak and L.S. Kothari
4. Quantum Mechanics by V. K. Thankapan
5. Quantum Mechanics by Ghatak & Loknathan; McMillan India Publication
6. Lectures on quantum field theory by Ashok Das (World Scientific).

Name of Course: Mathematical Methods-II

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Mathematical Methods-II	MPCT203	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of Mathematical Physics
- To gain skill in problem solving and critical thinking.
- To understand the applications of mathematical methods in physics.

Learning Outcomes

After studying this subject, student will be able to

- Use ordinary differential equations, symplectic geometry etc to understand dynamical systems and Hamiltonian mechanics belong to mathematical physics.
- Expand and elucidate physical theories.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage:25%)**

Special Functions:

Introduction, The Factorial Function, Definition of the Gamma Function; Recursion Relation, The Gamma Function of Negative Numbers, Some Important Formulas Involving Gamma Functions, Beta Functions, Beta Functions in Terms of Gamma Functions, Illustrative Examples.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Tensors:

Introduction, Cartesian Tensors, Tensor Notation and Operations, Inertia Tensor, Kronecker Delta and Levi-Civita Symbol, Pseudovectors and Pseudotensors, More About Applications, Curvilinear Coordinates, Vector Operators in Orthogonal Curvilinear Coordinates, Non-Cartesian Tensors, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Fourier Series and Transform:

Introduction, Simple Harmonic Motion and Wave Motion; Periodic Functions, Applications of Fourier Series, Average Value of a Function, Fourier Coefficients, Dirichlet Conditions, Complex Form of Fourier Series, Other Intervals, Even and Odd Functions, An Application to Sound, Parseval's Theorem, Fourier Transforms, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Ordinary Differential Equations and Laplace Transform:

Introduction, Separable Equations, Linear First-Order Equations, Other Methods for First-Order Equations, Second-Order Linear Equations with Constant Coefficients and Zero Right-Hand Side, Second-Order Linear Equations with Constant Coefficients and Right-Hand Side Not Zero, Other Second-Order Equations, The Laplace Transform, Solution of Differential Equations by Laplace Transforms, Convolution, The Dirac Delta Function, A Brief Introduction to Green Functions, Illustrative Examples.

Text Book:

1. Mathematical Methods in Physical Sciences by M. L. Boas, Second Edition, John Wiley & Sons.

Reference Books:

1. Mathematical Methods for Physicists by G. Arfken, Weber, and Harris Academic Press, 6th Ed.
2. A. Joshi, Matrices and Tensors in Physics, Wiley India
3. Mathematical Physics by P. K. Chattopadhyay, Wiley Eastern Limited.
4. Vector Analysis, Murray Spiegel (Schuam Series).
5. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics, McMillan
6. S. D. Joglekar, Mathematical Physics: The Basics, Universities Press 2005
7. S. D. Joglekar, Mathematical Physics: Advanced Topics, CRC Press 2007

Name of Course: Electronics -II

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Electronics -II	MPCT204	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To understand and be able to apply the conceptual structure of Analog and Digital Electronics
- To gain skill in problem solving and critical thinking.
- To understand the application of Analog and Digital Electronics in day to day life.

Learning Outcomes

After studying this subject, student will be able to

- Understand physical interpretation of Analog and Digital Electronics.
- Understand the application of Analog and Digital Electronics in computer, Aircraft technology and electronics, Satellites and electronics, Television, Internet technology etc.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Regulated power supply

Concept of Voltage Regulator using discrete components. Types of power supplies :series and shunt regulators, CV,CC, SMPS. Three pin regulators. (IC 78XX/79XX, IC LM 317).

Applications of special function ICs

IC 555: basic operation and pin description ,Applications of IC 555: astable, monostable and bistable multivibrator ,VCO IC 566 and its applications. PLL IC 565 : Block diagram, applications like frequency multiplier, frequency division, frequency synthesizer

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Digital techniques and applications: Review of Basic logic gates and their applications, Karnaugh map(K-map) simplification Techniques for SOP and POS functions up to Four variable , Combinational Circuits: Half adder, full adder, parallel binary adder, half Subtractor , full subtractor, parallel binary subtractor, Binary to Gray and Gray to binary code converters Decoder and Encoder ,Multiplexers and Demultiplexers, Bit error correction: Parity Generators and Checkers. ,BCD to Seven segment

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Sequential circuits: Types of flip-flops: Latch and Flip-flop, S-R flip-flops, D flip flop, J-K flip flop, T Flip Flop, Flip-flops, Registers: Classification of Shift Register, Serial in serial-out, serial-in parallel-out, parallel-in serial-out and parallel-in parallel out. Asynchronous(ripple) 4-bit binary counter 4.3. BCD Counter. 4.4. Synchronous counters 4.5. UP/DOWN counter 4.6. Ring counters.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

D/A Conversion: Weighted resister or Resistive divider, R-2R ladder or Binary ladder network, Specification of D/A converter, A/D Conversion: parallel comparator ,Dual slope type, Counter type, Successive approximation, Memories: Memory organization, Characteristics of memories, Classification of memory , Flash type Semiconductor Memory: RAM-SRAM and DRAM, ROM-PROM, EPROM, EEPROM, Flash memory

Reference Books:

1. Electronic Principles: A. P. Malvino, TMH
2. Power Supplies: B. S. Sonde
3. SMPS, Inverters, Converters: Gottlieb
4. Digital Logic and Computer Design by M. Morris Mano, 4/e, Pearson Education, Chennai
5. Electronics Devices and Circuit by J. B. Gupta, 5/e, S. K. Kataria& Sons-New Delhi
6. Principles of Electronics by V. K. Mehta & Rohit Mehta, 11/e, S. Chand-New Delhi.
7. Op-amps and Linear Integrated Circuits by Ramakant A. Gayakwad, 4/e, Prentice Hall of India-New Delhi

SEMESTER - III

Name of Course: Atomic and Molecular Physics

<table>
<tr><th rowspan="3">Subject Title</th><th rowspan="3">Subject Code</th><th colspan="2">Teaching Scheme Hours per Week</th><th rowspan="3">Total Teaching Hours per semester</th><th colspan="4">Examination Scheme</th><th rowspan="3">Total Marks</th><th rowspan="3">Credit</th></tr>
<tr><th rowspan="2">L</th><th rowspan="2">Pr.</th><th colspan="2">Internal Assessment (IA)</th><th colspan="2">University Exam (UE)</th></tr>
<tr><th>Max. Marks</th><th>Hrs</th><th>Max. Marks</th><th>Hrs.</th></tr>
<tr><td>Atomic and Molecular Physics</td><td>MPCT301</td><td>4</td><td>-</td><td>60</td><td>30</td><td>1.5</td><td>70</td><td>3</td><td>100</td><td>4</td></tr>
</table>

Rationale:

The objective of this course is to study

- Schrödinger equation for One-electron atoms, Two-electron atoms, Many-electron atoms.
- Physics in global warming and ozone ‘hole’ problems.
- Classical view of Einstein coefficients

Learning Outcomes

After studying this subject, student will be able to

- Understand the basic of elementary processes atomic molecular and Laser which are important in many fields e. g. trace analysis, plasma and gas discharge physics, gaseous dielectrics and laser media, and physics of the atmosphere.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Hydrogenic Atom, Two particle systems: Bosons and Fermions, Exchange Forces, Atoms: Helium, Orthohelium (S=1) and Parahelium (S=0), The Periodic Table, Hund's Rule, Hund's First, Second and Third Rule, Illustrative Examples

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Solids: The free electron gas, Fermi Surface and Fermi Energy, Fermi Temperature, Bulk Modulus, Band Structure, Bloch's Theorem.

Fine Structure of Hydrogen: The Relativistic Correction, Spin Orbit Coupling, The Zeeman Effect: Weak Field Zeeman Effect, Strong Field Zeeman Effect (Paschen - Back effect), Intermediate field Zeeman Effect, Hyperfine Splitting, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Interaction of atoms with Electromagnetic Fields:

Two Level Systems, Time dependent perturbation theory, Sinusoidal perturbations, Emission and Absorption of Radiation: Electromagnetic Waves, Absorption, Stimulated Emission and Spontaneous Emission, Incoherent perturbations, Spontaneous Emission: Einstein's A and B Coefficients, The lifetime of an excited state, Selection Rules, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

The Born-Oppenheimer separation for diatomic molecules, The Rotation and Vibration of Diatomic Molecules, Electronic Structure of Diatomic Molecules, Rotational Energy Levels of Diatomic Molecules, Vibrational - Rotational Spectra of Diatomic Molecules, Raman Scattering, Electronic Spectra of Diatomic Molecules, The Frank - Condon Principle, Dissociation and Pre-dissociation, Fluorescence and Phosphorescence.

Text Book:

1. Introduction to Quantum Mechanics, D J Griffiths, Second Edition, Pearson
2. Physics of Atoms and Molecules, B H Bransden and C J Joachin, Second Edition, Pearson

References:

1. G. Aruldhas, Molecular structure and spectroscopy, Prentice Hall of India 2nd ed, 2002
2. R Eisberg and R Resnick, Quantum physics of Atoms, Molecules, Solids, Nuclei and Particles, John Wiley & Sons, 2nd ed,
3. Rajkumar, Atomic and Molecular Physics, Meerut, 2003
4. Gupta and Kumar, Atomic and Molecular Physics, Pragati Prakashan, 2000
5. Wolfgang Demtröder, Atoms, molecules & photons, Springer-Verlag 2006
6. C. N. Banwell, Fundamentals of molecular spectroscopy, Tata McGraw-Hill, 3rd ed

Name of Course: Nuclear and Particle Physics

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Nuclear and Particle Physics	MPCT302	4	-	60	30	1.5	70	3	100	4

Rationale:
A course dealing with one of the major areas of modern Physics which is a desirable part of the background of a Physicist. Applications of many theoretical concepts developed in other courses are discussed. The use of models in Physics is emphasized.

Learning Outcomes:
After learning the course the student will be able to: understand and explain the nucleus and nuclear interactions, Emphasize experimental facts about nuclear processes in discussions of particle accelerators, detectors, radioactivity (alpha, beta, and gamma decay), interaction of radiation with matter, nuclear reactions, nuclear structure, nuclear models, and nuclear applications in science and technology.

Course Content

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Constituents of the Nucleus and Some of Their Properties: Introduction, Rutherford Scattering and estimation of Nuclear size, Measurement of nuclear radius, Constituents of the Nucleus and their properties, Nuclear Spin, Moments and Statistics, Parity.
Alpha Decay: Range of Alpha Particles, Disintegration energies of spontaneous alpha decay, alpha decay paradox-Barrier Penetration, Illustrative Examples

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Beta decay - Continuous beta ray spectrum- difficulties encountered in understanding it, Pauli's Neutrino hypothesis, Fermi theory of beta decay, Fermi - Kurie Plot, Life times of Beta Decay and the Strength of the Interaction Matrix Element, Selection rules for Beta Decay, The detection of Neutrino, Cowan and Reins Experiment, Parity Non - Conservation in Beta Decay.
Gamma Emission: Gamma Ray emission and selection rules, Internal Conversion, Nuclear Isomerism, Illustrative Examples

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Nuclear Models
Liquid drop model: Binding Energies, Weizsacher's SEMF, Mass Parabolas, Stability limits against spontaneous fission, Barrier Penetration, Nucleon Emission,
Shell model: Evidence that led to the shell model, Main assumptions of the single particle shell model, Spin orbit coupling of electron, Spin orbit coupling in Nuclei, The single particle shell model: Parabolic and Square well potential, Predictions of the shell model, The collective model of the Nucleus, Illustrative Examples
Nuclear Energy: Fission, Fusion and Nuclear Reactor.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Elementary Particle Physics

Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons, C, P and T invariance, Application of symmetry arguments to particle reactions, Parity non-conservation in weak interaction, Relativistic kinematics. Illustrative Examples

Text Book:

1. S B Patel, Nuclear Physics: An Introduction, New Age International P Limited, Publishers, 2002.

Reference Books:

1. D. Griffiths, Introduction to Elementary Particles, Harper and Row, New York, 1987
2. Y. R. Waghmare, Introductry Nuclear Physics, Oxford- IBH, Bombay, 1981
3. D C Tayal, Nuclear Physics, Himalaya Publishing House, 1998.
4. A.Bohr and B.R. Mottelson, Nuclear structure, vol. 1 (1969) and vol.2 Benjamin, Reading, A, 1975
5. Kenneth S. Kraine, Introductry Nuclear Physics, Wiley, New york, 1988
6. P.H. Perkins, Introduction to high energy physics, Addison-Wesley, London, 1982.
7. Shirokov Yudin, Nuclear physics vol. 1 & 2 , Mir publisher, Moscow,1982.
8. H. A. Enge, Introduction to Nuclear Physics, Addison-Wesley,1975
9. G.E. Brown and A.D. Jackson, Nucleon – Nucleon interaction, North- Holland, Amsterdam, 1976
10. I. Kaplan, Nuclear Physics, 2nd Ed. ,Narosa, Madras,1989
11. B.L Cohen, concepts of nuclear physics , TMGH, Bombay,1971

Name of Course: Electrodynamics

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Electrodynamics	MPCT303	4	-	60	30	1.5	70	3	100	4

Rationale:
The objective of this course is

- To study and be able to apply the conceptual structure of Electrodynamics.
- To provide an introduction to electrodynamics and a wide range of applications including communications, superconductors, plasmas, novel materials, photonics and astrophysics.

Learning Outcomes
Students completing this subject should be able to

- Explain classical electrodynamics based on Maxwell's equations including its formulation in covariant form;
- Solve problems involving the calculation of fields, the motion of charged particles and the production of electromagnetic waves; and
- Analyze the solution of these problems in the context of a range of applications.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's Law, Maxwell's Equations, Magnetic Charge.
Conservation Laws:
Charge and Energy: The continuity Equation, Poynting's Theorem, Momentum: Newton's third law in Electrodynamics, Maxwell's Stress Tensor, Conservation of Momentum, Angular Momentum, Illustrative Examples.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Electromagnetic Waves:
Waves in One Dimension: The wave equation, Sinusoidal waves, Boundary conditions - Reflection and Transmission, Polarization, Electromagnetic Waves in Vacuum: The wave equation for E and B, Monochromatic Plane Waves, Energy and Momentum in Electromagnetic Waves, Electromagnetic Waves in Matter: Propagation in Linear Media, Reflection and Transmission at Normal Incidence, Reflection and Transmission at Oblique Incidence, Illustrative Examples.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Potentials and Fields:
The Potential Formulation: Scalar and Vector Potentials, Gauge Transformations, Coulomb Gauge and Lorentz Gauge, Continuous Distributions: Retarded Potentials, Jefimenko's Equations, Point Charges: Lienard-Wiechert Potentials, The Fields of a Moving Charge, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Radiation:
Dipole Radiation: What is Radiation?, Electric Dipole Radiation, Magnetic Dipole Radiation, Radiation from an Arbitrary Source, Point Charges: Power Radiated by a point Charge, Radiation Reaction, The Physical Basis of the Radiation Reaction, Illustrative Examples.

Text Book:

1. Introduction to Electrodynamics by David J Griffiths, 3rd edition, Prentice Hall, India

Reference Books:

1. Classical Electrodynamics by J D Jackson , 4nd edition 2005, John Wiley & sons.
2. Classical Electrodynamics by W Greiner, Springer Verlag 2000, New York.

Name of Course: Astronomy and Astrophysics - I (Elective-I)

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Astronomy and Astrophysics - I	MPET304A	4	-	60	30	1.5	70	3	100	4

Rationale:

The main objective of this course is to teach the fundamentals of Astronomy, earth, sun, moon and other planets of the solar system, Instruments used in space measurements.

Learning Outcomes:

After learning the course the student will be able to understand the solar system, sun and the activity on the surface of the sun, its effect on the earth's environment, observational instruments and techniques related to space and astrophysics.

Course Content:

Unit: 1 (Lecture Hours: 15/ Weightage : 25%)

The Geometry of the sphere: Introduction, Spherical geometry, Position on the earth's surface, Spherical trigonometry, other formulae of Spherical trigonometry, The small spherical triangle, Solid angle

The celestial Sphere- Co-ordinate systems: Introduction, The horizontal system, The equatorial system, Southern hemisphere celestial spheres, Circumpolar stars, The measurement of latitude and declination, the geometric celestial sphere, Transformation of one Co-ordinate system into another, Right Ascension, The Sun's geometric behavior, Sunset and Sunrise, Megalithic Man and the Sun, Sidereal Time, The ecliptic system of Co-ordinate, Galactic Co-ordinates

The celestial sphere- Timekeeping systems: Introduction, Sidereal time, Mean solar time, Relationship between mean solar time and sidereal time, The civil day, The Greenwich date and zone time, The tropical year and the calendar, The Julian date, Ephemeris time, The Earth's geographical zones, The seasons, Twilight

Reference: Astronomy Principles and Practice, A E Roy and D Clarke, 4th Edition, Institute of Physics Publishing

Unit: 2 (Lecture Hours: 15/Weightage: 25%)

Optics for astronomy: Principles of geometric optics, Lenses, mirrors and simple optical elements, Simple telescopes, Image quality: telescopic resolution, Aberrations

Astronomical telescopes: Telescope mounts and drives, Reflecting telescope optics, Telescopes in space, Ground based telescopes, Adaptive optics, The next stage: ELTs (Extra Large Telescopes) and advanced AO (Adaptive Optics)

Reference: To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Celestial Mechanics: Elliptical orbits, Newton mechanics, Equations of motion, Solution of the equation of the motion, Equation of the orbit and Kepler's first law, Orbital elements, Kepler's second law and third law, Kepler's laws derived, Systems of several bodies, Orbit determination, Position of the orbit, Escape velocity, The Virial theorem, The Jeans limit

References:

1. *An Introduction to Modern Astrophysics, B W Carroll and D A Ostile, 2nd Edition, Pearson International Edition.*
2. *Fundamental Astronomy, H Kartunen, P Kroger, H Oja, M Poutanen, K J Donner, 5th Edition, Springer.*

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Solar system: Planetary configurations, Orbit of the Earth and visibility of the Sun, The orbit of the Moon, Eclipses and Occultations, The structure and surfaces of the planets, Atmospheres and magnetospheres, Albedos, Photometry, Polarimetry and Spectroscopy, Thermal radiation of the planets, Mercury, Venus, The Earth and the Moon, Mars, Jupiter, Saturn, Uranus and Neptune, minor bodies of the solar system, Origin of the Solar system

Reference: Fundamental Astronomy, H Kartunen, P Kroger, H Oja, M Poutanen, K J Donner, 5th Edition, Springer.

Text books:

1. An Introduction to Modern Astrophysics, B W Carroll and D A Ostile, 2nd Edition, Pearson International Edition.
2. Fundamental Astronomy, H Kartunen, P Kroger, H Oja, M Poutanen, K J Donner, 5th Edition, Springer.
3. To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press
4. Astronomy Methods: A Physical Approach to Astronomical Observations, Hale Bradt, 1st Edition, Cambridge University Press
5. Astronomy Principles and Practice, A E Roy and D Clarke, 4th Edition, Institute of Physics Publishing

References

1. Bhatnagar and Livingston: Fundamentals of Solar Astronomy
2. Markus Aschwanden: Physics of the Solar Corona
3. Michael Stix: The Sun: An Introduction
4. W.M.Smart: Text book of Spherical Astronomy.
5. A.E.Roy: Orbital Motion.
6. K.D.Abhyankar: Astrophysics:Stars and Galaxies.Tata McGraw Hill Publication (Chap.2)
7. G.Abell: Exploration of the Universe.
8. Baidyanath Basu: Introduction to Astrophysics.
9. M.Schwarzschild: Stellar Evolution
10. R.Bowers and T.Deeming:Astrophysics (John and Barlett.Boston).
11. A.Unsold: The New Cosmos (3rd Edition). Springer-Verlag 1983.
12. L.Spitzer: Physical Processes in the Interstellar Medium. John Wiley 1978.
13. Bowers and Deeming: Astrophysics Vols.1 and 2.
14. J.A.Ratcliffe: An Introduction to the Ionosphere and Magnetosphere.
15. Kaula. W.M.: An Intoduction to Planetary Physics.
16. Harold Zirin: Astrophysics of the Sun.
17. W.N.Hess and G.Mead(Ed): Introduction to Space Science.

18. Sagan C. Owen T. C. and Smith. H.J.: Planetary Atmospheres.
19. Kaufmann, W.J. : Exploration of the Solar System.
20. C.R.Kitchin: Astrophysical Techniques.
21. W.A.Hiltner (Ed): Astronomical Techniques.
22. Carleton: Methods of Experimental Physics. Vol.XIIA.

Name of Course: Applied Electronics-I (Elective-I)

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Applied Electronics-I	MPET304B	4	-	60	30	1.5	70	3	100	4

Rationale:
The objective of this course is

- To study and be able to apply the conceptual structure of Microprocessors and Microcontroller.
- To gain skill in problem solving and critical thinking.
- To study the application of Microprocessors and Microcontroller in day to day communication.

Learning Outcomes
After studying this subject, student will be able to

- Understand physical interpretation of Microprocessors and Microcontroller.
- Understand the application of Microprocessors and Microcontroller in computer, Aircraft technology and electronics, Satellites and electronics, Television, Internet technology etc.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**
Microprocessor and types of microprocessor,Pin diagram of 8085 microprocessor, Microprocessor operations, 8085 Microprocessor architecture diagram with its functions, Register set of 8085 ,Flag Classification ,Interrupt types and serial I/O, Bus organisation: Address & Data bus and control bus and demultilexing of buses, Instructions: Data transfer, Arithmetic, Logical, Branch, Stack and I/O read and write cycle.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**
Type of addressing mode of 8085, T-state, Machine Cycle, Instruction cycle, Timing diagram, Timing Delays, Addition and subtraction programmers ,Multiplication and division programmers, Looping, Counting and Indexing. Logic operations viz. AND, OR, NOR, NAND NOT, EXOR, Counter and Timing delays. Stack and subroutines. Memory and I/O mapping, Chip selection and decoder interfacing, Interfacing to EPROM and R/W Memory.

Unit:3 **(Lecture Hours: 15/Weightage: 25%)**
Difference between microprocessor and microcontroller ,Block diagram of microcontroller : CPU, input device, output device, memory and buses, common features of Microcontrollers , Evolution,Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports, Functions of each pin of 8051, Clock circuit, reset Circuit , phase and state in machine cycle of 8051, Memory organization of 8051: Program and Data memory Map, External Memory Addressing

and Decoding Logic of 8051, Stack, Stack Pointer and Stack operation, Timers/Counters logic diagram and its operation in various modes, I/O Ports structure: Port 0, Port 1, Port2, Port 3., Serial Communication in various modes, Interrupt structure, vector address, priority and operation, Modes of operation: Power down and idle mode

Unit:4 **(Lecture Hours: 15/Weightage: 25%)**

Addressing Modes : Immediate, Register, Direct, Indirect, Indexed, Relative and bit addressing, Instruction set :Data Transfer, Arithmetic, Logical, Branching, and Machine Control, Looping , Counting, sorting and Indexing, Data manipulation, Masking , Stack operation, Conditional programming, Configuration and programming of Timer/Counter using SFRs: TMOD, TCON, THx, TLx, Configuration and programming of interrupts using SFRs: IE,IP, Configuration and programming of I/O Port : P0,P1,P2,P3, Application of microcontroller in various field

Reference Books:

1. Microprocessors Architecture, programming and applications with 8085/8080 a Second edition (up dated) 1995. by Ramesh S. Gaonkar, (wiley Eastern Limited).
2. Microprocessors and Microcontrollers by B.Ram, Dhanpatrai and Sons.
3. Microprocessors and Microcontrollers by Krishna Kant, PHI
4. The 8051 Microcontroller – Architecture Programming & Application by K. J. Ayala (Penram Internation)

SEMESTER - IV

Name of Course: Statistical Mechanics

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Statistical Mechanics	MPCT401	4	-	60	30	1.5	70	3	100	4

Rationale

The aim of the course is to teach the theoretical basis of Statistical Physics and to show how it provides the crucial link between the microscopic quantum world and the behavior of macroscopic material which is amenable to experiment. Concepts and methods appropriate for the description of systems containing very many distinguishable or indistinguishable particles will be presented and the distinction of dealing with systems of closely or widely-spaced quantum levels.

Learning Outcomes

By the end of the course successful students are expected to be able to:

Utilize the terms and basic methods of Statistical Physics, Derive expressions for the variation of various properties of macroscopic amounts of material, appreciate the different statistics arising from distinguishable and indistinguishable particles and relate these to the behavior of solids and gases, Calculate and manipulate Partition Functions and to derive Thermodynamic state functions analytically in some specific cases, Analyze the distinction between Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann statistics, and the origin of these differences.

Summarize non-classical behaviors such as Electron Degeneracy pressure and Bose-Einstein Condensation.

Course Content

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Review of the Laws of Thermodynamics, Radiation: Blackbody Radiation, Plank's Distribution Law. Phase Space, Ensembles, Liouvilles Theorem, Postulates of equal propri probabilities, micro and macro states, Sterling's approximation, Classical Maxwell Boltzmann distribution law, Principle of equipartition of energy, relation between partition function and thermodynamic quantities. Illustrative Examples

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Microcannonical ensemble, Perfect gas in microcanonical ensemble, Gibbs Paradox, Cannonical Ensemble, Cannonical ensemble as an approximation to microcannonical ensemble, Perfect monoatomic gas in cannonical ensemble, Grand Cannonical Ensemble, Comparison of ensembles, Maxwells Distribution from cannonical distribution, Equapartition theorem, Virial Theorem, Partition functions. Illustrative Examples

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Quantum Statistics: Introduction to quantum statistics with an overview of classical statistical mechanics, Density operator, density matrix, Postulates on the form of density matrix. Illustrative Examples

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Ideal Bose Systems: Thermodynamic behavior of an ideal Bose Gas, Bose Einstein Condensation, Thermodynamics of Black Body Radiation, Liquid Helium.

Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi Gas, Degeneracy, Compressibility of Fermi Gas, Concept of Fermi Energy. Illustrative Examples.

Text Book:

1. Statistical Mechanics by Gupta and Kumar

References:

1. Statistical Mechanics, R K Pathria & Paul D. Beale
2. Statistical and Thermal Physics, F Reif
3. Statistical Mechanics, K Huang
4. Statistical Mechanics, R. Kubo
5. Statistical Physics, Landau and Lifshitz

Name of Course: Plasma Physics

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Plasma Physics	MPCT402	4	-	60	30	1.5	70	3	100	4

Rationale:

The objective of this course is

- To study and be able to apply the conceptual structure of Plasma Physics.
- To provide an introduction to plasma physics and its applications in industrial and astrophysical phenomena.
- To study Kinetic theory of plasma.

Learning Outcomes

Students completing this subject should be able to

- Analyze the solution of these problems in the context of a range of applications.
- Understand the peculiar physical characteristics of the plasma, produced by different ionization systems.

Course Content:

Unit: 1 (Lecture Hours: 15/Weightage: 25%)

Introduction, Occurrence of Plasmas in nature, Definition of Plasma, Concept of Temperature, Debye Shielding, The Plasma Parameter, Criteria for Plasmas, Applications of Plasma Physics, Uniform E and B Fields: E = 0, Finite E, Gravitational Fields, Illustrative Examples.

Unit: 2 (Lecture Hours: 15/Weightage: 25%)

Introduction, Non Uniform B Field: Grad B Drift, Curvature Drift, Magnetic Mirrors, Non Unifom E Field, Time varying E Field, Time Varying B Field, Summary of Guiding Center Drifts, Adiabatic Invariants: First Adiabatic invariant (μ), Second Adiabatic Invariant (J), Third Adiabatic Invariant (ϕ),Illustrative Examples

Unit: 3 (Lecture Hours: 15/Weightage: 25%)

Relation of Plasma physics to ordinary Electromagnetics: Maxwell's Equations, Classical Treatment of Magnetic Materials, Classical Treatment of Dielectrics, The dielectric constant of plasma, The fluid equation of motion: The convective derivative, The stress tensor, Collisions, Comparison with ordinary Hydrodynamics, Equation of Continuity, Equation of State, The Complete set of Fluid Equations, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Fluid Drifts perpendicular to B, Fluid Drifts parallel to B, The Plasma Approximation, Representation of Waves, Group Velocity, Plasma Oscillations, Electron Plasma Waves, Sound Waves, Ion Waves, Validity of the Plasma Approximation, Comparison of ion and electron waves, Illustrative Examples.

Text Book:

1. Introduction to Plasma Physics by F. F. Chen, 2nd edition, Springer.

Reference Books:

1. Fundamentals of Plasma Physics by Bittencourt, 3rd edition, Springer.
2. Introduction to Plasma Physics, B M Smirnov, 1st Edition 2017, Manakin Press
3. Text Book of Plasma Physics, Suresh Chandra, CBS PUBLISHERS & DISTRIBUTORS-NEW DELHI, 2010

Name of Course: Statistical Methods

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Statistical Methods	MPCT403	4	-	60	30	1.5	70	3	100	4

Rationale:
The quantum of data available today in the field of research, it is very essential for the students to learn how to deal with large amount of data. At the same time, understanding and interpreting large samples of data reveal wonderful mysteries of the world around us.

Learning Outcomes
The student will be able to understand different quantities and their relations.
They will be able to interpret various types of graphs used in the process of research.

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**
Introduction to Scientific Data Analysis:
Histogram, Relationships and X-Y Graphs, Key Numbers Summarize Experimental Data: The Mean and the Median, Variance and Standard Deviation, Population and Sample, Population Parameters, True Value and Population Mean, Sample Statistics, Which Standard Deviation do we use?, Approximating Standard Deviation, Illustrative Examples.

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**
Data Distributions:
Probability, Probability Distributions, The Normal Distribution, The Central Limit Theorem, Standard Error of the Sample Mean, The ***t*** - Distribution, The log - normal distribution, Population Mean and Continuous Distributions, Population Mean and Expectation Value, The Binomial Distribution, Normal Distribution as an Approximation to Binomial Distribution, The Poisson Distribution, Normal Distribution as an Approximation to Poisson Distribution, Illustrative Examples

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**
Measurement, Error and Uncertainty:
The Process of Measurement, True Value and Error, Precision and Accuracy, Random and Systematic Errors, Random Errors: Common Sources of Error, Resolution Error, Parallax Error, Reaction Time Error, Systematic Error: Calibration Errors, Offset and Gain Errors, Loading Errors, Dynamic Effects, Zero Order System, First Order System, Uncertainty in Measurement, Illustrative Examples.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**
Least Squares:
The equation of a straight line, The best straight line through X-Y data, Least Squares, Uncertainty in ***a*** and ***b,*** Least Squares, Intermediate calculations and significant figures, Using the line of best fit, Linear correlation coefficient ***(r)***, Significance of ***(r),*** Residuals, Data Rejection, Illustrative Examples.

Text Book:

1. Data Analysis for Physical Scientists, Les Kirkup, 2nd Edition, Cambridge, 2012

Reference Books:

1. Statistical Methods in Practice: for Scientists and Technologists, R Boddy, G Smith, Wiley, 2009
2. Fundamentals of Statistics, S C Gupta, 7th Edition, Himalaya Publishing House.
3. Fundamentals of Statistics, Michael Sullivan, 4th Edition, Pearson, 2012.

Name of Course: Astronomy and Astrophysics - II (Elective - II)

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Astronomy and Astrophysics - II	MPET404A	4	-	60	30	1.5	70	3	100	4

Rationale:

The main objective of this course is to teach the fundamentals of Astronomy, earth, sun, moon and other planets of the solar system, Instruments used in space measurements.

Learning Outcomes:

After learning the course the student will be able to understand the solar system, sun and the activity on the surface of the sun, its effect on the earth's environment, observational instruments and techniques related to space and astrophysics.

Course Content:

Unit: 1 (Lecture Hours: 15/ Weightage : 25%)

Detectors: Detector characterization: Detection Modes, Efficiency and Yield, Noise, Spectral Response and Discrimination, Linearity, Stability, Response Time, Dynamic Range, Physical Size and Pixel Number, Image degradation.

The CCD: General Operation, Channel Stops, Blooming, Full well and Gain, Readout time, read noise and bias, Dark current, cooling, and vacuum enclosures, charge transfer efficiency, The buried channel CCD, Alternative CCD readout designs, The MPP CCD, Surface Issues

Photo-emissive devices: The Photomultiplier Tube, The micro channel plate, Image intensifiers and the ICCD, Infrared arrays, Thermal detectors, Gamma-ray instruments

References:

1. *To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press*
2. *Astronomy Methods: A Physical Approach to Astronomical Observations, Hale Bradt, 1st Edition, Cambridge University Press*

Unit: 2 (Lecture Hours: 15/Weightage: 25%)

Light and concepts: Stellar parallax, Intensity, flux density and luminosity, The magnitude scale, Extinction and optical thickness, Blackbody radiation, The quantization of energy, Temperatures, The color index, Radiative transfer

The Classification of Stellar Spectra:

The formation of Spectral line, The Spectral Types of Stars, The Maxwell Boltzmann Velocity Distribution, The Boltzmann Equation, The Saha Equation

The Hertzsprung - Russell Diagram

References:

1. *To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press*
2. *Astronomy Methods: A Physical Approach to Astronomical Observations, Hale Bradt, 1st Edition, Cambridge University Press*

Unit: 3 (Lecture Hours: 15/Weightage: 25%)

Stellar Evolution: Evolutionary time scales, The contraction of stars towards the main sequence, The main sequence phase, The giant phase, The final stages of evolution, The evolution of close binary stars, Comparison with observations, The origin of the elements.

Stellar Structure: Internal equilibrium conditions, Physical state of the gas, Stellar energy resources, Stellar models: Gas Pressure and Radiation Pressure, The pressure of a Degenerate Gas, Relativistic Gas, Non-relativistic Gas.

Variable Stars: Classification, **Pulsating variables:** Cephieds, W Virgins Stars, RR Lyrae Stars, Mira Variables, Other Pulsating Variables, **Eruptive variables:** Flare Stars, Nebular Variables, Novae, Supernovae

References:

1. *To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press*
2. *Astronomy Methods: A Physical Approach to Astronomical Observations, Hale Bradt, 1st Edition, Cambridge University Press*

Unit: 4 (Lecture Hours: 15/Weightage: 25%)

The Sun: The Solar Interior: The Core, The Radiative Zone, The Convective Zone, The Solar Neutrino Problem, **The Solar Atmosphere**: The Photosphere, Granulation, Differential Rotation, The Chromosphere, The Transition Region, The Corona, Coronal Holes and The Solar Wind, The Parker wind Model, The Hydrodynamic Nature of the Upper Solar Atmosphere, Magnetohydrodynamics and Alfven Waves, The Outer Atmoshpere of Other Stars, **The Solar Cycle:** Sunspots, Plages, Solar Flares, Solar Prominences, Coronal Mass Ejections, The time dependent shape of the Corona, The Magnetic Dynamo Theory, Evidence of Magnetic Activity in Other Stars.

Reference: To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press

Text books:

1. An Introduction to Modern Astrophysics, B W Carroll and D A Ostile, 2nd Edition, Pearson International Edition.
2. Fundamental Astronomy, H Kartunen, P Kroger, H Oja, M Poutanen, K J Donner, 5th Edition, Springer.
3. To Measure the Sky: An Introduction to Observational Astronomy, F R Chromey, 1st Edition, Cambridge University Press
4. Astronomy Methods: A Physical Approach to Astronomical Observations, Hale Bradt, 1st Edition, Cambridge University Press
5. Astronomy Principles and Practice, A E Roy and D Clarke, 4th Edition, Institute of Physics Publishing

References

1. Bhatnagar and Livingston: Fundamentals of Solar Astronomy
2. Markus Aschwanden: Physics of the Solar Corona
3. Michael Stix: The Sun: An Introduction
4. W.M.Smart: Text book of Spherical Astronomy.

5. A.E.Roy: Orbital Motion.
6. K.D.Abhyankar: Astrophysics:Stars and Galaxies.Tata McGraw Hill Publication (Chap.2)
7. G.Abell: Exploration of the Universe.
8. Baidyanath Basu: Introduction to Astrophysics.
9. M.Schwarzschild: Stellar Evolution
10. R.Bowers and T.Deeming:Astrophysics (John and Barlett.Boston).
11. A.Unsold: The New Cosmos (3rd Edition). Springer-Verlag 1983.
12. L.Spitzer: Physical Processes in the Interstellar Medium. John Wiley 1978.
13. Bowers and Deeming: Astrophysics Vols.1 and 2.
14. J.A.Ratcliffe: An Introduction to the Ionosphere and Magnetosphere.
15. Kaula. W.M.: An Intoduction to Planetary Physics.
16. Harold Zirin: Astrophysics of the Sun.
17. W.N.Hess and G.Mead(Ed): Introduction to Space Science.
18. Sagan C. Owen T. C. and Smith. H.J.: Planetary Atmospheres.
19. Kaufmann, W.J. : Exploration of the Solar System.
20. C.R.Kitchin: Astrophysical Techniques.
21. W.A.Hiltner (Ed): Astronomical Techniques.
22. Carleton: Methods of Experimental Physics. Vol.XIIA.

Name of Course: Applied Electronics-II (Elective-II)

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme				Total Marks	Credit
					Internal Assessment (IA)		University Exam (UE)			
		L	Pr.		Max. Marks	Hrs	Max. Marks	Hrs.		
Applied Electronics-II	MPET404B	4	-	60	30	1.5	70	3	100	4

Rationale

The knowledge of microwave devices is essential for M. Sc Physics students and they need to assimilate it in order to maintain Microwave devices used in Telecommunication Industry. Hence, the basic knowledge of microwave signal generation, propagation, amplification and measurement is vital. The course has been designed looking at the current demands of electronics in the industry.

Learning Outcomes

After learning the course the students should be able to:

1 Understand basic concepts and applications of microwave systems.
2 Design, analyze and solve problems related to microwave transmission lines.
3 Design, analyze and solve problems related to microwave waveguide.
4 Analyze, test and use various passive microwave components for different applications.
5 Design and implement the microwave layouts.
6 Design and implement the microwave amplifier, oscillator, and mixer circuits

Course Content:

Unit: 1 **(Lecture Hours: 15/Weightage: 25%)**

Microwaves: frequency band, EM waves, General applications of microwaves, Transmission lines: Parameters, general line equation, lossless line, $\lambda/4$ line, standing waves , VSWR, reflection coefficient ,stub matching (single and double) ,Waveguides: Wave propagation through guided medium, reflections of waves Rectangular waveguide : structure , cut off wavelength , group and phase velocities, characteristic wave impedance , TE ,TM modes , field patterns , examples, S Parameters basics Circular waveguide: structure, cut off wavelength, modes, examples, comparison with rectangular waveguide

Unit: 2 **(Lecture Hours: 15/Weightage: 25%)**

Passive and Active microwave Devices: Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Wave-guide Corners, Bends, Twists, Attenuator, Circulator, Isolator and Resonator. Microwave Active components: Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers, Microwave Transistors, Microwave oscillators and Mixers. Microwave tubes: Klystron, TWT, Magnetron.

Unit: 3 **(Lecture Hours: 15/Weightage: 25%)**

Microwave Measurements Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure, Measurement of Microwave antenna parameters.

Unit: 4 **(Lecture Hours: 15/Weightage: 25%)**

Radio wave propagation : Modes of propagation, Ground Wave Propagation, Structure of troposphere and ionosphere, Characteristic of Ionospheric layers, Sky wave propagation, Definitions for Virtual height, MUF and Skip distance, OWF, Fading, ionospheric absorptions, Multi-hop propagation, Space wave propagation and Super refraction.

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Reference Books:

1. Samuel Liao - Microwave devices and circuits, PHI
2. Dennis Roddy - Microwave Technology, PHI
3. G. Kennedy - Electronic Communication systems, McGraw-Hill Book Company
4. Annapurna Das, Sisir K.Das- Microwave engineering, (TMG)
5. Siteshkumar Roy & Manojit Mitra - Microwave semiconductor devices, PHI
6. A. K. Gautam - Microwave engineering, (S. K. Kataria pub)
7. Sanjeev Gupta, Microwave Engineering, Khanna Pub.

Practical / Project Exam Assessment Scheme (Semester – I to IV)

Name of Course: Practical – I , II, III and IV

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme University Exam (UE)		Total Marks	Credit
		L	Pr.		Max. Marks	Hrs		
Practical – I	MPCT105	-	9	135	100	6	100	4
Practical – II	MPCT205	-	9	135	100	6	100	4
Practical – III	MPCT305	-	9	135	100	6	100	5
Practical – IV	MPCT405	-	9	135	100	6	100	5

Note: 1. Lab Duration: 3 Hrs. x 3 days per week = 9 Hrs/week
2. University Exam: 2 Practical Exam of 3 hrs. Duration each.

Name of Course: Project– I, II, III and IV

Subject Title	Subject Code	Teaching Scheme Hours per Week		Total Teaching Hours per semester	Examination Scheme University Exam (UE)		Total Marks	Credit
		L	Pr.		Max. Marks	Hrs		
Project– I	MPCT106	-	9	135	100	1	100	4
Project– II	MPCT206	-	9	135	100	1	100	4
Project– III	MPCT306	-	9	135	100	1	100	5
Project– IV	MPCT406	-	9	135	100	1	100	5

Note: 1. Project duration: 3 Hrs. x 3 days/week = 9 Hrs/week
2. University Exam Duration: 1 Hour (Presentation by Student, Demonstration of Project)

Semester - I
List of Experiments

Sr.	Experiment Name
1	Draw Lissajous Figures for different phase differences and of equal amplitude.
2	Harmonic Oscillator and An- Harmonic Oscillator (a) To study the variation of amplitude with the time period for simple Harmonic oscillator and An-Harmonic oscillator. (b) To study the variation of potential energy with displacement for simple Harmonic oscillator and An-Harmonic oscillator.
3	Study of the hysteresis loop for a given ferromagnetic material on a CRO using a solenoid.
4	Hall Effect (a) Measure the magnetic field by Gauss and Tesla meter. (b) Find the poles of an electromagnet with the help of hall probe and Gauss meter. (c) Measurement of Hall voltage. (d) Calculate the charge carrier concentration n (density), Hall coefficient R_H, mobility of charge carrier (μ)
5	Determination of Resistivity & Band Gap of Semiconductors by Four Probes Method at different temperatures.
6	Measure the Dielectric Constant of a given material using Dielectric constant measurement kit.
7	Applications of PN junction Diodes Clipper circuit and Clamper circuit Characteristics of opto electronics devices Characteristics of photo-transistor Characteristics of LDR
8	Input and output characteristics of CE, CB and CC configuration.
9	Power amplifier Class -B push pull power amplifier Class -A power amplifier Tuned amplifier
10	I-V Characteristics of JFET
11	I-V Characteristics of MOSFET
12	Op-amp Op-amp as inverting amplifier & non- inverting amplifier Op-amp as integrator & Differentiator Op-amp as summing amplifier Schmitt trigger using OPAMP

Note: New experiments can be introduced AND/OR replaced as per the need by the permission of the Head/Principal of Institute

Semester - II
List of Experiments

Sr.	Experiment Name
1	Fourier Analysis of Wave forms.
2	Experimental study of the modulus of rigidity and internal friction in metals with temperature.
3	Hall Effect (a) Measure Hall voltage as a function of probe current at constant magnetic field. (b) Measure Hall Voltage as a function of magnetic field at constant Hall probe current. (c) Study of the dependence of Hall coefficient on Temperature.
4	Measurement of Susceptibility of magnetic materials using Quinck's Tube Method.
5	Determination of the wave length of the light of the helium-neon laser by means of Michelson interferometer.
6	Determine the value of e/m using Thomson Method.
7	To design and develop voltage regulator using 78xx and 79xx and measure the dropout voltage for the given voltage regulator.
8	To design and develop Zener diode as voltage regulator
9	Design Monostable multivibrator using IC 555 for Vcc =12v and pulse width of 1ms.
10	Design Astable multivibrator for an output frequency of 5Khz and duty cycle 40%
11	Combinational Circuits Adder (Half and Full). Subtractor (Half and Full). Decoder and encoder. Multiplexer and De multiplexer
12	Sequential Circuits RS and JK Flip-flop Shift Registers Counters
13	Analog to Digital and Digital to Analog Converter

Note: New experiments can be introduced AND/OR replaced as per the need by the permission of the Head/Principal of Institute

Semester - III
List of Experiments

Sr.	Experiment Name
1	To determination Wavelength of Sodium Light using Michelson's Interferometer
2	An optical method for determine dielectric constant, dipole moment and polarizability of a polar liquid by Hollow Prism.
3	Dissociation Energy of Iodine Molecule (I_2) using Spectrometer
4	To determine the absorption coefficient of Aluminium for radioactive source using G M Counter
5	To study the angular dependence of radiation for a given radioactive source using G M Counter
6	Simulation of radioactive decay
7	Study of Edser - Butler Plate (Determination of unknown wavelength and air gap)
8	Measurement of Refractive Index of Liquids using Laser
9	Determination of particle size of lycopodium particles by laser diffraction method
10	Energy resolution of NaI detector and understanding of its Pulse processing electronics
11	Peak to total ratio and efficiency of NaI detector
12	Sum peak analysis and detector size effect on peak to total ratio using NaI detector
13	Angular correlation ratio using NaI detector
14	Design and Study Regulated power supply using IC LM 317 voltage regulator IC
15	Design and Study Regulated dual power supply using IC LM 317 & 1C LM 337 voltage regulator ICs
16	Design and Study Constant current supply using IC 741 and LM 317
17	16 channel digital multiplexer
18	8085 Microprocessor kit and simulator introduction
19	Develop/Execute a simple program to move data from one register to the other using 8085 Microprocessor kit
20	Develop/Execute program immediate data between different registers using 8085 Microprocessor kit
21	Develop/Execute a program for addition and Subtraction using 8085 Microprocessor kit
22	Develop/Execute a program for multiplication and division using 8085 Microprocessor kit
23	Square Wave Generation using 8085 Microprocessor kit

Note:

1. The students must perform a Minimum of 6 and a Maximum of 12 Experiments from the above list of Experiments
2. New experiments can be introduced AND/OR replaced as per the need by the permission of the Head/Principal of Institute

Semester - IV
List of Experiments

Sr.	Experiment Name
1	Zeeman Effect using Fabry - Perot etalon / Lummer — Gehrecke plate
2	Ultrasonic Interferometry - Velocity measurements in different Fluids
3	Double slit - Fraunhofer diffraction (missing order etc.)
4	Determination of Young’s modulus of metal rod by interference method
5	To determine the Wavelength and the Velocity of Ultrasonic Waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the Diffraction of light through an Ultrasonic Grating
6	Febry Perot Interferometer
7	h/e by vacuum photocell
	Scientific Data Analysis Using computational Technique
8	• A detailed overview on how to plot different types of graph of data generated from experiments done in the Physics Laboratory by the Students
9	• Plotting Graphs and analyzing them using Scientific/ Experimental data
10	• Introduction to Curve fitting
11	• Use of statistical and trigonometric functions
12	• Solving Problems in Physics (Use of Descriptive Statistics Tools)
13	• Plotting Histograms from the given data and interpreting them
14	• Data Distribution Functions (Normal Distribution, T-Distribution, Binomial Distribution, The Poisson Distribution…) for Scientific Data Analysis and Interpretation
15	Study of 8 bit DAC
16	To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode
17	Temperature dependence of avalanche and Zener breakdown diodes
18	Waveform Generator using ICs (OP-AMP)
19	Temperature on - off controller using IC (OP-AMP)
20	To study about various microwave components, Gunn power supply and VSWR meter
21	To obtain V-I characteristics of Gunn diode
22	To set the microwave bench for optimum operation
23	Measure the voltage maxima and minima on slotted waveguide and calculate (1) cut-off, guide and free space wavelength (2) phase velocity and group velocity
24	To Measure attenuation of fixed attenuator To Measure attenuation of variable attenuator
25	Mode Characteristics of Klystron
26	Guide Wavelength of Klystron Amplifier
27	Dielectric Constant of Teflon using Microwave Bench Setup
28	Measurement of Microwave antenna parameters (Demonstration ONLY)

Note:

1. The students must perform a Minimum of 6 and a Maximum of 12 Experiments from the above list of Experiments
2. New experiments can be introduced AND/OR replaced as per the need by the permission of the Head/Principal of Institute

<u>**Structure of the Paper in End Semester Examination**</u>

KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR
M.Sc. Physics Semester-1/2/3/4 (New Course: CBCS) April/October-20XX

Subject Code:	**Subject Name:**	
Date:	**Time:**	**Total Marks: 70**

Instructions: 1. Use of Scientific calculator is permitted.
2. Indicate **clearly**, the options along with respective question number
3. Attempt all the questions as per the options provided

SECTION – A (35 Marks)

Q1. Answer All Questions. Each Question Carries 1 Mark (10 x 1 = 10 Marks)
(MCQ, Definitions, Fill in the Blanks, True or False type questions can be asked from Unit-1 & Unit-2).

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Q2. Answer all questions. Each question carries 5 Marks (2 x 5 = 10 Marks) from Unit-1 & Unit-2

A. 5 Mark Question
OR
A. 5 Mark Question
B. 5 Mark Question
OR
B. 5 Mark Question

Q3. Answer any 5 Questions. Each question carries 3 Marks (5 x 3 = 15 Marks) from Unit-1 & Unit-2)

1.
2.
3.
4.
5.
6.
7.
8.

SECTION – B (35 Marks)

Q4. Answer All Questions. Each Question Carries 1 Mark (10 x 1 = 10 Marks)
(MCQ, Definitions, Fill in the Blanks, True or False type questions may be asked from unit-3 and unit-4.)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Q5. Answer all questions. Each question carries 5 Marks (2 x 5 = 10 Marks) from Unit-3 & Unit-4

A. 5 Mark Question

OR

A. 5 Mark Question

B. 5 Mark Question

OR

B. 5 Mark Question

Q6. Answer any 5 Questions. Each question carries 3 Marks (5 x 3 = 15 Marks) from Unit-3 & Unit-4)

1.
2.
3.
4.
5.
6.
7.
8.

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