KANNUR UNIVERSITY

(Abstract)

M.Sc Physics Programme -Revised Scheme, Syllabus and Model Question Papers - Core/Elective Courses under Credit Based Semester System-Affiliated Colleges -Implemented with effect from 2014 Admission - Orders issued.

ACADEMIC BRANCH

U.O No. Acad/C4/6689/2014 Dated, Civil Station (PO), 15-07-2014

Read: 1. U.O.No.Acad/C1/11460/2013 dated 12/03/2014.
2. Minutes of the meeting of the Board of Studies in Physics (P G) held on 08-05-2014.
3. Minutes of the meeting of the Faculty of Science held on 25-03-2014.
4. Letter dated 30-05-2014 from the Chairman, Board of Studies in Physics (P G).

ORDER

1. The Revised Regulations for Credit Based Semester System have been implemented in this University with effect from 2014 admission vide paper read (1) above.

2. The Board of Studies in Physics (P G), vide paper read (2)above, has finalized the Scheme, Syllabus and Model Question Papers for M.Sc Physics under Credit Based Semester System with effect from 2014 admission.

3. As per the paper read (3) above, the meeting of Faculty of Science approved the Scheme, Syllabus and Model Question Papers for M.Sc Physics w.e.f.2014 admission.

4. The Chairman, Board of Studies in Physics (P G) vide paper (4) above, has forwarded the Scheme, Syllabus and Model Question Papers for M.Sc Physics for implementation with effect from 2014 admission.

5. The Vice Chancellor after considering the matter in detail and in exercise of the powers of Academic Council conferred under section 11 (1) of Kannur University Act 1996 and all other enabling provisions read together with has accorded sanction to implement Scheme, Syllabus and Pattern of Question Papers (Core/Elective Courses) for M.Sc Physics Programme under Credit Based Semester System with effect from 2014 admission subject to report Academic Council.

6. The Implemented Scheme, Syllabus and Model Question Papers are appended.

7. Orders are, therefore, issued accordingly.

Sd/-
DEPUTY REGISTRAR (ACADEMIC)

For REGISTRAR

To

The Principals of Colleges offering M.Sc Physics Programme.

(PTO)

Copy to:

1. The Examination Branch (through PA to CE).
2. The Chairman BOS in Physics (P G).
3. PS to VC/PA to R/PA to CE
4. DR/AR 1 (Acad).
5. SF/DF/FC.

Forwarded /By Order

SECTION OFFICER

KANNUR UNIVERSITY KANNUR PIN-670567 Date:........... MANGATTUPARAMBA

For more details; log on www.kannur university .ac.in

15/07/14

M.Sc. PHYSICS

DEGREE SYLLABUS

FOR

CREDIT BASED CURRICULUM

(2014 Admission onwards)

KANNUR UNIVERSITY

2014

PREAMBLE

- The Board of Studies in Physics (PG) considered the introduction of **Credit and Semester System** in affiliated colleges for the PG programmes in Physics and resolved to implement the pattern **2014 admission onwards**.
- The name of the Programme shall be **M.Sc. Physics** under Credit and Semester pattern.
- A workshop aided by Kerala state Higher Education Council was held on 15-02-2014 for finalising the syllabus.
- **Eligibility** for admission will be as per the rules laid down by the University from time to time.
- The course shall be offered in **four semesters** within a period of two academic years.
- There are **three elective** courses. The instruction hours per week and number of credits of these courses are given in Table .Examination of the theory papers will be conducted at the end of each semester. Examination for the 1st and 2nd semester practical courses will be conducted at the end of second semester. Practical Examination for III and IV Semesters will be conducted at the end of IV Semester.
- **7-point indirect relative grading system** is to be followed.
- **Seminar** for Continuous Assessment (CA) is to be conducted by each course teacher separately. An extra seminar is also included in each semester for enhancing the aptitude in new research topics. However the credits are awarded only in 2nd and 4th semester.
- At least two meetings of teachers may be held in every department in every college, one in mid-year and one towards the year end. The recommendations of these meetings should be sent to the Chairman of Board of Studies.
  Email: meppayilnarayanan@gmail.com

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Associate Professor & HoD
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SIR SYED COLLEGE
TALIPARAMBA

1. These scheme and syllabus shall come into effect from **2014** admission onwards.

2. The minimum duration for completion of a two year M.Sc. programme in Physics is four semesters. The maximum period for completion is eight semesters (4years).

The duration of each semester shall be five months inclusive of examinations. There shall be at least 90 instructional days and a minimum of 450 instructional hours in a semester. Ist and IIIrd semesters shall be from June to October and IInd and IVth semesters shall be from November to March.

3. The total marks for the programme is **1500**.

4. The students admitted in the P.G. programme shall be required to attend at least 75% of the total number of classes (theory/practical) held during each semester. The students having less than prescribed percentage of **attendance** shall not be allowed to appear for the University examination.

Attendance	**% of marks for attendance**
Above 90% attendance	100
85 to 89%	80
80 to 84 %	60
76 to 79 %	40
75 %	20

Condonation of shortage of attendance to a maximum of 12 days of the working days in a semester subject to a maximum of two times during the whole period of post graduate programme may be granted by the *Vice- Chancellor* of the University. *Benefit of Condonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meeting of the University bodies and participation in other extracurricular activities on production of genuine supporting documents with the recommendation of the Head of the Department concerned.* A student who is not eligible for such condonation shall **repeat the course** along with the subsequent batch.

Students who complete the courses and secure the minimum required attendance for all the courses of a semester and register for the university examinations at the end of the semester alone will be promoted to higher semester.

5. The evaluation scheme for each course (including projects) shall contain two parts; (a) Continuous Assessment (CA) and (b) End Semester Evaluation (ESE). **20%** marks shall be given to CA and the remaining **80 %** to ESE. The ratio of marks between internal and external is **1:4** excluding viva-voce.

CONTINUOUS ASSESSMENT (CA):

Theory

	Components	**% of internal marks**
i	Two test papers	40
ii	Assignments/Book review/debates	20
iii	Seminars/Presentation of case study	20
iv	Attendance	20

Practicals

	Components	**% of internal marks**
i	Two test papers	40
ii	lab skill	20
iii	records/viva	20
iv	Attendance	20

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. **There shall not be any chance for improvement for internal marks.**

The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principal, after endorsed by the Head of the Department.

TESTS

For each course there shall be at least **two** class tests during a semester. The probable dates of the tests shall be announced at the beginning of each semester. Marks should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the tests.

ASSIGNMENTS

Each student shall be required to do 2 assignments for each course. Assignments after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation etc. and inform the same to the students. Punctuality in submission is to be considered.

SEMINAR

Every student shall deliver **one seminar as an internal component for every course** and must be evaluated by the respective course teacher in terms of structure, content, presentation and interaction. The soft and hard copies of the seminar report are to be submitted to the teacher in charge.

All the records of Continuous Assessment (CA) must be kept in the department and must be made available for verification by university.

The results of the CA shall be displayed on the notice board within 5 working days from the last day of a semester. It should be get signed by the candidates.

The marks awarded for various components of the CA shall not be rounded off, if it has a decimal part. The total marks of the CA shall be rounded off to the nearest whole number.

END SEMESTER EVALUATION (ESE):

There shall be **double valuation system** of answer books. The average of two valuations shall be taken in to account. If there is a variation of more than 10 % of the maximum marks, the answer books shall be valued by a third examiner. The final marks to be awarded shall be the **average of the nearest two** out of three awarded by the examiners. After that there shall be no provision for revaluation.

End Semester Evaluation in **Practical courses** shall be conducted and evaluated by two examiners- **one internal and one external**. Duration of practical external examinations shall be decided by the Board of Studies concerned.

PROJECT WORK:

There shall be a project work with Dissertation to be undertaken by all students. The Dissertation entails field work, lab work, report, presentation and viva voce. The class hours allotted for project work may be clustered into a single slot so that students can do their work at a centre /location for a continuous period of time. However appropriate changes can be made by the concerned Board of studies in this regard.

Project work shall be carried out under the supervision of a teacher in the parent department concerned or prescribed by the department coordinator.

A candidate may, however, in certain cases be permitted to work on the project in an industrial/ research organization on the recommendation of the Head of the Department/ Department Coordinator. In such cases, one of the teachers from the department concerned would be the supervisor/internal guide and an expert from the industry/ research organization concerned shall act as co-supervisor/ external guide.

The project report shall be prepared according to the guidelines approved by the university. Two typed copies of the project report shall be submitted to the Head of the Department, two weeks before the commencement of the ESE of the final semester.

Every student has to do the project work independently. **No group projects** are accepted. The project should be unique with respect to title, project content and project layout. No two project report of any student should be identical, in any case, as this may lead to the cancellation of the project report by the university.

Evaluation of Project work:

a)1. The ESE of the project work shall be conducted by **two external examiners**.

2. Evaluation of the Project Report shall be done under mark System.

3. The evaluation of the project will be done at two stages:

i) Continuous/Internal Assessment (CA) (supervising teacher/s will assess the project and award internal marks)

ii) External evaluation (by external examiners appointed by the University)

4. Marks secured for the project will be awarded to candidates, combining the internal and external marks

5. The internal to external component is to be taken in the ratio 1:4.

6. Assessment of different components of project may be taken as below

Internal(Viva) 20% of total	
Components	**% of internal Marks**
Punctuality	20
Use of Data	20
Scheme/Organization of Report	40
Viva-voce	20

External(80% of Total)	
Components	**%of external Marks**
Relevance of the Topic	5
Statement of Objectives	10
Methodology/Reference/Bibliography	15
Presentation of Facts / Figures / Language style/Diagrams etc.	20
Quality of Analysis/Use of Statistical tools	15
Findings and recommendations	10
Viva-Voce	25

7. External Examiners will be appointed by the University from the list of IV semester Board of Examiners in consultation with the Chairperson of the Board.

8. Internal Assessment should be completed 2 weeks before the last working day of IV th semester.

9. Internal Assessment marks should be published in the department.

10. Chairman Board of Examinations, may at his discretion, on urgent requirements, make certain exception in the guidelines for the smooth conduct of the evaluation of project.

PASS CONDITIONS

1. Submission of the Project report and presence of the student for viva are compulsory for internal evaluation. For external evaluation the Project report submitted by the student shall be evaluated by the external examiners. No marks shall be awarded to a candidate if she/he fails to submit the Project report for external evaluation.

2. A student shall be declared to pass in the Project report course if she/he secures minimum **40 % marks of the aggregate and 40% separately for external.**

3. The student should get a minimum of 40 % marks for pass in the project. In an instance of inability of obtaining a minimum of 40% marks, the Project work may be redone and the report may be resubmitted along with subsequent examinations through parent department.

4. There shall be **no improvement chance** for the marks obtained in the Project Report.

PROJECT-

i) Arrangement of contents

The project should be arranged as follows-

1. Cover page and Title page
2. Bonafide certificate/s
3. Declaration by the student
4. Acknowledgement
5. Table of contents
6. List of tables
7. List of figures
8. List of symbols, Abbreviations and Nomenclature
9. Chapters
10. Appendices
11. References

ii)Page dimension and typing instruction

The dimension of the Project report should be in A4 size. The project report should be printed in bond paper and bound using flexible cover of the thick white art paper or spiral binding. The general text of the report should be typed with 1.5 line spacing. The general text shall be typed in the font style' Times New Roman' and font size 12. Paragraphs should be arranged in justified alignment with margin 1.25'' each on top. Portrait orientation shall be there on Left and right of the page. The content of the report shall be around 40 pages.

iii) A typical specimen of Bonafide Certificate

KANNUR UNIVERSITY

<Font Style Times New Roman-size 18>

BONAFIDE CERTIFICATE

<Font Style Times New Roman-size 16>

<Font Style Times New Roman-size 14>

Certified that this project report "………..**TITLE OF THE PROJECT**……………." is the bonafide work of "…………….**NAME OF THE CANDIDATE**…………..." who carried out the project work under my supervision.

<<Signature of HoD>>	<<Signature of Supervisor/co-supervisor>>
SIGNATURE	SIGNATURE
<< Name>>	<<Name>>
HEAD OF THE DEPARTMENT	SUPERVISOR
<<Academic Designation>>	<< Academic Designation>>
<< Department>>	<<Department>>
<<Seal with full address of the Dept.& college>>	<< Seal with full address>>

VIVA VOCE:

The Viva voce shall be conducted by **two** examiners. For external viva, both of them shall be **external examiners**

Appearance of CA and ESE are compulsory and no marks shall be awarded to a candidate if he/she is absent for CA/ESE or both

GRADING SYSTEM

Seven Point Indirect Relative grading system:

Evaluation(both internal and external) is carried out using Mark system .The grading on the basis of a total internal and external marks will be indicated for each course and for each semester and for the entire programme.

The guidelines of grading is as follows-

TABLE-1

% of Marks (CA+ESE)	Grade	Interpretation	Range of grade points	Class
90 and above	O	Outstanding	9-10	First class with Distinction
80 to below 90	A	Excellent	8-8.9	
70 to below 80	B	Very good	7-7.9	First class
60 to below 70	C	Good	6-6.9	
50 To below 60	D	Satisfactory	5-5.9	Second class
40 to below 50	E	Pass/Adequate	4-4.9	Pass
Below 40	F	Failure	0-3.9	Fail

$$\text{S.G.P.A} = \frac{\text{Sum of Credit points of all courses in the semester}}{\text{Total credits in that semester}}$$

$$\text{Credit point} = \text{Grade point (G) X credit©}$$

C.G.P.A = $\dfrac{\text{Sum of credit points of all completed semesters}}{\text{Total credits acquired}}$

$$\mathrm{OGPA} = \frac{\textbf{Sum of } \boldsymbol{credit\ points} \textbf{ obtained in four } \boldsymbol{semesters}}{\boldsymbol{Total\ credits}\ (\mathbf{80})}$$

PASS REQUIREMENT:

COURSE:

A CANDIDATE SECURING E GRADE WITH 40% OF AGGREGATE MARKS AND 40% SEPARATELY FOR ESE FOR EACH COURSE SHALL BE DECLARED TO HAVE PASSED IN THAT COURSE.

SEMESTER

Those who secure not less than 40 % marks (both ESE and CA put together) for all the courses of a semester shall be declared to have successfully completed the semester.

The marks obtained by the candidates for CA in the first appearance shall be retained (irrespective of pass or fail)

The candidates who fail in theory unit shall reappear for theory unit only, and the marks secured by them in practical unit, if passed in practical, will be retained.

A candidate who fails to secure a minimum for a pass in a course will be permitted to write the same examination along with the next batch.

For the successful completion of a semester, a candidate should pass all courses and secure a minimum SGPA of 4. However a student is permitted to move to the next semester irrespective of his/her SGPA. A student will be permitted to secure a minimum SGPA of 4.00 required for the successful completion of a Semester or to improve his results at ESE of any semester, by reappearing for the ESE of any course of the semester concerned, along with the examinations conducted for the subsequent admission

IMPROVEMENT:

A candidate who secures minimum marks (40 %) for a pass in a course will be permitted to write the same examination along with the next batch if he/she desires to improve his/her performance in ESE. If the candidate fails to appear for the improvement examination after registration, or if there is no change/up gradation in the marks after availing the improvement chance, the marks obtained in the first appearance shall be retained. There shall be no improvement chance for the marks obtained in internal assessment. Improvement of a particular semester can be done only once. The student shall avail the improvement chance in the succeeding year along with the subsequent batch.

There will be no supplementary examinations. For re-appearance/ improvement student can appear along with the next batch.

CREDIT DISTRIBUTION

Each course shall have certain credits. For passing the programme the student shall be required to achieve a minimum of **80** credits. Each Board of studies can distribute the credits for different courses subjected to a total maximum of 80.

AWARD OF DEGREE

The successful completion of all the courses prescribed for the Post Graduate degree programme with E grade (40 % of maximum marks) and with a minimum SGPA of 4.0 for all semesters and minimum CGPA 4.0 satisfying minimum credit 80, shall be the minimum requirement for the award of degree.

Position certificates up to third position will be issued on the basis of highest marks secured for the programme. In the case of a tie, highest of CGPA is to be considered.

TOUR Study tour to educational and scientific institutions may be conducted. No credit shall be assigned to it.

COURSES IN VARIOUS SEMESTERS

CORE

Semester -I (16C)

(PHY1C01)	Mathematical Physics - I (4C)
(PHY1C02)	Classical Mechanics (4C)
(PHY1C03)	Electrodynamics (4C)

(PHY1C04)	Electronics (4C)
PHY1P01)	Practical –I Basic Physics Laboratory-I (No credit)*
(PHY1P02)	Practical –II Computer & Electronics Laboratory-I (No credit)*
(PHY1C05)	Seminar (No credit) (Any new research oriented general topic can be selected)

Semester -II (23C)

(PHY2C06)	Quantum Mechanics -I (4C)
(PHY2C07)	Mathematical Physics -II (4C)
(PHY2C08)	Statistical Mechanics (4C)
(PHY2C09)	Spectroscopy (4C)
(PHY2P01)	Practical –I Basic Physics Laboratory- II (3C)
(PHY2P02)	Practical –II Computer & Electronics Laboratory-II (3C)
(PHY2C05)	Seminar-I (1C- Including PHY 1C 05) (Any new research oriented general topic can be selected)

**External Practical Exam. for PHY1P01 & PHY2P01, PHY1P02 & PHY2P02 are to be conducted at the end of Semester II.*
*(Basic Physics Laboratory OR Computer& Electronics Laboratory in a given semester- depending on the Student-batches. Thus half the class performs BPL, the remaining half Computer Lab in Semester I. In Semester II, these laboratories are interchanged; so that by the end of the first Year, a student will have carried **both** these laboratories.)*

Semester -III (16C)

(PHY3C10)	Quantum Mechanics -II (4C)
(PHY3C11)	Solid State Physics (4C)
(PHY3C12)	Nuclear& Particle Physics 4C)
(PHY3E 01-05)	Elective –I (4C) (Any one)
(PHY3P03)	Practical III -Advanced Physics and Electronics Practical (No credit)
(PHY3Pr01)	Project (No credit)
(PHY3C13)	Seminar-II (No credit) (Any new research oriented general topic can be selected)

Semester -IV (25C)

(PHY4C14)	Optics (4C)
(PHY 4C15)	Numerical Techniques& Probability (4C)
(PHY 4E06-12)	Elective –II (4C) (Any one)
(PHY 4E06-12)	Elective –III (4C) (Anyone- other than Elective –II)
(PHY 4P03)	Practical III -Advanced Physics and Electronics Practical -III (3C)
(PHY4Pr01)	Project (3C)
(PHY4C16)	General Viva-Voce (2C)
(PHY4C13)	Seminar-II (1C) (Any new research oriented general topic can be selected)

ELECTIVES

III Semester (Any one)

PHY 3E01 -Plasma Physics

PHY 3E02 -Radiation Physics

PHY 3E03 - Microprocessors and Applications

PHY 3E04 -Chaos and Nonlinear Physics

PHY 3E05 -Atmospheric Physics

IV Semester (any Two)

PHY 4E06 -Optoelectronics

PHY 4E07 -Astrophysics

PHY 4E08 -Electronic Instrumentation

PHY 4E09 -Communication Electronics

PHY 4E10 - Condensed Matter Physics

PHY 4E11 -Nano science and Technology

PHY 4E12 -Experimental Techniques

*The topics for Seminar can be any new research oriented general topic which can be selected by the student.

Credit & Mark distribution for M.Sc. PHYSICS

semester	Paper code	Title	Marks			Credit	Hrs/ week
			Internal	External	Total		
I	PHY1C01	Mathematical Physics -I	15	60	75	4	4
	PHY1C02	Classical Mechanics	15	60	75	4	4
	PHY1C03	Electrodynamics	15	60	75	4	4
	PHY1C04	Electronics	15	60	75	4	4
	PHY1P01	Practical –I	-	-	-	-	4
	PHY1P02	Practical –II	-	-	-	-	4
	PHY1C05	Seminar-1	-	-	-	-	1
	Total		60	240	300	16	25
II	PHY2C06	Quantum Mechanics -I	15	60	75	4	4
	PHY2C07	Mathematical Physics- II	15	60	75	4	4
	PHY2C 08	Statistical Mechanics	15	60	75	4	4
	PHY2C 09	Spectroscopy	15	60	75	4	4
	PHY2P01	Practical-I	12	48	60	3	4
	PHY2P02	Practical-II	12	48	60	3	4
	PHY2C05	Seminar-I	10	-	10	1	1

	Total		94	336	430	23	25
III	PHY3C10	Quantum Mechanics –II	15	60	75	4	4
	PHY3C11	Solid state Physics	15	60	75	4	4
	PHY3C12	Nuclear& Particle Physics	15	60	75	4	4
	PHY3E01-05	Elective-I	15	60	75	4	4
	PHY3P03	Practical-III	-	-	-	-	4
	PHY3Pr01	Project	-	-	-	-	4
	PHY3C13	Seminar II	-	-	-	-	1
	Total		60	240	300	16	25
IV	PHY4C14	Optics	15	60	75	4	4
	PHY4C15	Numerical techniques & probability	15	60	75	4	4
	PHY4E 06-12	Elective-II	15	60	75	4	4
	PHY4E 06-12	Elective-III	15	60	75	4	4
	PHY4P03	Practical-III	12	48	60	3	4
	PHY4Pr01	Project	12	48	60	3	4
	PHY4 C16	General Viva-voce	-	40	40	2	-
	PHY4C13	Seminar II	10	-	10	1	1
	Total		94	376	470	25	25
Total					**1500**	**80**	

Hours & Credits distribution for M.Sc. Physics

Sem.	No. of theory courses	Practicals	Theory		Practicals		Project		Seminar		Viva		Total Hours	Total credits
			Hrs.	C	Hrs.	C	Hrs.	C	Hrs.	C	Hrs.	C		
I	4	2	16	16	8	0	0	0	1	0	0	0	25	16
II	4	2	16	16	8	3+3	0	0	1	1	0	0	25	23
III	4	1	16	16	4	0	4	0	1	0	0	0	25	16
IV	4	1	16	16	4	3	4	3	1	1	0	2	25	25

.

Question paper pattern

PHY XXXX…………………………………………………………

Time: 3 Hrs. Maximum marks: **60**

Instructions to question setters

(Questions should be asked from all modules following a uniform distribution.)

Section A

(Answer any **two**)

1. a) essay question from one or more modules (Don't repeat the same module again in this section)

Or

b) essay question from one or more modules (Don't repeat the same module again in this section)

2. a) essay question from one or more modules (Don't repeat the same module again in this section)

Or

b) essay question from one or more modules (Don't repeat the same module again in this section)

(**2 x 12 =24** Marks)

Section –B(Answer any **four**……….)

1 mark for part **a**

3 marks for part b

5 marks for part c

3. a) Direct type question (to test knowledge acquired)
   b) Understanding type
   c) Problem type (Ability to synthesize knowledge or critical evaluation of knowledge)
4. a)…………………………………………
   b)…………………………………………
   c)…………………………………………

5. a)…………………………………………
   b)…………………………………………
   c)…………………………………………
6. a)…………………………………………
   b)…………………………………………
   c)…………………………………………

7. a)…………………………………………
   b)…………………………………………
   c)…………………………………………
8. a)…………………………………………
   b)…………………………………………
   c)…………………………………………

(**4X9=36** Marks)

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SEMESTER I(16 C)

PHY1C01: MATHEMATICAL PHYSICS -I (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Module I: **Matrices**: Orthogonal matrices- Hermitian Matrices-Unitary matrices-Diagonalisation of matrices (Book 1 Chapter 2)

Curvilinear coordinates: Orthogonal coordinates- Gradience, Divergence and curl in Orthogonal Curvilinear coordinates-Special coordinate systems--Cylindrical, spherical polar &Cartesian (Book 1 Chapter 3).

Tensor and differential form: Tensor analysis-Introduction-definition-definition of different rank tensors-Contraction and direct product-quotient rule-pseudo tensors-General tensors-Matric tensors (Book 1, Chapter 4)

Module II: **Eigen value problems**: Eigen value equations-matrix Eigen value problems- Hermitian eigen value problems-Hermitian matrix diagonalisation-Normal matrices- (Book 1,Chapter 6)
Ordinary differential equations: Introduction- First order equations-Second order linear ODEs-Series solution, Forbenius method- Inhomogeneous linear ODE's-Nonlinear differential equations (Book 1, Chapter 7)

Module III:**Complex variable theory**: complex variable and functions-Cauchy Reimann conditions-Cauchy's integral theorem-Cauchy's integral formula—Laurent expansion-Singularities-Calculus of residues-Evaluation of definite integral-Evaluation of sums (Book 1, Chapter 11)

Module IV:**Orthogonal Polynomials**:((Book 1, Chapter 12)

Gamma function: definition properties-the Beta function (Book 1, Chapter 13)

Bessel function: Bessel function of the first kind-orthogonality-Neumann's function,Bessel function of the second kind-Modified Bessel functions-spherical Bessel functions (Book 1, Chapter 14)

Legendre functions: Legendre polynomial-orthogonality-physical interpretation of Generating function-Associated Legendre equation-Spherical harmonics (Book 1,Chapter 15)

More special functions: Hermite functions-Application of Hermite function- Laguerre functions (Book 1,Chapter 18)

Book for study:
1. Arfken&Weber, Mathematical methods for Physicists by (Seventh edition), Academic press.
Books for reference:
1. K.F.Riley et al., Mathematical methods for Physics and Engineering Cambridge University Press.
2. Pipes& Harvil, Applied Mathematics for Physicist & Engineers, Mc Graw Hill

PHY1C02 -CLASSICAL MECHANICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Module 1: **Scattering:** Scattering in a central force field. Transformation of the scattering problem to laboratory coordinates.

Module 2: **Lagrangian Formulation: Elementary** ideas of calculus of variation, Euler – Lagrangian equation –-Hamilton's principle-Deduction of Hamilton's principle- Principle of Least action. Lagrange's equation from Hamilton's principle-Hamiltonian function.

Module 3: **Hamiltonian Formulation:** Configuration space and phase space-Hamiltons canonical equation-applications of Hamiltons equation-Two dimensional isotropic harmonic oscillator-Particle in a central force field-Charged particle in an electromagnetic field-Kepler problem.

Module 4: **Canonical Transformation:** Legendre Transformations-Canonical transformations-example-Infinitesimal canonical transformation-Poisson brackets-properties-Hamilton equations in Poisson bracket form-angular momentum Poisson brackets.

Module 5: **Hamilton-Jacobi Formulation** :Hamilton-Jacobi equations-Hamilton's principle and characteristic functions-Hamilton- Jacobi equation for liner Harmonic oscillator-Action angle variable-Hamilton-Jacobi formulation of Kepler problem-Hamilton-Jacobi equation and Schrodinger equation.

Module 6: **Rigid Body Dynamics** :Coordinate systems with relative translational motions-Rotating coordinate systems -Space fixed and body fixed systems of coordinates-Description of rigid body motion in terms of direction cosines and Euler angles-Infinitesimal rotations-Rate of change of a vector-Centrifugal and Coriolis forces-moment of Inertia Tensor-Euler's equation of motion -force free motion of a symmetric top (Book2)

Module 7: **Small Oscillations**: Formulation of the problem-Lagranges equations of motion for small oscillations-Eigen value equation-Frequency of free vibrations-Normal co-ordinates-Normal frequencies-Free vibrations of a linear triatomic molecule.

Books for study

1.Classical Mechanics, Herbert Goldstein

2.Classical Mechanics, Gupta ,Kumar& Sharma, Pragatti Prakashan

References

1. Introduction to Classical Mechanics, R G Takwale and P S Puranic, TMH

2. Classical Mechanics, J.C. Upadhyaya,

3. Classical Mechanics, G.Aruldas, PHI

. Classical Mechanics, A K Saxena, CBS

PHY1C03 ELECTRODYNAMICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Module 1: **Basic Concepts of Electrodynamics:** Gauss law – Poisson's equation and Laplace's equation-method of images-Laplace equation in Cartesian, spherical and cylindrical co-ordinates - Biot-savart Law-Ampere's theorem- Boundary value problems with linear dielectrics (Sphere and semi-infinite slab) (Units 2, 3, 4, 8 of T1 & Units 1, 3,4, 5 & 6 of T2

Module 2: **Maxwell's Equations and Propagation of Electromagnetic waves:**Maxwell's equations and their empirical basis-The wave equation –Flow of electromagnetic energy (Poynting vector)- Boundary conditions– PlaneElectromagnetic waves in a non-conducting media – Polarization – Plane monochromatic waves in a conducting media. (units 16, 17 of T1 & units 7, 8,9 of T2)

Module 3: **Electromagnetic waves in bounded regions:**Reflection and refraction of electromagnetic waves at the boundary of two non-conducting media for oblique incidence – Brewster angle, Critical angle - Propagation between parallel conducting plates – Wave guides and cavity resonators (Unit 18 of T1 & Unit 9 of T2)

Module 4: **Potentials and fields:** Scalar and vector potential –Gauge Transformations– The wave equation with sources -Retarded Potential – Liénard – Wiechert Potentials (Unit 10 of T2 &Units 16 and 21 of T1)

Module 5: **Radiation:** What is radiation? – Electric dipole radiation – Magnetic dipole radiation – Radiation by a point charge and power radiated- Larmor formula - Radiation damping-Radiation reaction: The Abraham-Lorentz formula. (Units 10, 11 of T2)

Module 6: **Relativistic electrodynamics:**Basic concepts of Lorentz Transformation – Geometry of space time – Lorentz transformation as an orthogonal transformation – Covariant form of electromagnetic equations like continuity equation, Maxwell's equations etc – The electromagnetic field tensor – Transformation law for the electromagnetic field. (Unit 22 of T1 & Unit 12 of T2)

Books for study

1. Foundations of electromagnetic Theory – John R.Reitz, Frederic J Milford, Robert W Christy, Third Edition, Narosa Publishing House.

2. Introduction to Electrodynamics, Third edition, David J Griffiths, Prentice Hall India

References.

1. Classical electrodynamics-Third edition -John David Jackson (for module-1)

2. Introduction to electrodynamics: A Z Capri and P V Panat

3. Field and Electromagnetics: David K Cheng

PHY1C04-ELECTRONICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Module 1: **OPERATIONAL AMPLIFIER:** Operational Amplifier- -- Differential amplifier circuit using transistors-- Op -Amp basics-- Op Amp specifications- -DC offset parameters-- Frequency parameters (Book 1)

The ideal Operational amplifier—Open loop and closed loop Op-amp configurations –P Spice Simulation(qualitative idea only) Voltage series feedback amplifier—voltage shunt feedback amplifier --virtual ground-- Practical Inverting Op-amp—Ideal Non inverting Op-amp—The voltage follower—Practical non inverting Op-amp—Op-amp parameters—General description of various stages used in Op-amp—type 741—

Open loop and closed loop frequency response—frequency compensation—Dominant pole and pole zero compensations——slew rate—slew rate equation –effect of slew rate in applications (Book 2)

Basic Op-amp circuits—Summing, scaling and averaging amplifiers—Voltage to current converter—Current to voltage converter—Integrator—Differentiator (Book 2)

Module2: **Active filters :**First order low-pass Butterworth filter—First order high-pass Butterworth filter—Square wave generator—triangular wave generator—saw tooth wave generator-- (Book 2 Ch.7)

Zero crossing detector—Schmitt trigger—Comparators—Sample and hold circuit –voltage limiters (Book2 Ch.8)

Module3: **DIGITAL ELECTRONICS**

Multiplexers: DE Multiplexers—Applications of Multiplexers (Book 3 Ch.7.22 to 7.24)

Flip-flops and timing circuits: NOR gate and NAND gate SR latch—Gated latches—Edge triggered Flip Flops—Asynchronous inputs—Flip Flop operating characteristics—Maser Slave Flip flops—Conversion of flip Flops—Application of Flip Flops—Schmitt trigger—Monostable Multivibrator—Astable Multivibrator—Crystal controlled clock generators (Book 3 Ch. 8)

Shift registers: Buffer register—serial in serial out, serial in parallel out, parallel in serial out, parallel I parallel out shift registers (Book3 Ch.9)

Counters: Asynchronous counters—mod-8 ripple counter—synchronous counter (Book 3 ch.10)

Digital to Analog and analog to digital converters: R-2R ladder type DAC—counter method ADC—Successive approximation type ADC (Book3 ch13)

Memories: RAM, ROM, PROM, EPROM, EEPROM (Book3 ch.14)

Module4: **Microprocessors:** Intel 8085—functional block diagram—Register array—Developments of microprocessors from 8085 to core i 7 (Book 4)

Books for study1.Electronic devices and circuit theory— Robert L. Boylested & Louis Nashelsky (PHI)

2. Op-amps and Linear Integrated circuits—Ramakanth A. Gayakwad(PHI)

3. Fundamentals of digital circuits—A. Anand kumar(PHI)

4. Microprocessor Architecture, Programming and applications with the 8085—Ramesh Goanka

Books for reference:

1.A Text book of Electronics- S.L.Kakani., K.C. Bhandari (New age)

2.Electronics-analog and Digital- I.J.Nagrath (PHI)

PHY1P01/PHY2P01 – (Practical-I)-BASIC PHYSICS LABORATORY-I (3C)

(No credits for I semester.)

(At least **14** Experiments should be done)

(At least **two** experiments from each cluster)

Cluster 1

1 Meyer's oscillating disc – Viscosity of Liquid

2 Koenig's method - Determination of Y and σ.

3. Vibrating strip – Mode constants

Cluster 2

1. Cornu's Hyperbolic fringes – Determination of Y, σ and K with Pyrex.

2. Cornu's elliptical fringes – Determination of Y, σ and K with glass.

3. Cauchy's constants - Determination of Cauchy's constants - λ sodium light

4. Rydberg constant – by spectrometer and diffraction grating

Cluster 3

1. Stefan's constant – Determination of Stefan's constant.

2. Thermocouple – Constants, Neutral and inversion temperatures (Calibrated potentiometer must be used)

3. Lee's Disc – K of liquid/powder and air using thermocouple & B.G

Cluster 4

1. Quincke's method – Susceptibility of a liquid at different concentrations.

2. Guoy's method – Susceptibility of glass and aluminium or suitable powder

3. Hysteresis – BH curve using CRO or B.G

Cluster 5

1. LASER –fundamental experiments- diameter of thin wire, Determination of wavelength using a diffraction grating,

2. LASER – Intensity distribution and divergence of the beam, Pitch of a screw.

3. LASER – Determination of refractive index of mirror substrate.

Cluster 6

1. Maxwell's L.C.Bridge – Determination of resistance and inductance of a given coil.

2. Transformer- efficiency, secondary impedance and inductance

3. Anderson's bridge-Self-inductance.

Reference Books

1. Dunlap.R.A. Experimental physics – modern methods, Oxford University press (1988)

2. Malacara. D – Methods of Experimental Physics, Academic press

3. Smith E.V Manuel of Experiments in Applied Physics – Butterworth.

4. Worsnop & Flint, Advanced Practical Physics for students, Methusen & Co.

5. Practical Physics – S.L. Gupta& Kumar – Paragati Prakashan

6. C.J Babu, Lab manual, Calicut University

7. R S Sirohi-A course of experiments with He-Ne Laser-New Age International.

PHY1P02 / PHY2P02-PRACTICAL –II - COMPUTER &ELECTRONICS LABORATORY-I (3C)

(No credits for I semester)

Electronics (At least **14** should be done)

(At least **two** experiments should be done from each cluster)

Cluster 1

1. Series Voltage regulator with feedback using transistors (Regulation characteristic with load for different input voltages)

2. Series Voltage regulator with feedback using IC741. (Regulation characteristic with load for different input voltages)

3. Low voltage and high voltage regulators using IC723.

Cluster 2

1. Two stage R.C Coupled transistor/FET amplifier (I/O resistance with and with outfeed back)

2. Negative feedback amplifier (I/O resistance with and with outfeed back)

3. Differential amplifier using transistors (Frequency response, CMRR)

Cluster 3

1. Wien Bridge oscillator using OPAMP (with simple resistive feed back and using FET a voltage controlled resistor for amplitude stabilization)

2. Saw tooth Generator using transistors (for different frequencies)

3. Miller Sweep Circuits using OPAMPS. (For different frequencies)

Cluster 4

1. Measurements of OPAMP parameters

2. Schmitt Trigger using OPAMP. (Trace Hysteresis curve, Determine LTP and UTP)

3. OPAMP – analogue integration and differentiation.

Cluster 5

1. Precision Full wave rectifier using OPAMP

2. Astable and monostablemultivibrator using OPAMP.

3. Voltage controlled oscillator using 555 IC

4. r.m.s. value of sine and triangular wave

Cluster 6

1. Binary Adders – HA and FA using NAND gates

2. D/A converter – a) Binary weighted resistors b) R-2R Ladder (Four bit or more. Verify output for different digital inputs)

3. Study of Flip – Flops. RS & JK using IC 7400 (Verify Truth tables)

<u>**Computer Programming**</u> (Problem analysis – algorithm – programming in C++ and execution)

(At least **6** should be done)

1. Familiarization of programming – Quadratic equations – solutions – real & complex Matrices - sum, product, Transpose & Trace.

2. Inverse of a Matrix

3. Programme to accept a decimal number as input and print the octal, Hexa decimal, binary and one’s compliment of the binary as output.

4. Integration of a given function using the Simpson’s 1/3 rule.

5. Lagrange Interpolation.

6. Solution of a set of linear equations by Gauss’s elimination method.

7. To demonstrate Total internal reflection graphically for various values of refractive indices of the media.

8. Simulate motion of the planet around the sun and verify Kepler’s laws. Use Newton – Feynman method.

9. Fourier analysis of a given periodic function.

10. Draw the i – d curve for various refractive indexes and study variation with refractive index.

11. Variation of the field along the axis of a circular coil. Graphical representation for different values of currents and radii of the coils.

12. Simulate Brownian motion and random walk in two dimensions – Apply it for the study of noise.

13. Simulate damped harmonic motion and find a) Damping Coefficient b) Relaxation time c) Q – factor.

Reference Books:

1 Paul B Zbar and Malvine A.P – Basic Electronics – a lab manual TMH.

2 Begart R and Brown J – Experiments for electronic devices and circuits – Merill International series.

3 Buchla – Digital Experiments – Merill International series.

4 Jain R.P and Anand M.M.S Digital Electronics Practice using ICS, TMH.

5 Subramanian S.V – Experiments in Electronics – Mac Millan

6 S. Poorna Chandra Rao&B.Sasikala – Hand book of Experiments in Electronics and Communication Engineering.

7. Electronic circuits-Fundamentals & applications- Mike Tooley(Routledge)

8. Electronics lab Manual- K.A.Navas

9 Numerical methods – E.Balaguruswamy.

10. Numerical techniques – Gupta &Malik

11. Let's C++ Yashwanth Kanethkar

12. Graphics under C++ Yashwanth Kanetkar

13. Object Oriented Programming with C++ – E. Balaguruswamy

SEMESTER II (23C)

PHY2C06- QUANTUM MECHANICS-I (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Module 1: **Mathematical tools of Quantum Mechanics**: Hilbert space and wave functions - Dirac notation – Operators - Representation in discrete bases - Representation in continuous bases, (Book2 - Chapter 2 Section 2.1 to 2.6)

Module 2: **The formulation of Quantum Mechanics:** Fundamental postulates – The equation of motion – Schrodinger, Heisenberg and Interaction pictures – Uncertainty principle – Wave packet and its time development – Linear harmonic oscillator in Schrodinger and Heisenberg picture. (Book1- Relevant sections of Chapter 3 and 4)

Module 3: **Theory of Angular Momentum and Hydrogen atom:** Orbital angular momentum – General formalism of angular momentum – Matrix representation of angular momentum – Spin angular momentum – Eigen functions of orbital angular momentum – 3D problems in spherical coordinates – The Hydrogen atom – Addition of angular momenta – Clebsch Gordan coefficients. (Book2 chapter 5.1 to5.4, 5.6, 5.7, 6.3.1, 6.3.5and 7.3)

Module 4: **Symmetry and Conservation Laws:** Space-time symmetries, Space translation and conservation of linear momentum- Time translation and conservation of energy- Space rotation and conservation of angular momentum, Space inversion and time reversal.(Book1- Chapter 6)

Module 5: **Approximation methods for stationary states:** Time independent perturbation theory - non degenerate and degenerate cases - stark and effect in Hydrogen atom - Variation method for bound states - Ground state energy of He atom- WKB approximation (Book2- Section 9.1 to9.2.2 and 9.3, 9. 4.1 – 9.4.3)

Books for study

1.V.K. Thankappan : "Quantum Mechanics" (Wiley Eastern Ltd)

2.N. Zettili, "Quantum Mechanics – Concepts and applications'II Edition (John Wiley & Sons, 2004)

References:

1.. L..I.Schiff : "Quantum Mechanics" (McGraw Hill)

2. P.M.Mathews and K.Venkatesan : "A Textbook of Quantum Mechanics" (Tata McGraw Hill)

3. A.Messiah : “Quantum Mechanics”

4. J.J.Sakurai : “Modern Quantum Mechanics” (Addison Wesley)

5. Stephen Gasiorowics : “Quantum Physics”

6. A.Ghatak and S.Lokanathan : “Quantum Mechanics” (Macmillan)

8. Eugence Merzbacher, Quantum Mechanics

PHY2C07: MATHEMATICAL PHYSICS- II

(Contact hours -72 hrs;Credit-4;Max. Ex. Marks: 60; Max.Int.Marks:15)

Module I: **Infinite Series** (Book 1, Chapter 1)

Infinite series-Series of function-Binomial theorem

Modules II: **Partial differential equations** (Book 1, Chapters 9):

Introduction-First order equations-Second order equations-Separation of variables-Laplace and Poisson’s equations-Wave equation-Heat flow, or Diffusion PDE.

Green’s function (Book 1, Chapter 10)

One dimensional problems - Problems in two and three dimensions.

Module III: **Integral transforms** (Book 1, Chapter 20):

Introduction-Fourier transform-Properties of Fourier transform-Fourier convolution theorem-Signal processing applications-Discrete Fourier transform-Laplace transform-Properties of Laplace transform-Laplace convolution theorem-Inverse Laplace transform.

Module IV: **Group theory** (Book 2 Chapters 1 and 3)

Definition of groups-Abelian and Non Abelian group-multiplication table-rearrangement theorem-conjugate element and classes-sub groups-direct product groups- Isomerism and homomorphism – permutation groups-representation of groups-invariant subspaces and reducible representations-irreducible representations - Schur’s lemmas - orthogonality theorem-proof and interpretation-characters of representation-character table-irreducible representation of C_{3V} and C_{4V} - qualitative idea of continuous groups, O(3),SU(2) and SU(3) groups.

Books for study:

1. ARFKEN &WEBER, Mathematical methods for Physics (Seventh edition),Academic press.

2. A.W.Joshi Group theory for Physicists,Wiley.

Books for reference:

1.K.F.Riley et al.,Mathematical methods for Physics and Engineering Cambridge University Press.

2.Pipes& Harvil, Applied Mathematics for Physicist & Engineers, Mc Graw Hill.

PHY2C08 - STATISTICAL MECHANICS (4C)

(Contact hours -72 hrs; Credit-4; Max. Ex. Marks: 60; Max.Int.Marks:15)

Module 1: **Overview of classical Thermodynamics**
Postulates of equilibrium thermodynamics, Intensive parameters of thermodynamics, The Euler and Gibbs-Duhem relations, Thermodynamic Potentials, Max wells relations (Chapter-3 of T2)

Module 2: **Statistical Basis of Thermodynamics and Micro canonical Ensemble**
The macroscopic and microscopic states. Contact between statistics and thermodynamics (Boltzmann relation between entropy and micro states) -Further contact between statistics and thermodynamics-Classical ideal gas. Gibbs paradox.The correct enumeration of microstates (Distinguishability and Indistinguishability). Phase space. Liouville's theorem and its significance The microcanonical ensemble—Examples (Classical ideal gas and Simple harmonic oscillator) Quantum states and phase space. (Chapters 1&2 of T1)

Module 3: **The Canonical Ensemble and Grand canonical ensemble**:
Canonical ensemble- Equilibrium between system and reservoir.A system in the canonical ensemble -method of most probable values- Physical significance of statistical quantities in the canonical ensemble. Partition function for non-generate and degenerate systems. Thermodynamics of classical systems like free particles (ideal gas). Thermodynamics of harmonic oscillators and quantum harmonic oscillators.Energy fluctuations in the canonical ensemble.Equipartition theorem and virial theorem.
Grand canonical ensemble- Equilibrium between a system and a particle-energy reservoir.A system in Grand canonical ensemble.Physical Significance of statistical quantities. Classical ideal gas, one dimensional classical and quantum oscillators as examples in grand canonical ensemble. Energy and density fluctuations in the grand canonical ensemble. (Chapters 3&4 of T1)

Module 4: **Theory of simple gases**
An ideal gas in quantum mechanical micro canonical ensemble- An ideal gas in other quantum mechanical ensembles- statistics of occupation numbers (Chapter-6 of T1)

Module 5: **Ideal Bose and Fermi Systems**
Validity criterion of the classical limit.Thermodynamic behavior of an ideal Bose gas.Bose-Einstein condensation.Bose-Einstein condensation in ultracold atomic gases (BEC in harmonic oscillator potential).Planck's theory of radiation.
Behavior of an ideal Fermi gas.Fermi temperature and Fermi energy.Magnetic behaviour of ideal Fermi gas –Pauli para magnetism- Landau dia magnetism. (Chapters 7 & 8 of T1)

Module 6: Phase transitions and Critical Phenomena
Simple fluids-simple uni axial ferro magnets. The Landau phenomenology-Dynamical model of phase transitions- Ising model definition-The lattice gas and the binary alloy-The Ising model in one dimension (Chapter 12 of T2 and Chapters 12 &13 of T1)

Books for study
T1 R K.Pathria and Paul D Beale, Statistical Mechanics, Butterworth Heinemann, III Edn.
T2 Silvio R A Salinas Introduction to Statistical physics I Edn Springer International Edition

References
1. Landau &Lifeshitz, Statistical Physics, Pergman.M
2. F. Reif, Fundamentals of Statistical and Thermal Physics, McGraw Hill
3. Roger Bowley and Mariana Sanchez, Introductory Statistical Mechanics, Oxford Science Publications -South Asian Edition
4 . Introduction to Staistical Mechanics- John Dirk Walecka, World Scientific, First Edition
5. B K Agarwal & Melvin Eisner- Statistical Mechanics II Edn.

PHY 2C09-SPECTROSCOPY (4C)

(Contact hours -72 hrs;Credit-4;Max. Ex. Marks: 60; Max.Int.Marks:15)

Module-1: **Atomic spectroscopy**
Introduction to atomic spectroscopy-the Hydrogen atom and the three quantum numbers-spectra of alkali metals-elements with more than one outer valence electron-forbidden transitions and selection rules-vector atom model-normal Zeeman effect-anomalousZeeman effect-magnetic moment of the atom and g factor-emitted frequencies in anomalousZeeman transitions-Paschen-Back effect-Stark effect.

Module-2: **Microwave spectroscopy**
Regions of the spectrum-classification of molecules, interaction of radiation with rotating molecules-rotational spectra of rigid diatomic molecules-the intensity of spectral lines-the effect of isotopic substitution-the non-rigid rotator-linear polyatomic molecules-symmetric top molecules-asymmetric top molecules. Microwave spectrometer.

Module-3: **Infrared spectroscopy**
The vibrating diatomic molecule-the energy of a diatomic molecule-the simple harmonic oscillator-theanharmonic oscillator-the diatomic vibrating rotator-breakdown of Born-Oppenheimer approximation-the interactions of rotations and vibrations-the vibration of poly atomic molecules-fundamental vibrations and their symmetry-the influence of the rotation on the spectra of poly atomic molecules-linear molecules-symmetric top molecules-other poly atomic molecules.

-4: **Raman spectroscopy**
Quantum theory of Raman effect-pure rotational Raman spectra-linear molecules-symmetric top molecules-spherical top molecules-asymmetric top molecules--vibrationalRaman spectra—rotational fine structure-structure determination from Raman and Infrared spectroscopy. Raman spectrometer.

Module-5: **Electronic spectroscopy of molecules**
Electronic spectra of diatomic molecules-the Born-Oppenheimer approximation-vibrational coarse structure: progressions- intensity of vibrational electronic spectra-Frank-Condon principle-rotational fine structure of electronic vibration transitions- the Fortrat diagram.

Module-6: **Spin Resonance spectroscopy**

Spin and an applied field-the nature of spinning particles-interaction between nuclear spin and magnetic field-the Larmour precession-NMR spectroscopy-Hydrogen nuclei- chemical shift- ESR spectroscopy-the position of ESR absorptions-the g factor

Module-6: **Mossbauer spectroscopy**

Principles ofMossbauerspectroscopy-applications-chemical shift-Quadrupole effects-effect of magnetic field.

Books

1. G. Aruldas: Molecular structure and spectroscopy -prentice hall
2. Collin N Banwell and Mc Cash : Fundamentals of molecular spectroscopy 4th Edn- TMH
3. B P Straughn & S Walker: Spectroscopy volume1-Chapman and Hall
4. HE White Introduction to atomic Spectra

SEMESTER III (16C)

PHY3C10: QUANTUM MECHANICS –II (4C)

(Contact hours -72 hrs; Credit-4; Max. Ex. Marks: 60; Max.Int.Marks:15)

Module 1: **Time dependent perturbation theory**:Time dependent perturbation theory - Transition probability, Transition probability for a constant Perturbation – Transition probability for a Harmonic perturbation, Interaction of an atom with radiation - Induced emission and absorption, The dipole approximation – selection rules.(Book2-chapter 10 relevant sections)

Module 2: **Theory of scattering:**Scattering cross section, scattering amplitude of spinless particles – scattering am;plitude and differential cross section- The Born approximation - Method of partial waves for elastic scattering, phase shifts, Optical theorm, , The Born approximation, (Book2 chapter 11 – relevant sections)

Module 3: **Identical particles:** Identical particles, Construction of symmetric and anti symmetric wave functions- Slater determinant, Pauli exclusion principle - Bosons and Fermions, Spin and Statistics - Two electron systems- Helium atom – Scattering of identical particles. (Book1- Chapter9)

Module 4: **Relativistic Quantum Mechanics**:

Early developments, the Klein-Gordon equation, charge and current densities, The Dirac equation, Dirac matrices, solution of free particle Dirac equation, spin of the electron, Equation of continuity, Hole theory, Dirac equation with potentials, Non-relativistic limit, Dirac equation for Hydrogen atom, Spin orbit coupling, Covariance of Dirac equation, The Weyl equation for the neutrino, Non-conservation of parity, Wave equation for photon, Charge conjugation for the Dirac and Klein Gordon equation, CPT theorem. (Book1chapter 10 relevant sections)

Module 5: **Quantization of fields**:

The principles of canonical quantization of fields, Lagrangian density and Hamiltonian density,

Second quantization of the Schrödinger wave field for bosons and fermions,(Book1Chapter 11relevant sections)

Module 6: **Interpretations of Quantum Mechanics:**

Quantum theory of measurement, Delayed choice experiment, Einstein-Bohr controversy, EPR paradox, Hidden variables, Bell's theorem, Epistemological and Ontological problems raised by quantum Mechanics (Book1chapter 12)

Books for study

1. V.K. Thankappan: "Quantum Mechanics" (Wiley Eastern)

2 .N.Zettili, , "Quantum Mechanics – Concepts and applications' (John Wiley & Sons,2004)

References:

1. L.L. Schiff : Quantum Mechanics" (McGraw Hill)

2. J.J. Sakurai : "Advanced Quantum Mechanics " (Addison Wesley)

3. Stephen Gasiorowicz : "Quantum Physics"Wiley

4.Powell and Crascmann, Quantum Mechanics, Addison-Wesley.

5. Biswas S.N. Quantum Mechanics

6. Bransden and Joachain, Introduction to quantum Mechanics, ELBS

7 . P.M Mathews and Venkatesan., “A Textbook of Quantum Mechanics" (Tata McGraw Hill)

8. J.D. Bjorken and D. Drell : “Ralativistic Quantum Fields” (McGraw Hill 1998)

PHY 3C11 - SOLID STATE PHYSICS (4C)

(Contact hours -72 hrs; Credit-4; Max. Ex. Marks: 60; Max.Int.Marks:15)

Module 1: Bragg law - Scattered wave amplitude - Brillouin Zones - Fourier analysis of the basis - Quasi crystals (Chapter 2)

Module 2: Vibrations of crystals with monatomic and diatomic basis - Quantization of elastic waves - phonon momentum - Phonon heat capacity (Chapters 4 & 5)

Module 3 : Energy levels in 1D - Effect of temperature on Fermi - Dirac distribution - Free electron gas in three dimension - Heat capacity of electron gas - Electrical conductivity and Ohm's law - Hall effect -Thermal conductivity of metals – Nanostructures - Nearly free-electron model - Bloch functions - Kronic-Penny model - Wave equation of electron in a periodic potential (Chapters 6 & 7)

Module 4: Band gap - equations of motion - Intrinsic carrier concentration - Impurity conductivity - Calculation of energy bands (Chapters 8 & 9)

Module 5: Superconductivity - Experimental and Theoretical survey (Chapter 12)

Module 6: Ferroelectric crystals –Antiferroelectricity - Ferroelectric domains – Piezoelectricity - Langevin equation - Quantum theory of diamagnetism of mononuclear systems - Quantum theory of paramagnetism - Cooling by isentropic demagnetization - ferromagnetic, ferrimagnetic and antiferromagnetic order - ferromagnetic domains - single domain particles (Chapters 14 & 15)

Text Books

1. C.Kittel-Introduction to Solid State Physics-VII Edition –John Wiley & Sons.

References

1. A.J.Dekker –Solid State Physics – Macmillan
2. Azaroff.V –Introduction to Solids-TMH
3. Omar Ali-Elementary Solid State Physics-Addison Wesley.
4. J.S.Blakemore-Solid State Physics-Cambridge University Press.
5. S.O.Pillai-solid State Physics-New Age International Publishers.
6. Gupta-Solid State Physics – Vikas Publishing
7. V.S Muraleedharan & A Subramania – Nano Science & Technology- Ane Books Pvt Ltd,2009
8. Bharat Bhushan(Ed), Hand book of Nano Technology, Springer 2003
9. Gouzhong Cao, Nano structure and Nano materials: Synthesis, Properties and applications, Imperial college press, 2004
10. M.A.Wahab –Solid State Physics-Structure and Properties of Materials-Narosa Pub.

PHY 3C12: NUCLEAR AND PARTICLE PHYSICS (4C)

(Contact hours -72 hrs; Credit-4; Max. Ex. Marks: 60; Max.Int.Marks:15)

1. **Basic properties of nucleii and study of nuclear force**:Nuclear size, shape, mass and binding energy, semi empirical mass formula, Angular momentumand parity, nuclear electromagnetic moments, characteristics of nuclear force, the deuteron, nucleon-nucleonscattering the exchange force model.
Texts: Introductory Nuclear Physics by Kenneth S Krane
Sections: - 3.1 $\rightarrow$3.5, 4.1, 4.2, 4.4 & 4.5
Reference Books: (1) Introduction to Nuclear Physics by Harald Enge
(2) Nuclear Physics by Roy & Nigam

2. **Nuclear Models**:The shell model, shell model potential, spin-orbit potential, magnetic dipole moments, electric quadruple moments, valence nucleons, Even Z-even N nucleii and collective structure.
Text: Kenneth S Krane- Section 5.1 & 5.2
Reference: Harald Enge and Roy & Nigam

3. **Nuclear Decays**:Beta decay, Energy release in beta decay, Fermi theory of beta decay, Experimental tests of the Fermi theory, angular momentum and parity selection rules, parity violation in beta decay. Energetics of gamma decay, classical electromagnetic radiation, transition to quantum mechanics, angular momentum and parity selection rules, Internal conversion.
Text: Kenneth S Krane - Sections 9.1 $\rightarrow$ 9.4 and 9.9, 10.1$\rightarrow$ 10.4 and 10.6
Ref : Harald Enge and Roy & Nigam

4. **Nuclear Reactions, Fission and Fusion:**Types of reactions and conservation laws, Energetics of nuclear reactions, reaction cross sections,compound nucleus reactions, Nuclear fission, characteristics of fission, energy in fission, Nuclear fusion: basic fusion processes, characteristics of fusion, solar fusion.
Text: Kenneth S Krane - sections 11.1, 11.2, 11.4 and 11.10, 13.1, 13.2 and 13.3, 14.1, 14.2 and 14.3
References : Harald Enge and Roy & Nigam

5. **Particle Physics:** Basic forces and classification of particles: The four basic forces, The force of gravity, the electromagnetic force, the week force and electroweak theory, the strong force.
Conservations laws: Conservation laws and symmetries, conservation of energy and mass, conservation of linear momentum, conservation of angular momentum, conservation of electric charge,conservation of baryon and lepton numbers, conservation of strangeness, conservation of isospin and its components, the TCP theorem, conservation of parity.
Quark model: The eightfold way, discovery of omega minus, the quark model, the confined quarks, experimental evidences for quark model, coloured quarks, quantum chromodynamics and gluons, Enough exercises.
Text: The particle Hunters - Yuval Ne‟eman & Yoram kirsh
Sections : 6.1-6.3, 7.1-7.11 and 9.1-9.8.
References: 1. Introductory nuclear Physics by Samuel S.M. Wong, Chapter 2
2. Introduction to Elementary Particles-David Griffiths.
For further reference:
Nuclear Physics: Fundamentals and Applications Video Prof. H.C. Verma IIT Kanpur
http://nptel.iitm.ac.in/courses/115104043/

ELECTIVE-I (Any one from PHY 3E01 to PHY 3E05)

SEMESTER IV (25C)

PHY4C14- OPTICS (4C)

Module- I: Laser and Modern Optics

Quantum Optics: Spatial and temporal coherence, classical coherence correlation function; Basic idea of quantum coherence correlation function, coherent states and its properties

Laser: Interaction of radiation with matter, Einstein coefficients, Light amplification; Population Inversion, pumping processes; rate equation for three and four level systems; Semi-classical theory of lasers, Cavity modes, Quality factor of cavity and ultimate line width of laser. Directionality and mono chromaticity of laser and coherence properties. Principles of Ruby, He-Ne, CO_2 ,Dye and Semi-conductor Lasers.

Module -II

Electro-optic effect - Kerr effect, Pockels effect, Electro-optic amplitude and phase modulation, Electro-optic effect in KDP crystals-longitudinal and transverse modes, electro-optic effect in Lithium Niobate, index ellipsoid in the presence of an external electric field, Magneto-optic effect - Faraday effect optical activity.

Nonlinear interactions of light and matter

Nonlinear polarization of the medium, Optical susceptibility tensor, Generation of second harmonic, Sum frequency and difference frequency generation, Optical rectification, Parametric amplifier and oscillation, Generation of third harmonic, Intensity dependent refractive index, Self-focusing, Wave equation for nonlinear optical media, Coupled wave equation for sum frequency generation,. Generation of second harmonic – Phase matching – Type I and Type II phase matching – Frequency mixing – Parametric amplifiers and oscillator –Spatial solitons – Stimulated Raman scattering (SRS) – Inverse Raman scattering (IRS) – Stimulated Raman Gain Spectroscopy (SRGS) – Coherent Antistokes Raman Scattering (CARS)

Module– III : Fibre Optics

Single mode and multimode with different refractive index profiles. Ray theory transmission- total internal reflection, acceptance angle, numerical aperture, transmission characteristics of optical fibres: attenuation and dispersion.,Signal Degradation In Fibers - Attenuation, Absorption, Scattering and Bending losses in fibers, Core and Cladding losses. Signal distortion in optical wave guides: Material dispersion, waveguide dispersion and intermodal dispersion. Pulse broadening in optical fibers. Power launching in Optical fibers, Source-output pattern,optical fibre amplifier as next generation lasers

References:

1. Lasers and Non-Linear Optics by B.B.laud (Wiley East. Ltd., New Delhi)

2. Quantum Optics by S.H.Kay and A.Maitland (Academic Press, London)

3. Non-Linear Optics by P.G.Harper and B.S.Wherrett (Academic Press, London)

4. . Laser spectroscopy: Edited by J.L.Hall

PHY4C15 - NUMERICAL TECHNIQUES &PROBABILITY (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

Probability and Expected Value

Probability definition- Calculation of Probability- Addition theorem of Probability- Multiplication theorem – Baye's theorem (Chapter 1 Book 1)

Theoretical Distributions

Binomial distribution (Pascal's triangle, Properties of binomial distribution, constants of binomial distribution, fitting a binomial distribution)– Poisson Distribution (Role of the Poisson distribution, constants of Poisson distribution, fitting a Poisson distribution, Poisson distribution as an approximation of the binomial distribution)- Normal distribution (Graph of Normal distribution, Relation between Binomial, Poisson and Normal distributions,

Properties of normal distribution, conditions for normality, constants of Normal distribution , area under the Normal curve).(Chapter 2, Book1)

CHI-Square test

χ^2 Distribution-Probability Density Function of χ^2 Distribution- Application of the χ^2 distribution- χ^2 test of goodness of fit.(Book 3)

Roots of transcendental equations

Bisection method, ordinary iteration method, condition for convergence, order of convergence, geometric signific ance, Regula –Falsi method, order of convergence, geometric significance Newton- Raphson method, order of convergence, geometric significance. (Book 4)

Differences

Forward and backward differences. Difference tables, Detection of errors, Difference of a polynomial. (Book 4)

Interpolations and Curve Fitting

Linear interpolation, Polynomial interpolation, Lagrange's interpolation, Newton's forward and backward interpolation formulae. Errors in interpolation. Least squares curve fitting (linear and non linear).(Book 4)

Numerical Integration

Trapezoidal rule, Simpson,s 1/3 and 3/8 rules. Gauss quadrature.(Book 4)

Solution of First of Differential Equations

Euler's method, geometric significance, Modified Euler's method, geometric significance , Milne's method, Runge – Kutta method. (Second order and fourth order methods only)(Derivation not required) (Book 4)

Books for Study

1. Text book of Probability and Theoretical Distribution-A.K Sharma, Discovery Publishing House,New delhi.
2. Basic Statistics- A.L.Agarwal,New Age International Publishers
3. Fundamentals of Statistics- S.C Gupta-Himalaya Publishing House Seventh edition
4. Numerical Methoids – S.Arumugam,A.Thangapandi Isaac, A.Somasundaram-ScitechPublications Pvt.Ltd.

Books for Reference

1. Introductory Methods of Numerical Analysis- S.S Sastry: (Prentice Hall of India)
2. Numerical Mathematical Analysis- J.B.Scarborough-Oxford and IBH, 6th Edition.
3. Numerical Analysis-Golden Maths Series- R.Gupta-Luxmi Publicatios Pvt.Ltd

4. Probability and Statistics Second Edition- Murray R Spiegel,John Schiller R Alu Srinivasan- Tata McGraw- Hill Schaum's Outlines

For ELECTIVE-II (Any one from PHY 4E06 to PHY 4E12)
For ELECTIVE-III (Any one from PHY 4E06 to PHY 4E12 without repeatition)

PHY3P03/PHY4P03- (Practical –III) - ADVANCED PHYSICS AND ELECTRONICS

(*At least 16 experiments should be done-8 from section A and 8 from section B*)

Section A

(8 *experiments should be done, but not more than two from one cluster*)

Cluster 1

1 G.M .Counter-Plateau and statistics of counting -to determine operating voltage and to verify the distribution law satisfied by the radioactive decay.

2 Absorption coefficient of beta / gamma rays using G.M .Counter.

3 Feather Analysis-End point energy of the beta particles from the given source.

Cluster 2

1 Millikan's oil drop experiment- to determine the charge of an electron.

2 Thomson's *e/m* experiment - to determine the specific charge of an electron.

3. Michelson interferometer- to determine wave length of D1 and D2 lines of sodium light and dλ.

***Cluster 3**

1 Hydrogen Spectrum- to determine -the wave length of the Balmer series & Rydberg constant .

2 Absorption spectrum of $KMnO_4$ - to determine -the wave length of the absorption band.

3 Absorption spectrum of Iodine- to determine the dissociation energy of Iodine.

*(For experiments in Cluster 3 Digital Camera with PC is preferred. For examinations computer Analysis gets more weightage of marks)

Cluster 4

1 Determination of band gap energy of Si & Ge using forward & reverse biased semiconductor diode.

2 Four probe method- the bulk resistance and band gap energy of the given semiconductor.

3 Hall effect in semiconductor- Hall coefficient and carrier concentration.(Magnetic field should be determined using solenoid inductor/Hibbert's magnetic standard and search coil and verify it by a Gauss meter).

Cluster 5

1 Optical fiber characteristics- to determine the numerical aperture, attenuation and band width.

2 Solar cell-spectral response and I-V characteristics.

3 Electron spins resonance- to determine g- factor.

section B

(8 experiments should be done , but not more than two from one cluster)

Cluster 1

1 Microprocessor- binary addition ,subtraction, multiplication, square root of a number and factorial of a number.

2 Microprocessor- Generation of pulse waves of specified duty cycles .

3 Microprocessor-Sorting of numbers in ascending and descending order.

Cluster 2

1 Second order Butterworth filter-low, high and band pass filters.

2 Narrow band pass filter with multiple feedback and band reject(notch) filter.

3 Study of passive filters –low and high- and then that of an active first order filter using the same passive elements.

Cluster 3

1 Push pull amplifier using transistors (Class AB) & Complimentary symmetry amplifier using single/dual power supply.

2 Power Amplifier using LM380 IC - To study the performance of different types of speakers.

3 IF Tuned Amplifier.

Cluster 4

1 Amplitude modulation and Detection.

2 Frequency modulation using NE566/C2206 and demodulation using IC NE565.

3 Pulse modulation and demodulation, Pulse width modulation.

Cluster 5

1 Wide band ac voltmeter.

2 Low voltage dc voltmeter using Op-Amp.

3 Low Distortion function generator.

References:

1. Worsnop& Flint – Advanced Practical Physics – Methusen& Co.

2. C.J Babu, Lab manual, Calicut University

3. S.L Gupta & Kumar, Practical Physics – PragathiPrakashan

4. K.A Navas – Electronics Lab Manual – 3rd Ed – Rajath Publishers.Ernakulam

5. S. PoornachandraRao& B Sasikala – Hand book of experiments in Electronics and Communication Engineering – Vikas Publishing House

6. Paul B Zbar and Malvino A.P – Basic Electronics – A Lab Manual – TMH.

7. S.PoornachandraRao& B Sasikala – Electronics Laboratory Primer – A Design approach – Wheeler Publications.

8. Bogart R and Brown J – Experiments for electronic devices and circuits – Merill International series.

9. Lab Experiments (LE) Vol. 2 No. 3 December 2002,Vol. 3 No. 2 June 2003.

Elective courses- (Semester III)

PHY3E01- PLASMA PHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1.Introduction to Plasma Physics : Existence of plasma, Definition of Plasma, Debye shielding 1D and 3D, Criteria for plasma, Applications of Plasma Physics (in brief), Single Particle motions - Uniform E & B fields, Non uniform B field, Non uniform E field, Time varying E field, Adiabatic invariants and applications . (13 hours

Text: Chen, Sections 1.1 to 1.7.7, 2.1 to 2.8.3

2. **Plasma as Fluids and waves in plasmas** : Introduction –The set of fluid equations, Maxwell's equations, Fluid drifts perpendicular to B, Fluid drifts parallel to B, The plasma approximations , Waves in Plasma - Waves, Group velocity, Phase velocity, Plasma oscillations, Electron Plasma Waves, Sound waves, Ion waves, Validity of Plasma approximations, Comparison of ion and electron waves, Electrostatic electron oscillations with B, Electrostatic ion waves with B, The lower hybrid frequency, Electromagnetic waves with B0, Cut-offs and Resonances, Electromagnetic waves parallel to B0, Experimental consequences, Hydro magnetic waves, Magnetosonic waves, The CMA diagrams. (16 hours)
Text: Chen, Sections 3.1 to 3.6, 4.1 to 4.21

3. **Equilibrium and stability** : Hydro magnetic equilibrium, The concept of β Diffusion of magnetic field into plasma, Classification of instability, Two stream instability, the gravitational instability, Resistive drift waves, the Weibelinstability . (11 hours)

Text: Chen, Sections 6.1 to 6.8

4. **Kinetic Theory** : The meaning of f(v), Equations of kinetic theory, Derivation of the fluid equations, Plasma oscillations and Landau damping, the meaning of Landau damping, Physical derivation of Landau damping, Ion Landau damping - Kinetic effects in a magnetic field. (10 hours)

Text : Chen, Sections 7.1 to 7.6.2

5. **Introduction to controlled fusion.** The problem of controlled fusion-magnetic confinements such as toruses – mirrors –pinches- laser fusion – plasma heating – fusion technology. (10 hours)

Text: Chen, Sections 9.1 to 9.8

Text Books: .

F. F. Chen, Introduction to Plasma Physics and Controlled Fusion, Volume I and II, Plenum Press, 2nd Edn.

Books for Reference:

1. J. D. Jackson, Classical Electrodynamics, Wiley Eastern, 1978.

2. D. R. Nicholson, Introduction to Plasma Theory.

3. N. A. Krall and A. W. Trivelpiece, Principles of Plasma Physics, McGraw-Hill

PHY3E02-RADIATION PHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Radiation source:

Types of radiations, ionizing, non-ionizing, electromagnetic, particles, neutral -gamma-neutrino neutron, charged alpha, beta, gamma, and heavy ion sources, radioactive sources – naturally occurring production of artificial isotopes, accelerators–cyclotrons, nuclear reactors.{Ref 1, 2}

2. Interaction of radiations with matter:

Electrons – classical theory of inelastic collisions with atomic electrons, energy loss per ion pair by primary and secondary ionization, specific energy loss, bremsstrahlung, range energy relation, energy and range straggling Heavy charged particles – stopping power, energy loss, range and range – energy relations, Bragg curve, specific ionization, Gamma rays – Interaction mechanism – Photoelectric absorption, Compton scattering, Pair production, gamma ray attenuation, attenuation coefficients, Elastic and inelastic scattering, Cross sections, linear and mass absorption coefficients, stopping power, LET, Neutrons – General properties, fast neutron interactions, slowing down and moderation. Ref 1,2}

3. Radiation quantities, Units and Dosimeters:

Particle flux and fluence, calculation of energy flux and fluence, curie, Becquerel, exposure and its measurements, absorbed dose and its relation to exposure, KERMA, Biological effectiveness, weighting factors, (WR and WT), Equivalent dose, Effective dose, Dosimeters, Primary and secondary dosimeters, Pocket dosimeter, Films and solid dosimeter (TLD and RPL), Clinical and calorimetric devices , Radiation survey meter for area monitoring. {Ref 2,3}

4. Biological effects:

Basic concepts of cell biology, Effects of ionizing radiations at molecular, sub molecular and

cellular levels, secondary effects, free radicals, deterministic effects, stochastic effects,,, Effects on tissues and organs, genetic effects, Mutation and chromosomal aberrations, applications in cancer therapy, food preservation, radiation and sterilization {Ref 3,4}

5. Radiation protection, shielding and transport:

Effective radiation protection, need to safeguard against continuing radiation exposure, justification and responsibility, ALARA, concept of radiologic practice. Time distance and shielding, safety specifications. method of radiation control, Shielding factor for radiations, Choice of material, Primary and secondary radiations, Source geometry, Beta shielding, Gamma shielding, neutron shielding, Shielding requirements for medical, industrial and research facilities, handling of the source, sealing, transport and storage of sealed and unsealed sources. records, spills. waste disposal, Enough exercises. {Ref 3,4,5}

References :

1. G.F.Knoll, Radiation detection and measurement, John Wiley & sons, New York, (2000)

2. K.Thayalan, Basic radiological physics, Jaypeebrothers medical Publishers, New Delhi, (2003)

3. W.J. Meredith and J.B. Masse, Fundamental Physics of radiology, Varghese publishing house , Bombay (1992)

4. M.A.S. Sherer, P.J.Visconti, E.R Ritenour, Radiation Protection in medical radiography, Mosbey Elsevier,(2006)

5. Lowenthal G.C and Airey P.L., Practical applications of radioactivity and nuclear radiation sources, Cambridge University Press (2005)

PHY3E03 -MICROPROCESSOR AND APPLICATIONS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Instruction set of 8085 & programming

Processor cycles—Instruction format of 8085—Addressing modes—Instruction set (Data transfer,Arithmetic,Logical,Branching& Machine control)—Timing diagrams (including the timing diagrams of 8085 instructions)—Assembly language programming—subroutine—delay routine—Assembly language programming in 8085 .

2. Memory and I/O interfacing

Memory mapping and I/O mapping—Address space partition—memory interspacing—Data transfer schemes—Programmed data transfer—direct memory access data transfer—serial data transfer

3. Interrupt structure

Need for interrupts—types of interrupts—software interrupts of 8085—Hardware interrupts of 8085—Enabling, disabling and masking of 8085 interrupts

4. General Purpose Interfacing devices

Generation of control signals for Memory and I/O devices—I/O ports (Intel 8212,8155)—Programmable peripheral interface (8255)—Programmable DMA controller (8257) – Programmable communication interface – USART (8251) – Programmable interrupt controller (8259) – Programmable interval timer/counter (8253)

5. Special purpose interfacing devices

Arithmetic co-processors (8087, 80287, 80384 and AMD 9511) – Intel 8231 – Intel 8275H – Intel (8271, 8272A)– 82064 – 8295 – Programmable keyboard/display interface(8279)-- Dynamic RAM Controller (8203, 8207, 8208) – ADC (0800, 0808) – Sample and hold – Zero cross detector –Phase shifter – Current to voltage convertor – Precision rectifier – Over voltage protection .

6. Micro controllers:

Overview of 8051 microcontroller; Inside 8051; 8051 register and stack, enough exercises.

7. Applications of Microprocessors:

Delay subroutine—7- segment LED display—Microprocessor based Protective relays—Measurement of electrical quantities—Measurement of physical quantities—stepper motor—Microprocessor based Traffic control—To generate square waves using microprocessor—Microprocessor based control of firing circuit of Thyristor—Interfacing of digital Multiplexer/data selector—interfacing of digital demultiplexer /decoder—Digital clock—washing machine controller.

Books for Study:

1. Fundamentals of Microprocessors and Microcomputers --- B. Ram ---DhanpatRai Publications

2. Introduction to Microprocessors –A.P. Mathur—TMH

3. Microcontrollers and embedded systems—Muhammed Ali Mazidi& Janice GuillespieMazidi—PHI

References:

1.Microprocessor Architecture Programming and applications with the 8085—Ramesh Gaonkar-5th edn.—PRI

2.Microprocessor interfacing—Gibson &Liu

3.Microprocessors—Gilmore

4.Microprocessors& its applications—R. Theagarajan,S. Dhanasekaran,S. Dhanapal

PHY3E04- CHAOS & NONLINEAR PHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Linearity and non-linearity: What is non-linearity- Linear and non-linear forces.mathematical applications of non-linearity.Working definition of non-linearity.effects of non-linearity. (Section1.1 1.4 and 2.1 2.24)

2. Linear and non-linear oscillators (Section 3.1 – 3.5, 3.8)

3. Qualitative features of non-linear systems (Section5.1- 5.6)

4. Discrete dynamical systems the logistic map. Stability.cycles. Doubling phenomena.Onset of chaos.Bifurcation.Lyapunov exponent. (Section 6.1 – 6.4)

5. Chaos in non-linear electronic circuits. Linear and non-linear circuits.Chas diode – Practical implementation.Bifurcation and chaos. (Section 11 – 11.8)

6. Characterization or regular and chaotic motions.

Lyapunov exponents.Numerical method of computing Lyapunov exponents. ID map. Lyapunov exponent for continuous time dynamical systems.

(Section 15.1 – 15. 3,4)

Book for Study:

Nonlinear Dynamics, M.Lakhmanan&S.Rajasekar, Springer Publishing Co.

PHY4E08- COMPUTATIONAL PHYSICS

1. Introduction to Python Programming:

Concept of high level language, steps involved in the development of a Program - Compilers and

Interpreters - Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs - Variables, operators, expressions and statements - ,Strings, Lists, Tuples, and Dictionaries, Conditionals, Iteration and looping -

2. Advanced Python Programming:

Functions and Modules -. Mathematical functions (math module), File input and Output, Pickling., Formatted Printing , Exception Handling Mathematics with python – Numpy module:- Arrays and Matrices – creation of arrays and matrices (arange, linspace, zeros, ones, random, reshape, copying), Arithmetic Operations, cross product, dot product , Saving and Restoring, Matrix inversion, solution of simultaneous equations, Data visualization- The Matplotlib, Module- Plotting graphs, Multiple plots, .Polar plots, Pie Charts, Plotting mathematical functions, Sine and other functions, Special functions – Bessel & Gamma, .Parametric plots, Power Series, Fourier Series, 2D plot using colors, Fractals

3. Numerical Methods*:

Roots of transcendental equations : Solution by successive approximation, Convergence criterion, Order of convergence, Newton-Raphson method, Bisection (half interval) method, Interpolation and curve fitting : Linear interpolation, Interpolating polynomials, Lagrange interpolating polynomial, Difference calculus, Detection of errors, Newton forward and backward difference formulae, Least squares curve fitting (linear and nonlinear)

4. Introduction to Computational approach in Physics*:

One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium - Simulation of free fall and numerical integration, Two dimensional motion: Projectile motion (by Euler method)- Accuracy considerations .(elementary ideas) Oscillatory motion – Ideal Simple Harmonic Oscillator (Euler method), Motion of a damped oscillator (Feynmann-Newton method) , Enough exercises.

(Visualisation can be done with matplotlib/pylab)

*(Programs are to be discussed in Python lab)

Text books for Numerical Methods:

1. Introductory methods of numerical analysis, S.S. Shastry , (Prentice Hall of India,1983)

2. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, New Delhi (or any other book)

3. Numerical Mathematical Analysis, J.B. Scarborough

References:

(For Python any book can be used as reference. Moreover a number of open articles are available freely in internet. Python is included in default in all GNU/Linux platforms and It is freely downloadable for Windows platform as well. However use of GNU/Linux may be encouraged).

1. www.python.org

2. Python Essential Reference, David M. Beazley, Pearson Education

3. Core Python Programming, Wesley J Chun, Pearson Education

4. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This

Tutorial can be obtained from website http://www.altaway.com/resources/python/tutorial.pdf

5. How to Think Like a Computer Scientist: Learning with Python, Allen Downey , Jeffrey

Elkner , Chris Meyers, http://www.greenteapress.com/thinkpython/thinkpython.pdf

6. Numerical Recipes in C, second Edition(1992), Cambridge University Press

7. Numerical Recipes in Fortran 77, second Edition(1992), Cambridge University Press

8. Numpy reference guide, http://docs.scipy.org/doc/numpy/numpy-ref.pdf (and other free resources available on net)

9. Matplotlib , http://matplotlib.sf.net/Matplotlib.pdf (and other free resources available on net)

10. Numerical Methods, E Balagurusamy, Tata McGraw-Hill

11. Numerical Methods , T Veerarajan, T Ramachandran, Tat MCGraw-Hill

12. Numerical Methods with Programs I BASIC, Fortran& Pascal, S BalachandraRao, C K Shantha. Universities Press

13. Numerical methods for scientists and engineers, K. SankaraRao, PHI

14. Computational Physics, V.K.Mittal, R.C.Verma&S.C.Gupta-Published by Ane Books,4821,Pawana Bhawan,first floor,24 Ansari Road,DaryaGanj,New Delhi-110 002 (For theory part and algorithms. Programs must be discussed in Python)

15. Numerical Methods in Engineering with Python by JaanKiusalaas

PHY3E05- ATMOSPHERIC PHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Introduction

Sub earth and the atmosphere. Sun-Earth relationship.Solstices and equinoxes.Motion of earth.Concept of time. Map projections. Vertical thermal structure of the atmosphere.Composition of the atmosphere-dry air, water vapor and aerosols.

2. Atmospheric radiation

Radiation.Laws of black body radiation.Radiation transfer.Solar radiation – latitudinal and seasonal variations.Passage through the atmosphere – absorption, scattering and reflection. Mean disposition of solar radiation. Terrestrial radiation – absorption in the atmosphere.Atmospheric window.Radiative heat exchange. Influence of clouds on radiation fluxes. Mean heat balance of earth – atmosphere system. Atmospheric green house effect – pole ward transport of energy – fundamental link with the general circulation.

3. Atmospheric thermodynamics

Gas laws and their application to the atmosphere.Equation of state for dry and moist air.Humidity parameters.Virtual temperature.First and second laws of thermodynamics.Specific heats of gases.Internal energy. Adiabatic processes. Potential temperature.Specific heats of gases.Internal energy. Adiabatic processes. Potential temperature.Entropy.Reversible and irreversible processes.

Carnot's cycle, thermodynamics of water vapor. Latent heat. The Clausius – Clapeyron equation. Thermodynamics of the atmosphere. Dry adiabatic laps rate – case of unsaturated moist air. Saturated adiabatic lapse rate.Pseudo adiabatic cases – equivalent potential temperature and saturation potential temperature. Normand's propositions – Normand point.

4. Atmospheric instability and convection

Stability criteria – parcel method – Brunt – Vaisala oscillations. Lifting, mixing and convective condensation levels. Potential instability and latent instability – stability indices – slice method of stability analysis. Growth of cumulus clouds – entrainment. Condensation and precipitation – cloud formation – condensation nuclei – growth of cloud droplets – growth of snow crystals – dew, fog, rain, hail and snow.

5. Environmental meteorology

Atmospheric pollution – definition.Sources and extent of pollution.Primary and secondary pollutants. Meteorological factors affecting air pollutants. Physical and effective stock height.Air pollution control and abatement.Urban planning.Urban and rural building climatology.

Books for study

1. Introduction to Theoretical meteorology, S.L. Hess.

2. Dynamic and Physical meteorology, G.H.Haltiner& martin

3. Clouds, Rain and Rainmaking, B.J.Mason

4. Physical meteorology, B.J. Retallac

5. Atmospheric Physics, J.V. Iribarne& H.R. Cho

6. An Introduction to Atmospheric Physics, D.G. Andrews. Meteorological Aspects of Air Pollution, WMO Technical Note.

Elective courses- (Semester IV)

PHY 4E06-OPTOELECTRONICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1.**Semiconductor Science and Light Emitting Diodes** (10 hrs)

Semiconductor energy bands - semiconductor statistics – extrinsic semiconductors – compensation doping – degenerate and non-degenerate semiconductors – energy band diagrams in applied field - direct and indirect band gap semiconductors, - p-n junction principles - open circuit- forward and

reverse bias – depletion layer capacitance – recombination life time – p-n junction band diagram - open circuit - forward and reverse bias – light emitting diodes – principles - device structures - LED materials, heterojunction high intensity LEDs – double heterostructure - LED characteristics and LEDs for optical fibre communications - surface and edge emitting LEDs.
(Book 1 Ch 3)

2.**Laser Output Control** (6 hrs)

Generation of high power pulses, Q-factor, Q-switching for giant pulses, methods of Q-switching, mode locking and techniques for mode locking.

Book 2 (Chapter 13)

3.**Photodetectorsand Photovoltaics** (18 hrs)

Principle of p-n junction photodiode - Ramo's theorem and external photocurrent - absorption coefficient and photodiode materials - quantum efficiency and responsivity - PIN-photodiode – avalanche photodiode – phototransistor - photoconductive detectors and photoconductive gain - noise in photo-detectors – noise in avalanche photodiode - solar energy spectrum - photovoltaic device principles – I-V characteristics - series resistance and equivalent circuit - temperature effects - solar cell materials, device and efficiencies

Book 1 (Chapter 5 & 6)

4.Optoelectronic Modulators (10 Hrs)

Optical polarization, birefringence, retardation plates, electro-optic modulators – Pockels effect - longitudinal and transverse electro-optic modulators, Kerr effect, Magneto-optic effect, acousto-optic effect – Raman Nath and Bragg-types.

5.Non-linear optics(8 Hrs)

Wave propagation in an anisotropic crystal - polarization response of to light - second order non-linear optical processes - second harmonic generation - sum and frequency generation, optical parametric oscillation - third order non-linear optical processes - third harmonic generation - intensity dependent refractive index - self-focusing - non-linear optical materials, phase matching - angle tuning - saturable absorption – optical bistability - two photon absorption.

Book 2 Chapter 16

Text Books:

1. Optoelectronics and Photonics: Principles and Practices, S.O. Kasap, Pearson 2009,

2. Laser fundamentals, William T. Silfvast, CUP 2nd Edn. (2009),

3. Fiber optics and Optoelectronics, R.P. Khare, Oxford University

Press, (2004), (Chapter 9)

4. Optoelectronics: an Introduction, J. Wilson and J.F.B. Hawkes,

PHI, (2000), (Chapter 3)

Reference Books:

1. Semiconductor optoelectronic devices: Pallab Bhattacharya, Pearson(2008)

2. Optoelectronics: An introduction to materials and devices, Jasprit Singh,

McGraw Hill International Edn., (1996).

2.Optical waves in crystals: Propagation and Control (2003)

PHY4E07-ASTROPHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1.Stellar magnitude sequence: Absolute magnitude and distance modulus, Colour index of a star, Luminosities of stars. Spectral classification of stars, Boltzmanns formula, Saha's equation of thermal ionization, Harward system of classification, Luminosity effect of stellar spectra, Importance of ionization theory, Spectroscopic Parallax-. Hertzsprung - Russel diagram. (10 hours)

2. Structure and evolution of stars, Observational basis, Equation of state for stellar interior, Mechanical and thermal equilibrium in stars, Energy transport in stellar interior, Energy generation in stars (thermonuclear reactions), Stellar evolution, White dwarfs Neutron stars, pulsars and black holes. (12 hours)

3. Binary and multiple stars – Introduction – Visual binary – spectroscopic binary – eclipsing binary – multiple stars – origin of binary stars – stellar masses and mass-luminosity relation – mass transfer in close binary systems. (10hrs)

4. Extragalactic Astronomy – Introduction – Normal galaxies – morphological classification – physical characteristics and kinematics – open questions – expansion of the universe – active galaxies – The zoo of galactic activity – Superluminal motion in quasars – black hole as central engine – Unification scheme - clusters of galaxies – large scale distribution of galaxies – Gamma Ray Bursts. (14 hours)

5. The space-time dynamics of the Universe- Introduction – what is general relativity? – the metric of the Universe – Friedmann equations for the scale factor – Contents of the Universe – The cosmic black body radiation – The evolution of the matter dominated universe – The closed solution (k=1) – The open solution (k=-1) – Approximate solution for early epochs – The age of the Universe – The evolution of the radiation dominated universe. (14 hours)

Text books:

1. Baidyanath Basu M : "An introduction to Astrophysics" (Prentice Hall of India) Relevant sections of Chapters 3,4,7, 14 and 15.

2. Arnab Rai Choudhuri: "Astrophysics for Physicists"- Cambridge University Press. (Chapters 9 and 10).

Reference books:

1. Text Book of Astronomy and Astrophysics with Elements of Cosmology- V.B. Bhatia-

Narosa publications (2001) ISBN: 81-7319-339-8

2. Modern Astrophysics - B.W. Carroll & D.A. Ostille - Addison Wesley (1996) ISBN:0- 201-54730-9

PHY4E08- ELECTRONIC INSTRUMENTATION (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1.**Basic concepts of measurement**

A generalized measurement system – Basic characteristics of measuring devices

instruments (Book 1 & 5)

2.**General purpose electronic test equipment**

Cathod ray oscilloscopes – Schematic block diagram – Electrostatic deflection – CRT

circuit vertical, deflection system – Horizontal deflection system – Oscilloscope

probes and transducer oscilloscope techniques – special oscilloscopes storage

oscilloscopes – Degital voltmeters Multi meters – Electronic counters – AC milli

voltneters – Wave analyzers& Spectrum Analyze – Signal generators – Regulated

power suppliers – Lock in Amplifier – Frequency response Analyzer. (Book 1 & 2)

3. **Transducers**

Transducer classification – principles of transducers – digital transducer – lev measurements – (Book 1&2)

4. Strain

Types of strain Gauges – theory of operation of resistance strain Gauges – type of electrical strain gauges – Materials for strain gauges – strain gauges circuits – Temperature compensation - applications. (Book 1)

5. **Power control**

Thyristors – terminal characteristics of Thyristors – thyristor turn-on-methods- Switching characteristics of Thyristors-thyristor gate characteristic. Series and parallel operation of thyristors – other members of the Thyristor family(Book 3)

Inverters – single phase voltage source inverters – operating principle (Book 3)

6. **Biomedical instrumentation**

Niomedial Recorders – Electro cardiographs (E.C.G) – Electrodes for E.C.G –

Electro cardiogram — Electro encephalograph (E..E.G) --Electro myograph (E.M.G.)

C T scan—MRI scan—Ultrasound scan—Endoscope--Pace maker-- (only block diagrams)

Books for Study

1.Instrumentation Devices and systems 2nd Edn – C.S Rangan and G.R. Sarma and V.S.V. Mani (TMH)

2.Modern electronic instrumentation and measurements techniques (2002)- Albert D Helfrick and William d cooper (PHI)

3.Power electronics – Dr.P.S.Bimbhra – Khanna Publishers

4.Hand book of Biomedical Instrmentation -R.S.Khandpur -TMH

5.Electronic Instrumentation H.S. Kalsi TMH

6. Medical Electronics and Instrumentation by Sanjay Guha – University Publication

7. A course in electrical and electronic measurement instrumentation. A.K.Sawhney DhanpatRai& Co

PHY4E09- COMMUNICATION ELECTRONICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1.Antennas

Antenna parameters – Effects of ground on antenna – Antenna equivalent circuits – coordinate system – radiation field –Polarization-Power gain of an Antenna-effective area of antenna-effective length of an antenna-Hertzian dipole-half wave dipole-Vertical antennas-loop ferrite rod antenna-on resonant antenna-driver array-plastic arrays-UHF – VHF antenna –

Directional h f antenna – microwave antennas – wideband special purpose antennas.

2.Amplitude and angle modulation:

Amplitude modulation – Amplitude modulation and demodulation circuits – single side band generation and detection – SSB balanced modulator – Comparison of signal to noise ratios – Frequency modulation - Phase modulation – Angle modulation circuits – Detection of FM signals – Foster–Seeley discriminator – Ratio detector – Noise in FM

3.Digital communication

Fundamental of data communication systems – digital codes. Pulse amplitude modulation – Pulse code modulation – Pulse frequency modulation – Pulse time modulation – Pulse position modulation – pulse width modulation. Basic digital communication systems – Synchronization – asynchronous

transmission – probability of bit error in base hand transmission – notched filter – bit, timing recovery – eye diagram – digital carrier systems – carrier recovery circuits – differential phase shift keying error control coding – multiplex transmission – frequency and time division multiplexing.

4.Microwave Electronics & Radar

Microwave - Generation of microwaves – Klystron: Reflex klystron – Multicavity Klystron – magnetron – detection of microwaves – IMPATT, TRAPTT AND gun diodes. Rader – basic principles – Radar performance factors – radar equations – pulse and CW Doppler radar – moving target indication – MTI and automatic tracking radar.

5.Fiber Optic Communication

The basic communication system-Modulation-light emitting diode modulation circuits-Laser diode modulation and circuits-Analog modulation formats-Digital modulation formats-optic heterodyne receivers-Analog system design-Digital system design.

Books for study

1.Electronic communication (4th Edition) – Dennixs Rooddy& John Coolen PH I (1999)

2.Electronic communication systems – (4th Edn) – George Kennedy & Bernard Davis (McGraw Hill (1992)

3.Electromagnetic waves and Radiating Systems", Jordan E.C. and Balmain, K.G. (PHI, 1979).

4. "Digital Signal Processing" by Proakis and Manolakis, Prentice Hall of India (1997)

5. Electronic communication systems SanjeevanguptaKhanna publications (1995)

6. Communication Electronis – N.D.Deshpande& D.A. Deshpande TMH (1998)

7. Fibre Optic Communication- Joseph C. Palais-Pearson education

8.Optical fibre & Laser-Principles and applications – Anuradha De New Age International (2004)

PHY4E10- CONDENSED MATTER PHYSICS (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Elementary Excitations in Solids

Interacting electron gas- HatreeFock approximation; Plasmons and electron plasmon interactions; Linhard equation for dielectric constant of electron gas; Electron Hole interactions-excitons; Block

and Wannier representations, Frenkelexcitons, Ion-ion interactions,-classical equations of motion-Energy in lattice vibrations;Phonon dispersion relations-density of states Spin-spin interactions-magnons.

Text: Introduction to solid state theory O Madlung Springer Ny1978

2. Alloying phenomenon:

Physics of alloy formation-Phase diagrams and alloy formation-Ternary groups and quaternary

groups- band structure calculation of alloys superstructures-quantum well structures- super lattices

Text: Semiconductor physics and Devices: S S Islam Oxford

3. Defects in solids and strength of materials:

Diffusion in solids, Vacancies, dislocations and mechanical strengths, ionic conductivity etching, photo graphic processes, radiation damage in solids, Fracture, Ductile and brittle fractures, Fracture mechanics, Fatigue, Crack initiation and propagation, Creep, Generalized creep behaviour, Stress and temperature effects.

Text: Elementary solid state physics, Ali Omar; Pearson and Mechanical properties of matter: AH Cortell, Wiley NY.

4. Nano scale science and technology

Nano materials and Quantum mechanics- quantum dots-Three dimensional Systems(bulk materials)-two dimensional systems(films)-one dimensional systems(quantum wires)-Zero dimensional systems(quantum dots)- Energy levels of quantum dots- nano wires and nanotubessynthesis and applications

Text: Nano technology- Principles and fundamentals: Ed G nter ũ Schmid, Wiley

5. Thin Film Technology and Applications

Thin film Growth process- Nucleation & film growth- Semiconducting thin films-Vapour deposition techniques- Solution deposition techniques- Optoelectronic applications of thin films- Micro electronic applications,

Texts: Thin film devises and applications: Chpora& I Kaur, Plenum Press

Thin Film Fundamentals: A Goswami New Age Publishers

Text and Reference books:

1. Solid State Physics: Structure and Properties of Materials by A. M. Wahab (Narosa

Publishing House, India) 2nd Edition 2005

2. Elements of Solid State Physics (second Edition) by J. P. Srivatsava (Printice Hall of

India) 2001

3 Introductory Solid State physics by H. P. Myers (Taylor & Francis Ltd, London) 2nd

Edition 1998

4. Solid State Physics by Ashcroft &Mermin 1st edition 2003

5. Solid State Physics by C. M. Kachhava (Tata McGraw-Hill) 1st Edition 1996

6. Solid State Physics by Kittle (Wiley, 7th Edition) 2004

PHY4E11-NANO SCIENCE AND TECHNOLOGY (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Introduction- definition- history (Chapter 1, Book 1)

2. Investigating and manipulating materials in the nano scale – Electron microscopies- Scanning probe microscopies- Optical microscopies- Mass and Ion beam spectroscopy- X ray diffraction –particle size determination   (Chapter 2, Book 1)

3. Properties of individual nano particles: metal nano clusters – semiconducting nanoparticles – methods of synthesis   (Chapter 4, Book 2)

4. Carbon nanostructures- caron molecules- carbon clusters- carbon nanotubes-applications (Chapter 5, Book 2)

5. Bulk nano structured materials: Solid disordered nanostructures- Methods of synthesis and properties – Nano structured crystals (Chapter 6, Book 2)

6. Quantum wells, wires and dots: Preparation of quantum nanostructures – Size and dimensionality effects – Excitons – Single electron tunneling – Applications – Superconductivity (Chapter 9, Book 2)

7. Nanostructured Ferromagnetism: Basics of ferromagnetism – Effect of bulk nanostructuring of magnetic properties – Dynamics of nanomagnets – Nanopore containment of magnetic particles – Nano carbon ferro magnets – Giant and colossal magneto resistance – Ferro fluids

(Chapter 7, Book 2)

Books for study:

1. T. Pradeep: Nano The Essentials, Tata McGraw Hill, 2007

2. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, Wiley, 2006

References:

1. Bharat Bhushan (Ed.): Handbook of Nanotechnology, Springer, 2003

2. G. Cao: Nanostructure and nanomaterials: Synthesis, Properties, Applications, Imperial College press, 2004

3. M. Hosokawa, K. Nogi, M. Naito and T. Yokoyama (Eds.): Nanoparticle technology

PHY4E12 -EXPERIMENTAL TECHNIQUES (4C)

(Contact hours -72 hrs; Max. Ext. Marks: 60; Max.Int.Marks:15)

1. Vacuum Techniques:

Units and basic definitions, Roughing pumps - Oil sealed rotary vacuum pump and Sorption pump, High vacuum pumps – Turbo molecular pump, Diffusion pump, Oil vapour booster pump, Ion pumps - Sputter ion pump and Getter ion pump, Cryogenic pump, Vacuum gauges - Pirani gauge, Thermocouple gauge, penning gauge (Cold cathode Ionization gauge) and Hot filament ionization gauge, Vacuum accessories – Diaphragm, Gate valve, Butterfly valve, Baffle and isolation valves, magnetic valves, adjustable valves, air inlet valves, Traps - Liquid nitrogen trap, Sorption traps, and gaskets and O rings

2. Thin film techniques:

Introduction, Fabrication of thin films, Thermal evaporation in vacuum – Resistive heating, Electron beam evaporation and laser evaporation techniques, Sputter deposition, Glow discharge, Thickness measurement by quartz crystal monitor, optical interference method, electrical conductivity measurement, Thermo electric power, Interference filters - Multi layer optical filters

3. Cryogenic techniques:

Introduction, Liquefaction of gases – Internal and external work methods, Hampsen and Linde and Claude methods for air, Liquefaction of hydrogen and KammerlinghOnne's method for helium, manipulation of liquefied gases and the maintenance of low temperature – Henning and Hydrogen vapour cryostat, using liquids boiling under reduced pressure, production of low temperature below 1 degee K – Adiabatic demagnetisation and magnetic refrigerator, Special properties of liquid helium, temperature below 10-6 K - Nuclear demagnetisation, Measurement of low temperatures – Primary thermometers - gas thermometers and corrections, secondary thermometers - resistance

thermometers, thermocouple thermometers, vapour pressure thermometers, magnetic thermometers

4. Accelerator techniques:

High voltage DC accelerators, Cascade generator, Van de Graff accelerator, Tandem Van de Graff accelerator, Linear accelerator, Cyclotron, Synchrotron (Electron and proton), Ion sources – Ionization processes, simple ion source, ion plasma source and RF ion source, Ion implantation – techniques and profiles, Ion beam sputtering–principles and applications (10 hours)

5. Materials Analysis by nuclear techniques:

Basic principles and requirements, mathematical basis and nuclear reaction kinematics, Rutherford backscattering – introduction, kinematic factor, differential scattering cross section, experimental set up, energy loss and straggling and applications, Nuclear reaction analysis – Principle, instrumentation, resonance nuclear reaction, specific nuclear reactions for light elements, applications, Neutron activation analysis – principles and experimental arrangement, applications, Proton induced X-ray analysis – principle and experimental set up, applications to water samples, human hair samples and forensic samples, limitations of PIXE ,

Book for study: Advanced Experimental Techniques in Modern Physics – K. MuraleedharaVarier, Antony Joseph and P.P. Pradyumnan, PragatiPrakashan, Meerut (2006)

Books for Reference:

1. Scientific foundations of vacuum techniques – S. Dushman and J.M. Laffer

2. Hand book of thin film technology – Heissel and Glang

3. Thin film phenomena – K.L. Chopra, McGraw Hill (1983)

4. Low temperature Physics - by L.C.Jackson - John Wiley & Sons Inc. 1962.

5. Low temperature techniques - by F.Din and A.H.Cocket, George Newnes Limited

(London) 1960

6. R. Sreenivasan – Approach to absolute zero - Resonance magazine Vol 1 no 12 ,vol 2 nos 2, 6 and 10

7. R. Berry, P.M. Hall and M.T. Harris – Thin film technology – Van Nostrand (1968)

8. Dennis and Heppel – Vacuum system design

9. Nuclear Micro analysis – V. Valkovic

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Model Questions

Bar code……… **M……………………..**

Reg.No…………………………..

Name……………………………………..

I Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2014

PHYSICS

PHY1C01: MATHEMATICAL PHYSICS- I

Time:3 hrs. Max.Marks:60

Section A

(**Answer both questions(either a or b)**)

1.a)Use the Gauss elimination method to solve :

$3x+2y+z=11$

$2x+3y+z=13$

$x+y+4z=12$

Or

b)State and prove Cauchy's Integral theorem

2.a)Discuss different strategies of solving first order ordinary differential equations

Or

b)Obtain the generating function of Legendre polynomials.

[**2x12=24**]

Section B

(**Answer any four**)

(**1 mark for part a; 3 marks for part b; 5 marks for part c**)

3.a) What are the different types of Curvilinear coordinate system?

b) Write the limits of the variables used in the above questions.

c)Show that the nonlinear term in Navier - Stoke's equation[curl(v x curl v)] in hydrodynamics vanishes.(Given the fluid flowing through the cylindrical pipe in the z direction is given by $v=\mathbf{e_z}v(\rho)$)

4.a) What do you mean by second order linear ODE'S?

b) Explain Frobenius' method.

c) Apply Frobenius method to linear oscillator problem.

5. a) What do you mean by Tensors?

b) Distinguish between Covariant and Contravariant tensors.

c) Explain the term direct product of tensors. Illustrate the formation of a mixed tensor of rank 2 from a covariant vector a_i (rank 1) and a contravariant vector b^j (rank 1) by direct product.

6. a) Distinguish between linear and nonlinear ODE's.

b) Explain Bernoulli and Riccati equations.

c) Solve the inhomogeneous ODE: $(1-x)y'' + xy' - y = (1-x)^2$

7. a) Define Gamma function.

b) Write the definitions of Gamma function by Euler (Definite integral) and

Weierstrass(Infinite product)

c) Show that(1) $\Gamma(z+1) = z\Gamma(z)$ and (2) $\Gamma(n) = (n-1)!$.

8.a) What are the properties of matrices?

b)Obtain the formula for derivative of a determinant

c)State and prove determinant product theorem.

(4 x9=36)

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IV Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination March2016

PHYSICS

PHY1C02-CLASSICAL MECHANICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

SECTION - A

1. a) Obtain Hamilton's equation for motion of a body in a central force field. Hence show that the angular momentum is conserved for a particle moving in a central force field.
OR
b) Outline the Hamilton-Jacobi theory and apply it to solve the problem of one dimensional harmonic oscillator.

2. a) Discuss the force free motion of a symmetrical top and hence obtain an equation for its time period.
OR
b) Establish the Lagrangian and deduce Lagrange's equation of motion for small oscillations of a system in the neighborhood of stable equilibrium. **(2 x 12 = 24 Marks)**

SECTION – B

3. (a) What is meant by degrees of freedom?
(b) Discuss the effect of constraints on the degrees of freedom with a suitable example.
(c) Find the degrees of freedom for a (i) dumbbell and (ii) a rigid body free to move in space.

4. (a) Define Lagrangian of a system.

   (b) The Lagrangian of a system is given by $L = \frac{m}{2}\dot{x}^2 + q\dot{x}x - \frac{k}{2}x^2$, where k and q are constants. Determine the corresponding Hamiltonian .

   (c) Obtain the Lagrangian for Atwood's machine.

5. (a) Distinguish between configuration space and phase space.

   (b) Explain the Physical significance of Hamiltonian of a system

   (c) The bob of a simple pendulum is made to oscillate in viscous fluid. Sketch the phase space for its motion.

6. (a) Define Poisson bracket of two dynamical variables.

   (b) What are the advantages of the Poisson bracket formulation?

   (c) Evaluate: (i) $[q_j, p_k]$ (ii) $[L_x, L_y]$

7. (a) What are canonical transformations?

   (b) Deduce any one condition for a transformation to be canonical.

   (c) Show that the transformation $P = \frac{1}{2}(p^2 + q^2)$, $Q = \tan^{-1}\left(\frac{q}{p}\right)$ is canonical.

8. (a) What are action and angle variables?

   (b) What is the advantage of using action angle variables?

   (c) Using action angle variable, derive an expression for the frequency of harmonic oscillator.

(a) Define inertia tensor and give its physical significance.

(b)

(c) Calculate the inertia tensor for the system of four masses 1 g, 2 g, 3 g, 4 g located at (1,0,0), (1,1,0), (1,1,1) and (1,1,-1) respectively.

(4×9 = 36 Mark

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I Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2014

PHYSICS

PHY 1C03 -ELECTRODYNAMICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (Either a or b)

<u>Section A</u>

1. a) Starting from Maxwell's equations applicable to time varying fields, obtain the wave equation for a conducting medium. Discuss the solution of the wave equation and obtain the expression for skin depth.

Or

b) Obtain the expressions for field components and cut off frequency for TE modes in rectangular waveguide.

2. a) Show that the power radiated by a magnetic dipole is proportional to the fourth power of the frequency.

Or

b) Discuss the covariant formulation of Maxwell's equations and equation of continuity. Also obtain the electromagnetic field tensor.

(**2** × **12** =**24** Marks)

Section –B (Answer any **four**)

1 mark for part **a**

3 marks for part b

5 marks for part c

3. a) Write down Maxwell's equations in an infinite isotropic, homogeneous, non-conducting medium with no sources.

b) Show that for plane monochromatic waves propagating in vacuum **E**, **B** and κ are mutually perpendicular.

c) Starting with the equation of continuity and assuming Ohm's law, show that the charge density in a conductor obeys the equations (a) $\frac{\sigma}{\varepsilon}\rho + \frac{\partial\rho}{\partial t} = 0$ and (b) $\rho = \rho_0\, e^{-\frac{\sigma}{\varepsilon}t}$.

4. a) Explain *p* and *s* polarization.
   b) Prove Snell's law of refraction for oblique incidence.
   c) Prove that the Brewster's angle for no reflection case is, $\sin\theta_B = \frac{1}{\sqrt{1+\frac{\mu_1\varepsilon_1}{\mu_2\varepsilon_2}}}$

5. a) What are scalar and vector potentials? Explain the components of electromagnetic field in terms of potentials.
   b) Find out the Liénard-Wiechert potentials of a point charge moving with a constant velocity.
   c) Show that $\varphi(\mathbf{r}, t) = \frac{1}{4\pi\varepsilon_0}\int_V \frac{\rho(\mathbf{r}', t')}{|\mathbf{r}-\mathbf{r}'|}dV'$ satisfies the wave equation $\nabla^2\varphi - \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t^2} = -\frac{\rho}{\varepsilon_0}$

6. a) What is radiation reaction?
   b) Obtain Abraham-Lorentz formula..
   c) Derive Larmor formula for the power radiated by a moving point charge.

7. a) Using Maxwell's equation prove that div**J** + $\frac{\partial\rho}{\partial t}$ = 0.
   b) Derive the Poynting theorem for the flow of electromagnetic energy.
   c) A hollow rectangular waveguide has dimensions a = 6 cm and b = 4 cm. The frequency of the impressed signal is 3 GHz. For TE_{10} mode, compute the following (a) Cut off wavelength (b) Guide wavelength (c) Phase velocity.

8. a) Write down Lorentz transformation equations.
   b) Show that Lorentz transformations are orthogonal in Minkowsky's four dimensional space.
   c) Prove that the quantities **E.B** and $E^2 - c^2B^2$ are invariant under Lorentz transformations.

(**4**×**9** = **36** Marks)

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I Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2014

PHYSICS

PHY1C04-ELECTRONICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (Either a or b)

1.a)What are active filters? Derive general expressions for the voltage gain of first order low-pass and first order high pass filters.

` Or

b) Explain the working of a positive triggered J-K Flip Flop with the help of block diagram and truth table. Explain how the race around problem is eliminated in Master slave Flip-flop.

2 a) With necessary diagram, explain how an OP-AMP is used to generate a square wave, triangular wave and pulse. Explain the importance of each component associated with Op-Amp in each case.

Or

b) µBy drawing the block diagram of Microprocessor 8055, explain different blocks.

$(2 \times 12 = 24$ Marks)

Section B

(1 mark for part (a), 3marks for part (b), 5 marks for part (c))

(Answer any Four)

3a)Give two characteristics of Op-Amp.

b)How Op-amp works as an Integrator

c)In an Op-Amp operatingin inverting mode the input resistor and feedback resistor are 50 KΩ and 300KΩ respectively. The internal gain of Op-Amp is 10000. a) If the input signal is 1 Volt then calculate output voltage b)If the same Op-amp is used in non-inverting mode then what will be its output voltage and voltage gain?

c) Determine the Threshold voltages V_{UT} and V_{LT} of the Schmitt trigger circuit with R_1 =100 Ω, R_2=56 K, V_M= 1 V_{pp} with supply voltages +_ 15 V. Draw the output waveform.

4 a) What is a Butterworth filter?

b) Distinguish between low pass, Band pass and high pass filter circuits.

c) Design a Second order low-pass filter at a high cut off frequency of 1 K Hz.(Capacitors of 0.0047µF are given)

5 a).What is a Buffer Register?

b) Describe a parallel in serial out Shift register

c) Explain the shifting in the data 0101 serially. Draw timing diagram shoeing the loading of the serial input 0101 into the 4-bit serial-in, serial-out, shift register.

6. a)What do you mean by percentage resolution of a DAC?

b) Explain Successive Approximation method for ADC.

c)What are the output voltages caused by logic 1 in each bit position in an 8-bit ladder if the input level for 0 is 0V and for 1 is +10 V?

7. a)State two differences between synchronous and asynchronous counters.

b) Describe a Mode-8 Ripple counter using block diagram

c) For what minimum value of propagation delay in each FF will a 10-bit ripple counter skip a count when it is clocked at 10 MHz?

8 a) Draw sample and hold circuit using minimum components

b) Explain Dominant pole and Pole zero compensations in Op-Amps.

c) i) Design a differentiator to differentiate an input signal that varies in frequency from 10 Hz to about 1 kHz.

ii) If a sine wave of 1V peak at 1000 Hz is applied to the above differentiator, draw its output waveforms.

II Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination April 2015

PHYSICS

PHY2C06- QUANTUM MECHANICS-I

Time: 3 hrs. **Max. Marks 60**

SECTION A

Answer both questions (Either a or b)

1. A) Solve the problem of one dimensional Harmonic oscillator in the Heisenberg picture and obtain the matrices for H,x and p where the symbols have their usual meanings

   or

   B) Derive commutation relation for the components L_x, L_y, L_z, of orbital angular momentum and prove that all the three components commute with L^2. Find the eigen values of L^2 and L_z

2. A) Explain WKB approximation. List the connection formulae and explain them. Discuss briefly the validity conditions of WKB approximation.

   or

   B) Explain the relationship between symmetry and conservation laws quantum mechanically. Show that law of conservation of linear momentum is a a consequence of space translational symmetry.

(2x12=24)

SECTION B

(Answer any four)

(1 mark for part a, 3 marks for part b and 5 marks for part C)

3. A) Define Hilbert space?
   B) Discuss representation of vectors and operators. Give examples
   C) The wave function of a particle in a state $\Psi = (1/\pi\alpha)^{1/4} \exp(-x^2/2\alpha)$. Evaluate $\Delta x.\Delta p$.

4. A) Explain eigen value and eigen vectors with an example.
   B) What is a Hermitian operator? Show that for a Hermitian operator eigen values are real and explain its significance in Quantum mechanics
   C) Show that the expectation and eigen values of operators do not change with unitary transformation.

5. A) Define angular momentum quantum mechanically.

B) List the quantum numbers required to specify the state of the electron in the H_2 atom.

What are the allowed values?

C). Obtain C G coefficients for a system having $j_1 = 1$ and $j_2 = ½$

6. A) State Schwart's inequality for any two vector in linear vector space.

B). Show that the expectation value of a Hermitian operator is real whereas that of an anti hermitian operator is imaginary

C). The states Ψ and χ are given by $\Psi = 3i\,\varphi_1 - 7i\varphi_2$ and $\chi = \varphi_1 + 2i\varphi_2$ where φ_1 and φ_2 are orthonormal. Verify $(\Psi, \chi) = (\chi, \Psi)^*$

7. A) What is linear stark effect?

B). Bring out the meaning of time reversal invariance. Find the time reversed state of $\Psi(r, t)$

C). Calculate the ground state energy up to first order of the anharmonic oscillator.

having having the potential energy $V = ½\, m\omega^2 x^2 + bx$ where b is independent of x and

$bx << ½\, m\omega^2 x^2$

8. A) What are pauli's spin matrices?

B) Outline the variation method used for obtaining approximate value of ground state energy of a system.

C). For the ground state of a H_2 atom evaluate the expectation value of the radius r of the electron.

(4x9=36)

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II Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination April 2015

PHYSICS

PHY2C07: MATHEMATICAL PHYSICS -II

Time: 3 hrs. Max.Marks:60

Section A

Answer both questions (Either a or b)

1. a)What do you mean by comparison test in infinite series. Discuss the different types of comparison test.

Or

b) Apply Laplace transform method to solve Simple harmonic oscillator and Damped harmonic oscillator.

2. a)What are the different types of PDE's. Discuss the wave equation & obtain the d'Alembert's solution.

Or

b) State Schur's lemma 1 and 2 & prove Orthogonality theorem.

(2x12=24)

Section B

(Answer any four)

(1 mark for part a; 3 marks for part b; 5 marks for part c)

3.a)What is the difference between sequence and series

b) Explain the term convergence

c) Discuss the convergence of geometric series.

4. a)Define Green's function.

b)Obtain Green's function as eigen function expansion.

c) Solve the equation $-y'' = f(x)$ by Green's function method.

5. a)What do you mean by group.

b) What are the properties of group?

c) Show that the elements (i,-1,-i,1) form a group.

6. a)What do you mean by characters?

b) What are its properties?

c) Taking a typical group, illustrate how character table are prepared?

7. a)What is meant by integral transform

b) Using a schematic diagram, Illustrate how integral transforms can be used to solve problems in Physics.

c) Get the Fourier transform of Gaussian.

8. a)Define Laplace transform.

b) Give Laplace transform of any three elementary functions.

c) Obtain the Laplace transform of Dirac delta function.

(4x9=36)

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II Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination April 2015

PHYSICS

PHY2C08 - STATISTICAL MECHANICS

Time: 3 Hrs. Maximum marks: **60**

Section A

Answer both questions (Either a or b)

1. a) Derive the expression for entropy of a classical ideal gas. How is it modified to resolve the Gibb's paradox?

Or

b) What is an ensemble? Distinguish between micro canonical, canonical and grand canonical ensembles. Derive an expression for most probable distribution of energy among the various systems of canonical ensemble.

2. a) What is Bose-Einstein condensation? Derive the condition for the onset of Bose-Einstein condensation.

Or

b) Explain the one dimensional Ising model. Derive the expressions for the low field susceptibility.

(**2** × **12** =**24** Marks)

Section –B

(Answer any **four**)

1 mark for part **a**

3 marks for part **b**

5 marks for part **c**

3. a) Explain with examples the intensive and extensive parameters.

b) Obtain The Euler and Gibbs-Duhem relations.

c) What are thermodynamic potentials? Obtain various Maxwell's thermodynamic relations.

4. a) State and explain the postulate of equal a priori probabilities.

b) Obtain the Boltzmann relation between entropy and thermodynamic probability.

c) State and explain the Liouville's theorem.

5. a) Define fugacity, q-potential and grand partition function.

b) Show that if the partition function is given by Z, the mean energy is given by $\bar{E} = \frac{\partial}{\partial \beta}(\ln Z)$.

where, $\text{where}\, \beta = \frac{1}{kT}$.

c) Show that the fractional fluctuation of the number of molecules in the grand canonical ensemble is $\frac{\Delta N}{N} = \frac{1}{\sqrt{N}}$

6. a) On the statistical basis distinguish between the three categories of particles.

b) Derive Fermi-Dirac distribution law.

c) Calculate the extent of energy range between F(E) = 0.9 and F(E) = 0.1 of the Fermi-Dirac distributions at a temperature of 200 K and express it as a function of E_F which is 3eV.

7. a) Under which condition do we consider a system as a classical or quantum mechanical one?

b) Show that the pressure exerted by the particles of an ideal Bose gas at the transition temperature T_c is about one-half of that exerted by the particles of an equivalent Boltzmannian gas.

c) Using Bose-Einstein distribution, derive Planck's radiation law.

8. a) Define Fermi temperature and Fermi energy.

b) Obtain the expression for Fermi energy.

c) Show that the internal energy of ideal Fermi gas is U = $\frac{3}{2} NkT \frac{f_{5/2}(z)}{f_{3/2}(z)}$.

(**4×9 = 36** Marks)

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II Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination April 2015

PHYSICS

PHY2C09 - SPECTROSCOPY

Time: 3 Hrs. Maximum marks: **60**

Section A

Answer both questions (Either a or b)

1. a)Give the quantum theory of anomalous Zeeman Effect and obtain an expression for Zeeman shift.

OR

b) Discuss in detail the rotational fine structure of electronic vibrational spectra.

2. a) Obtain the resonance condition for NMR. Explain the basic requirements of a NMR spectrometer.

OR

b) Explain the quantum theory of Raman Effect in the case of a symmetric top molecule.
(**2** × **12** =**24** Marks)

Section –B

(Answer any **four**)

1 mark for part **a**

3 marks for part **b**

5 marks for part **c**

3. a) What is Gyro magnetic ratio?

b) Explain Paschen-Back Effect.

c) The wavelength of H_α line for hydrogen is 656.28nm. What is the wavelength of H_α line for deuterium?

4. a) Write the energy expression for diatomic vibrating rotator

b) Alternate lines of P and R branches of acetylene are less intense. Why?

c) Calculate the amplitude of vibration in the υ=0level of the molecule CO which has a force constant of 1870N/m

5. a) What is quadrupole moment of a nucleus.

b) What is the principle of ESR?

c) The ^{14}N resonance of a compound showed 3 lines at 5.997, 3.501 and 2.496MHz.

Calculate the quadrupole coupling constant $e2qQ/h$ and η.

6. a) How crystal symmetry is understood using Mossbauer spectroscopy?.

b) Explain recoilless emission and absorption of rays.

c) Calculate the recoil velocity of a free Mossbauer nucleus of mass $9.4684X10^{-26}$Kg, when emitting a γ ray of wavelength $8.57X10^{-11}$m. What is the Doppler shift of the γ -ray frequency?

7. a) Explain briefly the spectra of hydrogen

b) Explain the origin of hyperfine structure of spectral lines

c) Calculate the wave length separation between two component lines which are observed in normal Zeeman effect. The magnetic field used is $0.8wb/m^2$,

Specific charge=$1.76x10^{11}CKg^{-1}T$

8. a) Outline the effect of isotopic substitution on the rotational spectra of molecules.

b) Distinguish between symmetric top, spherical top and asymmetric top molecules.

c) The average spacing between successive rotational lines of CO molecule is $3.8626cm^{-1}$. Determine the transition which gives the most intense spectral line at 300K

(**4**×**9 = 36** Marks)

III Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2015

PHYSICS

PHY3C10- QUANTUM MECHANICS- II

Time: 3 hrs. **Max. Marks 60**

SECTION A

Answer both questions (either a or b)

1. A) Outline the time dependent perturbation theory. Apply it to the case of harmonic perturbation. Derive an expression for transition probability per unit time

   or

   B) Discuss the method of partial waves in scattering problems and bring out the importance of phase shifts

2. A) Derive Dirac equation for a free particle. Explain Dirac matrices

   or

   B) Discuss the principles of canonical quantization of fields. Define Lagrangian and Hamiltonian densities,

(2x12=24)

SECTION B

(Answer any four)

(1 mark for part A, 3 marks for part B and 5 marks for part C)

3. A) What is Pauli's exclusion principle?
   B). Find the wave functions of two systems of identical, noninteracting particles, the first consists of two bosons and the second of two spin half particles.
   C) In a scattering by a spherically symmetric potential only p- wave scattering occurs. Find the differential scattering cross section in terms of angle of scattering.

4. A). Define scattering cross section and scattering amplitude
   B). Write a short note on Bell's theorm

C). A particle of mass μ is scattered from a spherical repelling potential of radius R. $V(r) = V_0$ for $r \leq R$ and $V(r) = 0$ for $r \geq R$. Calculate the total cross section in the limit of low energies using Born approximation

5. A) Distinguish between particle and field.
   B) What is meant by second quantization?
   C) The lagrangian density of a certain field is given by

   $L= i\hbar\Psi^* (\partial\Psi/\partial t) - (\hbar 2/2m)\nabla\Psi^*.\nabla\Psi - V\Psi^*\Psi.$
   Obtain the corresponding field equation and identify the field.

6. A) Write down the Hamiltonian of an electron placed in an em fiel characterized by a vector and scalar potential.
   B). What do you mean by dipole approximation? Explain the selection rules for a dipole transition.
   C). Obtain an expression for the transition amplitude for an atom to be located at time t at various levels given that at time t = 0 the atom was residing at its ground state.

7. A). What is a four vector?
   B). Spin orbit coupling is relativistic in origin. Substantiate.
   C). Derive Klein Gordan equation and express it in four vector form.

8. A) What is CPT theorem?
   B). Derive the wave equation for photon.
   C). Obtain the eigen values of the operator

$k= \beta(\sigma^D .L +\hbar) /\hbar$ where σ^D is the dirac spin operator

(4x9=36)

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III Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2015

PHYSICS

PHY 3C11 - SOLID STATE PHYSICS

Time: 3 Hrs Max. Marks: 60

SECTION A

Answer both questions (Either a or b)

1. a) Explain the concept of reciprocal lattice. Derive the Bragg condition in terms of the reciprocal lattice vectors.

   Or

   b) Derive an expression for phonon dispersion in diatomic linear lattice. Distinguish between optical and acoustic branches of phonon vibrations.
2. a) What is Hall effect? Give the elementary theory of Hall effect. Mention the important uses of Hall effect.

   Or

   b) What is Meissner effect? Derive the London equations and explain the term coherence length.

(2x12=24 Marks)

SECTION B

(Answer any four)

(1mark for part **a, 3**mark for part b**, 5**mark for part **c)**

3. a) State Ohm's law and write the expression for electrical conductivity.
   b) Explain Fermi-Dirac distribution function. Plot this function for various temperature including 0K.
   c) The electronic specific heat of Zinc is 1.5×10^{-4} T $calmol^{-1}$ K^{-1}. Find the Fermi energy of Zinc.
4. a) Distinguish between conductor, semiconductor and insulator.
   b) Explain the meaning of effective mass.
   c) The Fermi level of an 'n' type semiconductor lies at 0.3 eV below the conduction band. If the concentration of donor atom is doubled, where will be the new position of Fermi level? Take $K_BT = 0.03eV$
5. a) Define superconductivity.
   b) Distinguish between Type I and Type II superconductors.
   c) Calculate the London penetration depth of lead at 0K, whose density is 11.32×10^3 kg|m^3 and the atomic weight is 207.19.
6. a) What are cooper pairs?
   b) Briefly explain BCS theory.

c) Calculate the critical current density for 1mm diameter wire of lead at (a) 4.2 K (b) 7 K. Given Tc for lead is 7.18 K and H_o for lead is $6.5x10^4$ A/m. A parabolic dependence of H_c upon T may be assumed.

7. a) What is Curie Weiss law?
   b) Write a note on the atomic theory of magnetism.
   c) A paramagnetic substance has 10^{28} atoms|m^3. The magnetic moment of each atom is $1.8x10^{-23}$ Am^2. Calculate the paramagnetic susceptibility at 303 K.
8. a) What are Ferro electric crystals?
   b) Briefly explain the quantum theory of paramagnetism.
   c) Given that the Curie temperature of a ferromagnet is 727^0C. What is the order of magnitude of the exchange integral? From this estimate internal field. Given $\mu_B = 9.3 \times 10^{-21}$ ergGauss.

(4x9=36 Marks)

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III Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2015

PHYSICS

PHY 3C 12-NUCLEAR& PARTICLE PHYSICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

1.

a) Derive an expression for the differential scattering cross-section for elastic scattering of electrons by a finite size nucleus. How this method does enable to determine the charge radius of the nucleus?

Or

b) Derive an expression for the ground state deuteron wave function by considering a square-well potential. Why L=1 is not a ground state of deuteron?

2. a)What is Parity in Particle physics? Where it is violated? Give its experimental details.

Or

b) Discuss eight fold way and illustrate it in the case of Baryon and meson octets.

($2 \times 12 = 24$ Marks)

Section B

(1 mark for part (a), 3marks for part (b), 5 marks for part (c))

(Answer any Four)

3.

a) What are the basic similarities between a liquid drop and an atomic nucleus?
b) Write down the Bethe-Weizsacker mass formula and explain the various terms that contribute to it.
c) Using the semi-empirical mass formula, find the atomic number (Z) of the most stable nucleus for a given mass number (A). Hence, explain which is most stable among ${}^{6}_{2}\mathrm{He}$, ${}^{6}_{4}\mathrm{Be}$, and ${}^{6}_{3}\mathrm{Li}$.

4.

a) What are the characteristic features of the nuclear force?

b) Explain the concept of scattering length in the study of low energy scattering and deduce an expression for the scattering cross-section in terms of scattering length.£Assuming that nuclear force arises from the exchange of mesons, estimate the mass of the meson using the Heisenberg's uncertainty relation. Given, the range of the nuclear force is 1.4 Fm.

5.a) write a note on Yukawa's proposal of Nuclear forces.

b) Give an account of Salam Weinberg theory

c)Find the quark content of the following particles

Σ^{+}, Ω, Π^{+}, P, λ^{0}

6.

a) Describe the phenomenon of internal conversion and define the internal conversion coefficient.
b) Discuss the selection rules for multipole radiation.
c) For the following nuclear transitions by gamma decays, state which of the types of multipole radiations that will be emitted:
   i. $\frac{3}{2}^{+} \rightarrow \frac{5}{2}^{+}$
   ii. $\frac{3}{2}^{+} \rightarrow \frac{5}{2}^{-}$

7.

a) How are neutrons classified according to their energy?
b) Explain one of the methods for detecting slow neutrons.
c) Nickel-59, has an absorption cross-section of 4.8 and scattering cross-section of 17.5. Compute the moderating ratio for Ni. How many collisions are needed to thermalise a 1 MeV neutron?

8.

a) State various types of fission processes.
b) Discuss Carbon-Nitrogen cycle. Explain its importance.
c) If a fission process starts with 1000 neutrons, calculate the number of neutrons in the hundredth generation. Given, the multiplicative factor, $k = 1.05$.

(4 x 9= 36 Marks)

IV Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2016

PHYSICS

PHY 4C 14- OPTICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

1. a) Derive an expression for the threshold power required for four level laser and show that a four level laser system is the most efficient one.

OR

b) Explain electro-optic effect in Lithium Niobate crystal and the states polarizations of the electromagnetic wave subjected through it in the presence of external electric field.

2. a) What is meant by phase matching? Explain the principles involved in type-I and type –II phase matching and how they are implemented to obtain harmonic generation.

OR

b) What are the different loss mechanisms in optical fiber? Explain how these losses are minimized to have an effective transmission of optical signals.

(2 x 12 =24 Marks)

Section B

(Answer any four, 1 mark for part a, 3 marks for part b and 5 marks for part c)

3. a) What are Einstein's coefficients?
   b) Derive an expression showing the relationship between Einstein's coefficients.
   c) Find the temperature at which A/B ratio becomes half for 532 nm radiation.

4. a) Define the term coherence
   b) What are spatial and temporal coherence and explain how to estimate the spatial coherence of an electromagnetic radiation.
   c) A stream of electrons each having energy of 0.5 eV impinges on a pair of extremely thin slits separated by 0.01 mm. Find the distance between adjacent minima on a screen 20 m behind the slits. (mass of electron = 9.1×10^{-31} kg and 1 eV= 1.6×10^{-19} J)

5. a) Mention the active medium employed for CO2 laser.

b) What are the various modes that produce laser action? Draw energy level diagram CO_2 laser and show the different laser wavelengths.

c) A beam of CO_2 laser of wavelength 10.6 μm has a diameter of 3mm, which illuminates on a wall 100 m away. Find the spot size on the wall in diffracted limited condition.

6. a) Explain Kerr effect

b) Describe the working of a Kerr Cell.

c) Distinguish between Electro-optic effect and Magneto-optic effect and explain how these effects are used in lasers.

7. a) What is meant by Harmonic generation of light?

b) A crystal with center of symmetry is not used for producing harmonic generation- Explain.

c) Describe Stimulated Raman Scattering and explain CARS.

8.a) What is meant by numerical aperture of an optical fibre?

b) Obtain an expression for numerical aperture of an optical fibre.

c) The refractive indices of core and cladding of an optical fibre are 1.532 and 1.514 respectively. Find the acceptance angle and V number if the diameter of the fibre is 0.42 micrometers.

(4 x9 =36 Marks)

IV Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2016

PHYSICS

PHY 4C 15- NUMERICAL TECHNIQUES AND PROBABILITY

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

1.What is curve fitting? Explain with algorithm, the principle of linear least square fit.

or

Obtain the Gauss quadrature formula and hence obtain the equations to solve for 2n unknowns. How is it superior to other numerical methods.

2.Explain the Lagrange interpolation technique and derive the expression for the n^{th} order polynomial. Hence obtain the expression for the second order polynomial.

or

What do you understand by the test of goodness of fit? I s it necessary to consult χ^2-table to decide about the null hypothesis? **(2 x 12 =24 marks)**

Section B(Answer any four questions)

(a) 1 mark (b) 3 marks (c) 5 marks

3. (a) What is meant by order of convergence?

(b) Find the order of convergence of Newton –Raphson Method.

(c) Find the roots of the equation $x^3 - 1.47x^2 - 5.73x + 6.76 = 0$ by Newton –Raphson method correct to 2 decimal places.

4. (a)What is the order of convergence of ordinary iteration method?

(b) Obtain the condition for convergence of ordinary iteration method.

(c) Find the root of the equation $2x = \cos x + 3$.

5. (a) When can Poisson distribution be a reasonable approximation of the binomial?

(b) Show that Poisson distribution is the limiting form of Binomial distribution.

(c) Fit a binomial distribution to the following data.

X	0	1	2	3	4
f	28	62	45	10	4

6. (a)Under what conditions can observed empirical frequency distribution be approximated to Binomial distribution?

(b) How does a normal distribution differ from a binomial distribution? Mention the properties of a normal distribution.

(c) Fit Poisson distribution to the following data and calculate the theoretical frequency.

No. of mistakes per page	0	1	2	3	4
No. of pages on which mistakes occurred	109	65	22	3	1

7. (a)Explain mutually exclusive events.

(b) State Multiplication theorem and prove it.

(c)One bag contains 4 white and 2 black balls. Another contains 3 white and 5 black balls. If one ball is taken from each bag, find the probability that one is white and one is black.

8. (a) Which are the different approaches used to solve a differential equation?

(b) Obtain Modified Euler"s method to solve a differential equation.

(c) Given y' = 1- y, and y(0) = 0, find (i) y(0.1) by Euler method.(ii) y(0.2) by modified Euler method. **(4 x 9 = 36 marks)**

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IV Semester M.A. / M.Sc. / M.Com. /M.Sc. computer Science Degree Examination November 2016

PHYSICS

PHY 3E03-MICROPROCESSORS & APPLICATIONS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

1.a)What is Timing diagram? Draw and Explain the Timing diagram for I/O Read operation.

Or

b) Give the architecture and operating modes of programmable peripheral interface 8255.

2. a)With the help of a block diagram, explain the microprocessor based system for temperature measurement

Or

b) Explain the different types of Interrupts in 8085 Microprocessor. Explain Interrupt Service Routine with block diagram and programme.

Section B

(1 mark for part (a), 3marks for part (b), 5 marks for part (c))

(Answer any Four)

3.a)Distinguish between fetch and Read operation

b) Explain the format and execution of any three branching instructions of 8085

c) Write a program to add two numbers 34 H and 48H.

4. a)What is the use of a DMA controller?

b) Explain the action of DMA data transfer.

c) Explain the action of the Instructions PUSH B and POP D using examples.

5a) What is chip select and how it is generated?

b) Explain the actions of SIM and RIM instructions with examples.

c) Assume that the 8085 Microprocessor return to main program after servicing RST 6.5(and while servicing all other interrupts are disabled). Write a program segment to check whether RST 5.5 interrupt is pending. If it is pending then the program has to enable RST5.5 without affecting any other interrupts. Otherwise the program has to enable all interrupts and retrn to main program.

6. a)What is delay routine?

b) Write a simple delay subroutine involving a single 8-bit register of 8085.

c)Write a delay routine to produce a time delay of 0.5 m sec in 8085 processor based system whose clock source is 6 MHz quartz crystal.

7. a)Give two important features of a Pentium processor

b) Draw the block diagram of Pentium processor.

c)Draw the diagram for interfacing seven segment disply with Microprocessor

8. a)Give two examples of Data transfwer instructions

b) Write a short note on USART

c) Register A of Microprocessor contains the data $C4_H$ and Register C contains 89_H. Subtract the content of Register C from A register. Show their contents after execution. Also find the changes in the flag register after execution.

IV Semester M.A./ M.Sc./M.Com./M.sc. computer Science Degree Examination November 2016

PHYSICS

PHY 4E07-ASTROPHYSICS

Time: 3 Hrs. **Max. Marks: 60**

Section A

Answer both questions (either a or b)

1.a) Explain how Saha's ionisation theory converts the spectral sequence into a temperature sequence.

OR

b) Explain the evolution of a 10 solar mass main sequence star.

2. a) Explain the Gold's model of Pulsars.

OR

b) Explain the evolution of matter dominated Universe, assuming Friedman equation.

(2 x 12 = 24)

Section B

(Answer any four)

(1mark for part **a**, **3**mark for part b, **5**mark for part **c)**

3.a) Distinguish between photo graphic and photo visual magnitudes.

b) Describe the H-R diagram.

c) Describe the Hubble's classification scheme of galaxies.

4.a) What is meant by the thermal equilibrium in stars?

b) Write down the equation of state for the stellar interior. What happens when matter becomes degenerate.

c) Explain the tripple alpha process.

5.a) Explain the processes that lead to Helium flash.

b) Briefly explain the state of white dwarfs.

c) What are binary pulsars? Explain their significance to general relativity.

6.a) Explain the significance of the rotation curves of galaxies.

b) What do you mean by the expansion of the Universe?

c) What are Gamma Ray Bursts?

7.a) Distinguish between Visual binary and spectroscopic binary. Which of them is expected to have larger periods in general, and why?

b) Describe briefly the mass transfer in binary systems.

c) The total mass of a binary system is 5 solar masses. If one star is twice as far from the center of mass as the second, estimate individual masses.

8.a) What are active galaxies?

b) Explain the role of redshift in cosmology.

c) What is critical density and how is it affecting the expansion of the Universe?

(4 x 9 = 36)