MARIAN COLLEGE KUTTIKKANAM (AUTONOMOUS)

MAKING COMPLETE

SYLLABUS FOR INTEGRATED MASTER OF SCIENCE IN PHYSICS

(QUANTUM NANOSTRUCTURES/FLEXIBLE ELECTRONICS)

2020 Admission

Affiliated to Mahatma Gandhi University Kottayam

Marian College Kuttikkanam (Autonomous)

Kuttikkanam P.O

Peermade, Idukki District

Kerala, India

Tel: 04869-232203, 232654

E-mail: mariancollege@mariancollege.org

Table of Contents

Acknowledgement

There are many profound personalities whose relentless support, guidance and cooperation made this syllabus preparation a success. The Board of Studies take this opportunity to express our sincere appreciation to all those who were part of preparation of the syllabus of P G course in Physics at Marian College (Autonomous) Kuttikkanam under Mahatma Gandhi University, Kottayam.

We express our sincere gratitude to the Manager, Principal and Vice Principal for their sincere co-operation and guidance for the completion of this work.

I also record our sincere thanks to all the Board of Studies members for their valuable contributions to make this venture a success.

For the Board of Studies in Physics,
Dr. Sunny Mathew.
(Chairman)

I. Department of Physics: Members of the Board of Studies.

Sl. No	Name & Designation	Academic Qualification	Representing Constituency	
1	Dr. Sunny Mathew Associate Professor	M Sc, M Phil, Ph.D	Faculty of Physics Marian College (Autonomous) Kuttikkanam	Chairman
2	Dr. Midhun H	M Sc, M Phil, Ph.D	Faculty of Physics Marian College (Autonomous) Kuttikkanam	Faculty of Physics
3	Dr. George James T Associate Professor	M Sc, Ph.D	Dept of Physics, Nirmala College Moovattupuzha	Faculty of Physics
4	Dr. Benoy M D Associate Professor	M Sc, Ph.D	Dept. of Physics, Mar Athanasius College (Autonomous), Kothamangalam	Faculty of Physics
5	Dr. Vinod G Associate Professor	M Sc, Ph.D	Dept. of Physics, Sree Sankara College, Kalady	Faculty of Physics
6	Dr. Vincent Mathew Professor	M Sc, Ph.D	Dept. of Physics, Central University of Kerala,Kasaragod.	Expert from outside the University
7	Dr. Reji Philip Professor& HoD	M Sc, Ph.D	Optics Division, Raman Research Institute, Bengaluru	Expert from outside the University
8	Mr. Jolly Cyriac Managing Director,	M.Tech	HOLMARC Opto-Mechatronics Pvt.Ltd Kochi	Representative from Industry
9	Dr. Vimal G Assistant Professor	M Sc, M Phil, Ph.D	St Dominic's College Kanjirappally	Meritorious alumnus
10	Dr. John Philip Professor& HoD	M Sc, Ph.D	IGCAR, Department of Atomic energy, Kalpakkam.	Expert from outside the college

11	Dr. Thomas Baby Deputy Director	M Sc, M Phil, Ph.D	Instrumentation Engineering,Rubber Research Institute, Kottayam.	Expert from outside the college
12	Dr. Jose K Xavier Associate Professor	M Sc, Ph.D	Dept. of Chemistry, MCK (A)	Faculty of Chemistry
13	Dr. Sabu Augustine Associate Professor	M Sc, M Phil, Ph.D	Dept. of Mathematics, MCK(A)	Faculty of Mathematics
14	Dr. Juby George	M Sc, M Phil. Ph.D.	Dept. of Computer Application, MCK(A)	Faculty of Computer Application
16	Mr. Siju P T, Assistant Professor	MA	Dept. of English, MCK(A)	Faculty of English
17	Mr. Umer Salim	B.Tech	CEO, I4Technologies	Industrial Expert
19	University nominee		Panel submitted to	the university.

II. REGULATIONS FOR INTEGRATED MASTER OF SCIENCE IN PHYSICS (QUANTUM NANOSTRUCTURE/FLEXIBLE ELECTRONICS)

1. Short Title

1.1. These Regulations shall be called Marian College Kuttikkanam (Autonomous) Regulations for the Integrated Post Graduate Programme in Physics (Quantum Nanostructure) under the Credit and Semester System (CSS) 2020.

1.2. These Regulations shall come into force with effect from the Academic Year 2020- 2021 onwards

2. Scope

2.1. The regulation provided herein shall apply to Integrated Master of Science in Physics, the Post Graduate programme, conducted by Marian College Kuttikkanam (Autonomous) with effect from the academic year 2020- 2021 admission.

3. DEFINITIONS

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

3.2. **Assessment** is the process of collecting, recording, scoring, describing and interpreting information about the outcome of the learning which is an ongoing process. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions', page 8).

3.3. **"CADL"** is an acronym for 'Continuous Assessment for Deepening Learning'. This is a mandatory component for all taught courses and optional for other courses.

3.4. **"CARS"** is an acronym for 'Continuous Assessment for Research Skills'. This is a mandatory component for all taught courses and optional for other courses.

3.5. **College** means Marian College Kuttikkanam (Autonomous), Kerala.

3.6. **College Continuous Assessment Coordinator** is nominated by the Principal to coordinate the continuous assessment undertaken by various departments within the college. They shall be ex-officio member to the college level examination committee.

3.7. **Common Course** means a course that comes under the category of courses for English.

3.8. **Complementary Course** means a course which would enrich the study of core courses.

3.9. **Continuous Assessment (CA)** is a continuous feedback to the scholar through examinations, assignments etc., which assess the academic progress of the scholar during the semester.

3.10. **Continuous Assessment Coordinator (CAC)** is a faculty member nominated by the department council to coordinate the continuous assessment activities undertaken in the department.

3.11. **Course:** A basic unit of education and/or training. A course or collection of courses forms a programme of study. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' page 8)

3.12. **Course Code** means a unique alphanumeric code assigned to each course of a programme.

3.13. **Course Outcomes (CO)** are statements that describe what students should be able to do at the end of a course.

3.14. **Credit (Cr)** of a course is the numerical value assigned to a course according to the relative importance of the content as in the syllabus of the programme.

3.15. **Credit Point (CP)** of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course (CP=GP x Cr).

3.16. **Cumulative Grade Point Average (CGPA)** is the value obtained by dividing the sum of credit points of all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places. CGPA determines the overall performance of a student at the end of the programme.

3.17. **Degree** A title/ qualification awarded after satisfactory completion of and achievement in a programme. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' p.8)

3.18. **Department** means the Post Graduate Department of Communication and Media Studies, Marian College Kuttikkanam (Autonomous) offering a programme of study approved by the College as per the rules.

3.19. **Department Council** means the body of all regular faculty members of a Department in the College. Regular faculty members from another department taking a course in the said department can be special invitees.

3.20. **Duration of Programme** means the period of time required for the conduct of the programme. The duration of MSc integrated Physics programme shall be 10 semesters spread over five academic years.

3.21. **Elective / Optional/Specialization Course** is a course that leads to specialization in a given discipline.

3.22. **Evaluation** is the process of making judgments based on evidences and interpretations gathered through examination and assessment and on the basis of agreed upon criteria. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' page 8)

3.23. **Examination** is a quantitative measure of learner's performance and is held at the end of the academic session or semester. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' page 8)

3.24. **Extra Credits** are additional credits awarded to a student over and above the minimum credits required for a programme.

3.25. **Degree** A title/ qualification awarded after satisfactory completion of and achievement in a programme. (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' p.8)

3.26. **Grace Grade Points** mean grade points awarded to course(s), as per the orders issued from time to time, in recognition of meritorious achievements of a student in NCC/NSS/Sports/Arts and cultural activities or such other similar areas. It is also awarded to students with learning disabilities as per government norms.

3.27. **Grade Point** means the numeric weightage attached to each letter grade (Ref. UGC Report in November 2019 on 'Evaluation Reforms in Higher Educational Institutions' page 8)

3.28. **Internship** is a period of time during which a student works for a company or organization in order to get experience of a particular type of work or research.

3.29. **Letter Grade or 'Grade'** for a course is a letter symbol which indicates the broad level of performance of a student in a course.

3.30. **Non-Credit Course** is a course for which no credits are awarded. The result of the Non-credit course shall be either 'Pass' or 'Fail'.

3.31. **Additional -Credit Course** is a course for which credits are awarded and course is optional.

3.32. **Open Course** means an elective course which is offered to students of other department.

3.33. **Parent Department** means the Department in which a student has joined for a degree or diploma or a certificate programme.

3.34. **Plagiarism** is the unreferenced use of other authors' material in projects/dissertations/assignments etc. and is a serious academic offence.

3.35. **Practical course** is a course supported by laboratory experiments.

3.36. **Programme** is a collection of courses in which a student enrols and which contributes to meeting the requirements for the awarding of one or more Certificates/ Diplomas/ Degrees. (Ref. UGC Report in November2019 on 'Evaluation Reforms in Higher Educational Institutions' page 9)

3.37. **Programme Core Course** means a course having credit and that the students admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

3.38. **Programme Credit** means the total credit of the Integrated MSc Programme, i.e. **200 credits.**

3.39. **Programme Outcomes (PO)** are what knowledge, skills and attitudes a graduate should have at the time of graduation.

3.40. **Programme Specific Outcomes (PSO)** are statements that describe what the graduates of a specific programme should be able to do.

3.41. **Project** means a regular study undertaken in the college / appropriate institute/ organization under the supervision of a faculty member in the parent department.

3.42. **Project co-guide** is the faculty member from the parent department who is nominated by HoD to supervise progress of project work of the student if he/she is doing project outside the parent department.

3.43. **Project guide** is the faculty member/scientist from the institute where student perform his/her project work, who supervises and guide the research/project work undertaken by the student.

3.44. **Repeat Course** is a course that is repeated by a student for having failed in that course in an earlier registration.

3.45. **Semester** means a term consisting of 90 working days, inclusive of tutorials, examinations and other academic activities.

3.46. **Semester End Examination (SEE)** is the examination conducted at the end of the semester for a course.

3.47. **Semester Grade Point Average** (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits taken by them in that semester. The grade points shall be rounded off to two decimal places.

SGPA determines the overall performance of a student at the end of a semester.

3.48. **Semester End Examination (SEE)** is the examination conducted at the end of the semester for a course.

3.49. **Seminar** means a discourse by a student, expected to train them in self-study, through original contributions and discussions by availing materials including e-resources.

3.50. **Summer project** is a structured work/research experience in an organization to gain industrial/academic/research training during the summer vacation with a view to enhance a student's academic, career and personal development. After the training, the student is required to submit a project report as specified by the department. Summer project is a non credit course.

3.51. **SWAYAM (Study Webs of Active-learning for Young Aspiring Minds)** is a programme initiated by Government of India and designed to provide best teaching learning resources to all.

3.52. **Taught Course** is a course supported by class room seminars and lectures.

3.53. **They**: The singular they is used as an inclusive and unbiased third person pronoun in order to include all genders.

3.54. **Tutorial** means a class to provide an opportunity to interact with students at their individual level to improve their performance.

4.43 **Weight** is a numeric measure assigned to the assessment units of various components of a course of study.

4.44 **Weighted Grade Point Average (WGPA)** is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points by the sum of weights. WGPA shall be obtained for CA and SEE separately and then the combined WGPA shall be obtained for each course.

4.45 **Workshop** means a smaller session of dedicated learning, conducted with or without the help of an external resource person(s) intended to impart specific skills to participants.

4.46 Words and expressions used but not defined in these regulations shall have the meaning assigned to them in the examination manual of the college or other competent statutory bodies.

5 **The title of the programme**

Title of the progamme is Integrated Master of Science programme in Physics (Quantum Nanostructures/ Flexible Electronics), It written short form as MSc Physics (Quantum Nanostructures/Flexible Electronics)

6 PROGRAMME STRUCTURE

5.1 Students shall be admitted to Integrated Master of Physics Programme under the Faculty of Sciences.

6

No	Type	Credit	Hours	10 Semesters
1	Core Theory & Practical	123	2646	(I-VIII Semesters)
2	Core Elective	5	108	(VI Semester)
3	Core Specialization	14	324	(IX & X Semesters)

4	Project & ViVa	15	576	(IX & X Semesters)
5	Complementary 1 Mathematics	12	216	(I, II,III & V Semesters)
6	Complementary 2 Chemistry	19	396	(I, II, III & IV Semesters)
7	Environment	2	36	(II Semester)
8	Research Methodology	3	54	(IV Semester)
9	Human Rights	2	54	(V Semester)
10	English	5	90	
	Total	200	4500	

7

7.1 The medium of instruction and examination shall be English.

7.2 INTERNSHIP/PROJECT WORK

7.2.1 Project work shall be carried out under the supervision of a faculty member of the Physics Department.

7.2.2 A candidate may, however, in certain cases be permitted to work on the project in an Industrial / Research Organization/ Institute on the recommendation of the Supervisor.

7.2.3 There should be appropriate continuous assessment of the progress of the project work.

7.2.4 The grade and credit for the semester programme project/ internship should be entered in the grade card issued by the College.

7.3 Comprehensive Viva-Voce shall be conducted at the end of the tenth semester which covers questions from all courses in the programme.

6 ATTENDANCE

6.1 The minimum requirement of aggregate attendance during a semester for appearing at the Semester End Examination shall be 75%. Condonation of shortage of attendance to a maximum of 10% in a semester can be given only once during the whole period of MCMS programme, subject to the fulfilment of procedure by the applicant.

6.2 If a student represents the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College Union / University Union activities, the student shall be eligible to claim the attendance for the actual number of days participated, subject to a maximum of 10 days in a semester based on the specific recommendations of the Head of the Department.

6.3 A student who does not satisfy the requirements of attendance shall not be permitted to appear for the Semester End Examinations.

6.4 Those students who are not eligible even with condonation of shortage of attendance shall repeat the semester along with the junior batches, if permitted.

7. BOARD OF STUDIES AND COURSES

7.1 The Board of Studies for MSc Physics shall design all courses of the programme.

7.2 The Board shall design and introduce new courses, modify, re-design, and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

7.3 The syllabus of a course shall include the title of the course, course outcomes, instructional hours, the number of credits and reference materials.

7.4 Each course shall have a unique alphanumeric code to represent the course.

7.5 Every programme conducted under Credit and Semester System (CSS) shall be monitored by the Academic Council of the College.

8. REGISTRATION

8.1 A student shall be permitted to register for the programme at the time of admission.

8.2 A student who has registered for the programme shall complete the programme within a maximum of 16 continuous semesters from the date of commencement of the programme.

9. ADMISSION

9.1 The admission to the Integrated MSc Physics programme shall be as per the rules and regulations of the College.

9.2 The eligibility criteria for admission shall be as announced by the College from time to time and published in the prospectus/website of the college.

9.3 Candidates admitted to the Integrated MSc Physics programme under Credit and Semester System (CSS) shall be required to have passed any higher secondary examinations of a board recognized by the Mahatma Gandhi University, Kottayam or as equivalent thereto with a minimum of 60% marks/CGPA score or equivalent grade.

9.4 Separate rank lists shall be drawn up for reserved seats as per the existing rules of reservation by the state and published.

9.5 The college shall make available a list of all programmes offered by the college in the prospectus/website.

10. SELECTION CRITERIA

10.1 Selection of the students is made on the basis of merit list prepared. The merit mark will be the total marks obtained in Part III of the qualifying examination (higher secondary) less handicap marks plus marks obtained for the Physics course plus bonus marks if any.

11. PROMOTION

11.1 Promotion of a student is governed by the examination manual of the college.

11.2 A student having 75% attendance and who fails to register for examination of a particular semester will be allowed to register notionally and is promoted to the next semester, provided application for notional registration shall be submitted within 15 days from the commencement of the next semester.

12. EXAMINATION, EVALUATION AND GRADING

12.1 The Department shall ensure that the college examination calendar is strictly followed.

12.2 There shall be provision for credit transfer subject to conditions specified in the examination manual of the College.

12.3 **Evaluation**: The evaluation scheme for each course shall contain two parts; **(a) Continuous Assessment (CA) and (b) Semester End Examination (SEE).** The ratio between CA and SEE is 2:3 in all taught courses.

12.4 CA and SEE shall be in direct grading for MCMS programme as per regulations in force in Mahatma Gandhi University, Kottayam.

12.5 Direct Grading for CA and SEE shall be based on 6 letter grades (A+, A, B, C, D and E) with numerical values of 5, 4, 3, 2, 1 and 0 respectively.

12.6 Grade Point Average (GPA): CA and SEE components are separately graded and the combined grade point with weightage 2 for CA and 3 for SEE shall be applied to calculate the GPA of each course. Letter grades shall be assigned to each course based on the categorization provided below.

Grade	**Grade point**	**Range**
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

12.7 **Continuous Assessment (CA):** The CA shall be based on a predetermined transparent system involving periodic tests, assignments and seminars (CARS and CADL) in respect of taught courses and based on tests, lab skill/records and viva in respect of practical courses. The weight assigned to various components for CA is as follows.

12.7.1 **Components of Continuous Assessment:**

All the three components of the Continuous Assessment are mandatory for taught courses.

12.7.1.1 For Taught Courses:

Component	Assessment Criteria		Weight
1	Continuous Assessment Tests (CAT)	CA1	2.5
		CA2	3.75
		CA3	3.75

2	Continuous Assessment for Research Skills (CARS)	5
3	Continuous Assessment for Deepened Learning (CADL)	5
Total		20
CA weight required for pass		2.0

12.8 To ensure transparency of the evaluation process, the CA grades awarded to the students in each course in a semester shall be published before the commencement of SEE.

13. SEMESTER END EXAMINATION (SEE)

13.1 There shall be a semester end examination of three hours duration for all the taught courses.

13.2 A question paper for taught course may contain five questions with or without sub questions based on the course outcomes. Each question together with its sub questions shall carry six weights each.

13.3 For practical courses, a practical examination shall be conducted at the end of each semester. There shall be two examiners to conduct the examination of which one shall be an external examiner and other member is faculty member nominated by HoD. Details of practical examination components are given along with syllabus.

13.4 Project examination at the end of tenth semester shall be conducted by three examiners, of which one shall be an external examiner, other members are project guide/project co-guide and or/faculty member nominated by HoD. Details of project evaluation components are given along with syllabus.

13.5 Comprehensive Viva-Voce and seminar at the end of tenth semester shall be conducted by two examiners, of which one shall be an external examiner and other member is the faculty member nominated by HoD. Details of seminar and viva -voce examination components are given along with syllabus.

13.7 **Minimum Grades**

13.7.1 **In CA Evaluation:** Minimum Grade in CA Evaluation: A student shall secure minimum C Grade for CA of a course to appear for the SEE of that particular course. Those who failed to achieve minimum C Grade (2 Grade Points) in CA and consequently lost the chance to appear for the SEE, shall be given an opportunity to improve their CA before the conduct of the Save a Semester Examination. For the CA improvement at this stage a student cannot repeat all the CA components, but could appear only for the CA Tests (CA1, CA2 and CA3 only). In case of failure to obtain the required pass grade in the CA retest as explained above, a student can appear for supplementary CA Tests along with the junior batch.

13.7.2 For all semesters, Semester Grade Point Average with letter grades is given (CA+SEE) as below:

Semester* Grade Point Average (SGPA)

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good (Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal (Pass)
Up to 1.99	D	Deficient (Fail)

***** The grading system will change in accordance with the amendments made by regulations in force in Mahatma Gandhi University, Kottayam.

13.7.3 Grades for the Programme (CGPA) are given below

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good (Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal (Pass)
Up to 1.99	D	Deficient (Fail)

* The grading system will change in accordance with the amendments made by regulations in force in Mahatma Gandhi University, Kottayam.

13.7.4 A minimum of C grade is required for a pass for both CA and SEE separately for every course.

13.7.5 If a student opts for the betterment of a course(s) in SEE, the student has to appear for the Save-a-Semester (SaS) examination for the respective course(s) conducted for that semester. The higher of the two grades will be accepted for final grading.

13.7.6 After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses and score a minimum SGPA of 2.00. However, a student is permitted to move to the next semester irrespective of their SGPA.

13.7.7 Credit Point (CP) of a course is calculated using the formula:

Credit Point (CP) of a course is calculated using the formula

CP = Cr x GP, where Cr = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA = TCP/TCr, where TCP = Total Credit Point of that semester = ∑_1^nCPi

TCr = Total Credit of that semester =∑_1^n Cri Where n is the number of courses in that semester.

13.7.8 **Cumulative Grade Point Average (CGPA)** of a Programme is calculated using the formula: CGPA=Σ(TCP × TCr)Σ TCr∕GPA shall be round off to two decimal places.

13.8 Pattern **of Questions**:

13.8.1 Questions for all assessments shall be set to assess the acquisition of the outcomes expected of a course. This shall include the knowledge acquired and application of knowledge in different situations, critical evaluation of knowledge and the ability to synthesize knowledge.

13.8.2 Pattern of questions for SEE shall be as follows:

Type of Questions	**Total no. of questions**	**No. of questions to be answered**	**Weights of each question**	**Total Weights**
Five questions with ***Either Or*** options. e.g. 1(A) ***Or*** 1(B)	10	5	6	30

- Each question may or may not contain sub divisions.
- If a question contains sub divisions, the total weights for all the sub divisions together shall be 6.
- The ***Either Or*** questions within a question shall measure the same outcomes.
- The question paper of a course shall be set in such a way that all the five questions cover all the modules and assess all outcomes defined for the course.
- A question may measure multiple outcomes.

The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E grades.

14 AWARD OF DEGREE

14.1 The successful completion of all the courses with a minimum of ‘C’ grade shall be the requirement for the award of degree by the Mahatma Gandhi University, Kottayam.

15 One Time Betterment Option – A candidate will be permitted to improve the CGPA of the programme within a continuous period of ten semesters immediately following the completion of the programme allowing **only once for a particular semester**. The CGPA for the betterment appearance will be computed based on the SGPA secured in the original or betterment appearance of each semester whichever is higher.

If a candidate opts for the betterment of CGPA of a programme, they have to appear for the SEE of the entire semester(s) excluding practical/ project / comprehensive viva. One-time betterment option is restricted to students who have passed in all courses of the programme at the regular (first) appearance.

16 Extra Credit for SWAYAM Courses

16.1 All students are encouraged to pursue SWAYAM course from https://swayam.gov.in/and obtain extra credits.

16.2 After successful registration of SWAYAM courses, students shall inform in writing to the Faculty Advisor concerned. The Faculty Advisors shall furnish the consolidated details to the HoD and the HoD shall forward the details to the Controller of Examinations.

16.3 The extra credits obtained from SWAYAM course will be shown in the consolidated mark sheet/grade sheet provided the proof of successful completion is submitted to the Controller of Examination before the commencement of final semester end examination.

17 Transitory Provision

Notwithstanding anything contained in these regulations, the Principal of the College shall, for a period of five years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to Integrated MSc Physics (Nano technology and Flexible Electronics) programme with such modifications as may be necessary.

III. Integrated M.Sc. Physics (Quantum Nanostructures/ Flexible Electronics) Programme

1. INTRODUCTION

Physics generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world. Physics also helps improve the quality of our lives through the use of high-tech developments in healthcare, energy, environment, communication etc.

The Integrated M.Sc Physics programme follows a semester-based course structure and continuous assessment within an innovative academic curriculum. The key features of the programme is the thrust given to the foundation topics in Physics and Mathematical Physics. It also gives ample importance to advanced areas in Physics and elective/specialization subjects. The students will be given an opportunity to undertake research project (Semester IX & X) under the guidance of faculty members in the department of Physics in association with premier scientific research organisations in the country/aboard which will certainly enhance their self confidence to meet with challenges in research at the global front. This programme offer students a higher level of education in basic sciences to enable them to tackle complex Physics problems compromising both academics as well as industrial fields. Syllabi are designed to furnish the growing need of industries and research. Class room teaching includes tutorials with problem solving approach, laboratory observations and assignments. It aims at developing awareness, aspiration and innovative ability to solve new scientific problems.

2. OBJECTIVES AND OUTCOMES OF THE PROGRAMME

2.1. **Objectives:**

The syllabi are framed to strengthen the ability scholars to do research in advanced areas of Physics by providing a more complete and logical frame work in the areas of basic Physics. By the end of the programme, the students should have attained a foundation in Mathematical methods to solve physics problems, Chemistry methods to prepare and analysis of materials, computational techniques to solve Physics problems.

By the same time, the students should have been introduced to basic and foundation courses in physics which are relevant subjects to complement the advanced core courses.

By the end of the programme, the students should have covered a wide range of topics in almost all areas of experimental and theoretical Physics, and had experience of independent works such as project, seminar etc.

2.2. Programme outcomes

Programme outcomes are what knowledge, skills and attitudes a graduate should have at the time of graduation. The following are the Programme Outcomes of Marian College, Kuttikkanam (Autonomous).

1: Domain Knowledge

2: Communicative competence

3: Proficiency in using Modern Technologies

4: Reflective response to ethical and social issues

5: Sustainability values

6: Critical thinking and Problem Solving

7: Entrepreneurship and Leadership

8: Team work and co-operation. `

9: Self-Directed and Lifelong Learning

2.3. **Programme Specific Outcomes: (PSO)**

1. Develop in depth knowledge of various branches of Physics.
2. Demonstrate skills and competencies to conduct wide range of scientific experiments and research in Physics.
3. Capable of analyzing and solving problems using reasoning skills based on concepts of Physics
4. Develop the knowledge, skills and attitudes necessary to pursue further studies in Physics and research in Physics.
5. Demonstrate understanding of the concepts from basic and applied branches of Mathematics to solve problems in Physics.
6. Demonstrate proficiency in problem-solving techniques using the computation techniques.
7. Develop the fundamental theories, concepts and applications in different basic areas of chemistry
8. Ability to apply fundamentals of electronics in various domains of electronic systems.
9. Understand the diverse applications of various fields of applied science and carry the knowledge and applications of basic sciences to community.
10. Develop in depth knowledge in specialization area Quantum Nanostructures/Flexible Electronics.
11. Develop communication skills for reporting the results in journals and oral presentation.

3. Salient Features

The major attractions of the programme are:

3.1. **The Integrated M.Sc in Physics** must include

- Common courses
- Core courses
- Complementary courses
- Elective /Specialization Courses
- Environmental and Human Right course
- Research Methodology in Science
- Research Project

- Noncredit courses
- Extra credit courses
- Summer project

❖Students can select two complementary course, one elective course and three specialization courses from the bunch of courses provided in the syllabus.

3.2. Students can complete summer projects **(non-credit)** during the summer vacation and gain industrial/academic/research training , the student is required to submit a project report as specified by the department.

3.3. Integrated M.Sc .Physics programme offer different **non-credit courses** which are highly related to day to day life and have much importance in skill enhancement of the students.

3.4. Integrated M.Sc. Physics programme offer different **Extra-credit courses** which are highly related to technical skill enhancement of the students. Interested students can select these courses to obtain certificate in the given courses.

IV. Course Outcomes and Mapping

All the individual courses in the programme have specific Course Outcomes which are mapped to the Programme Specific Outcomes (PSO) and the Programme Outcomes (PO). The programme has been designed such that the POs and PSOs are envisioned as the over-all aim of the programme. The achievement of the PSOs and POs are measured through the cumulative assessment of the course outcomes.

V. Instructional Methods

The Integrated M.Sc Physics programme envisages a student-centred learning and teaching approach, where the central focus is on learning. Instead of merely transferring knowledge, a teaching process that facilitates learning in an experiential way is emphasized. Self-directed and continuous learning skills are also stressed. It is expected that the students been powered to use their autonomy as learners to gain and practice specific knowledge and skills. Students should be enabled with problems solving skills by an approach that describes physical phenomena with relevant mathematical models and formulae and thereby equip them to clear national level competitive examinations. In order to inculcate scientific values and develop scientific temper, students are required to enroll in a research project during IX & X semester.

. The outcome focused pedagogy adopted for the curriculum transaction consists of:

- o Class room lectures
- o Problem solving sections
- o Experimentation of theories

- Assignments
- Peer teaching
- Presentations
- Expert Lectures
- Lab/ industrial visits
- Group discussions
- Modelling and simulation
- Talks / Seminars by experts.
- Special training / Workshops
- Practicals & Project work
- Online classes

1. **Scheme and syllabi of the programme.**

   Credit distribution of the programme.

No	Type	Credit	Hours	10 Semesters
1	Core Theory & Practical	123	2646	(I-VIII Semesters)
2	Core Elective	5	108	(VI Semester)
3	Core Specialization	14	324	(IX & X Semesters)
4	Lab Project & ViVa	15	576	(IX & X Semesters)
5	Complementary 1 Mathematics	12	216	(I, II,III & V Semesters)
6	Complementary 2 Chemistry	19	396	(I, II, III & IV Semesters)
7	Environment	2	36	(II Semester)
8	Research Methodology	3	54	(IV Semester)
9	Human Rights	2	54	(V Semester)
10	English	5	90	
	Total	200	4500	

2. **Credit and hours distribution of different courses**
3. **Scheme and syllabi of the programme.**

   Hours allotted for courses of the programme.

Type	No	Course	Le	Tu	Lab	Cr
		Semester I				
Core T	IPH2001	Mechanics	4	0	0	4
Core T	IPH2002	Thermal Physics	4	0	0	4

Core T	IPH2003	Basic Electronics	4	0	0	3
Comp 1 T	IPH2004	Mathematics- I	3	0	0	3
Comp 2 T	IPH2005	Chemistry- I	4	0	0	4
Core P	IPH2006	Core lab : Physics Lab	0	0	3	2
Comm	ICE2001	English Language Skills- I	3	0	0	3
			22	0	3	23

		Semester II				
Core T	IPH2009	Relativity, Waves and Optics	4	0	0	4
Core T	IPH2010	Basic Electrodynamics	4	0	0	4
Comp 1 T	IPH2011	Mathematics- II	3	0	0	3
Comp 2 T	IPH2012	Chemistry- II	4	0	0	4
Core P	IPH2013	Core lab : Physics Lab	0	0	3	2
Comp 2 P	IPH2014	Chemistry Lab	0	0	3	2
Comm	ICE2002	English Language Skills- II	2	0	0	2
Comm	IPH2015	Environmental Science	2	0	0	2
			19	0	6	23 46

		Semester III				
Core T	IPH2018	Mathematical Physics- I	4	0	0	4
Core T	IPH2019	Classical Electrodynamics	4	0	0	4
Core T	IPH2020	Modern Optics	4	0	0	4
Core P	IPH2021	Core lab : Physics Lab	0	0	3	2
Core P	IPH2022	Core Lab: Physics Lab	0	0	3	2
Comp 1 T	IPH2023	Mathematics- III	3	0	0	3
Comp 2 T	IPH2024	Chemistry- III	4	0	0	3
			19		6	22 68

		Semester IV				
Core T	IPH2028	Mathematical Physics- II	4	0	0	4
Core T	IPH2029	Basic Quantum Mechanics	5	0	0	4
Core P	IPH2030	Core Lab : Physics Lab	0	0	3	2
Core P	IPH2031	Core lab : Physics Lab	0	0	3	2

Comp 2 T	IPH2032	Chemistry- IV	4	0	0	4
Comp 2 P	IPH2033	Chemistry Lab	0	0	3	2
Comm	IPH2034	Research Methodology in Science	3	0	0	3
			16	0	9	21 89

			Semester V			
Core T	IPH2037	Mathematical Physics- III	4	0	0	4
Core T	IPH2038	Solid State Physics	5	0	0	4
Core T	IPH2039	Atomic and Molecular Physics	4	0	0	4
Core P	IPH2040	Core Lab : Physics Lab	0	0	3	2
Core P	IPH2041	Core lab : Physics Lab	0	0	3	2
Comp 1 T	IPH2042	Mathematics- IV	3	0	0	3
Comm	IPH2043	Human Rights	3	0	0	2
			19	0	6	21 110

			Semester VI			
Core T	IPH2046	Mathematical Physics- IV	4	0	0	4
Core T	IPH2047	Nuclear Physics	4	0	0	4
Core T	IPH2048	Classical Mechanics	5	0	0	4
Core P	IPH2049	Core Lab : Physics Lab	0	0	3	2
Core P	IPH2050	Core lab : Physics Lab	0	0	3	2
Core E1	IPH2051A	Core Elective	4	0	0	4
Core E1	IPH2052A	Core Elective LAB	0	0	2	1
			17	0	8	21 131

			Semester VII			
Core T	IPH2055	Advanced Electronics	4	0	0	4
Core T	IPH2056	Statistical Mechanics	4	0	0	4
Core T	IPH2057	Advanced Quantum Mechanics- I	5	0	0	4

Core T	IPH2058	Condensed Matter Physics	4	0	0	4
Core P	IPH2059	Core lab : Physics Lab	0	0	4	2
Core P	IPH2060	Core Lab : Physics Lab	0	0	4	2
			17	0	8	20 151

		Semester VIII					
Core T	IPH2062	Mathematical Physics- V		4	0	0	4
Core T	IPH2063	Advanced Atomic and Molecular Physics		4	0	0	4
Core T	IPH2064	Advanced Quantum Mechanics-II		5	0	0	4
Core T	IPH2065	Astronomy and Astro Physics		4	0	0	4
Core P	IPH2066	Core Lab : Physics Lab		0	0	4	2
Core P	IPH2067	Core Lab : Physics Lab		0	0	4	2
				17	0	8	20 171
		Semester IX					
Core T	IPH2069A	Core Specialization -I		4	0	0	4
Core T	IPH2070A	Core Specialization -II		4	0	0	4
Core T	IPH2071A	Core Specialization - III		4	0	0	4
Core P	IPH2072A	Core Physics Specialization Lab		0	0	3	1
Core P	IPH2073A	Core Physics Specialization Lab		0	0	3	1
Core R	IPH2074	Lab Project		0	0	7	0
				12	0	13	14/180
		Semester X					
Core R	IPH2074	Lab Project		0	0	25	13
Core R	IPH2075	Viva Voce					2
							15/200

Non Credit /Extra Credit courses (Optional)			
	Course	Total contact hours	Credit
Semester I			
IPH2007	Latex Programming	36	0
IPH2008	Python Programming-1	36	1
Semester II			
IPH2016	Life Inspiring Skills	36	0

IPH2017	Python Programming-2	36	1
Semester III			
IPH2025A	Summer project- I	36	0
IPH2026	Yoga Exercises For Sound Health	36	0
IPH2027	Machine Learning in Python -I	36	1
Semester IV			
IPH2035	Health and Emergency Care	36	0
IPH2036	Machine Learning in Python -II	36	1
Semester V			
IPH2025B	Summer project- II	36	0
IPH2044	Foundation Course in Reasoning	36	0
IPH2045	Machine Learning in Python -III	36	1
Semester VI			
IPH2053	Plant Propagation	36	0
IPH2054	Machine Learning in Python -IV	36	1

Semester VII			
IPH2025C	Summer project- III	36	0
IPH2061	Observational Astronomy	36	0

Semester VIII			
IPH2068	Finishing School	36	0

Core Physics Theory

IPH2001: Mechanics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes:

After the completion of the course the students shall be able to:

CO1: Apply particle dynamics, conservation laws and the theories of collisions.

CO2: Discuss inverse square law of force and central force motion.

CO3: Explain the harmonic motion, different types of oscillators.

CO4: Explain the material properties like elasticity and fluid dynamics.

CO5: Identify the basics of classical mechanics.

Prerequisites: Basic mechanics, reasoning power, initiative skills and basic mathematics.

Prerequisites: Basic mechanics, reasoning power, initiative skills and basic mathematics.

Unit I

Particle dynamics: Newton's laws of motion, equation of motion.

Conservation laws: Laws of conservation of momentum, collisions, inelastic collisions, impulse, momentum of a system of particles, reduced mass. Conservation of angular momentum, angular momentum of a system of particles, rotation of a rigid body about a fixed axis. Work-energy theorem, potential energy. Force and potential energy, conservative and non-conservative forces. Potential energy and work energy theorem.

Unit II

Gravitational field: Newton's law of universal Gravitation, gravitational field, gravitational potential, gravitational field equations, Poisson and Laplace equations. Central force, equation of motion, energy and potential, Kepler's law.

Unit III

Harmonic motion: Simple harmonic motion, damped harmonic oscillator, forced harmonic oscillator, forced undamped oscillator, forced damped oscillator, coupled oscillator.

Unit IV

Elasticity: Forces between atoms in a substance, elasticity, stress and strain, equivalence of shear strain to compression and extension strains, Poisson's ratio, relation between elastic constants, energy stored in a strained body, couple for twist, static solid beam and columns, Searle's experiment.

Fluid dynamics: Viscosity, equation of continuity, Bernoulli's equation, streamline and turbulent flow, lines of flow in air foil, Poisseuille's law, Stokes law.

Unit V

Lagrangian and Hamiltonian formalism: Equation of motion, Lagrangian, Lagrangian equation, degrees of freedom, generalized momentum, calculaus of variations, Hamilton's equation

Suggested Text books

1. Intermediate Dynamics, P. Hamill, Jones & Bartlett Learning.
2. Mechanics H S Hans and S P Puri Tata McGraw-Hill Ltd.

References

1. Mechanics, C. Kittel, W.D. Knight, M.A. Ruderman, C.A. Helmholz and B.J. Moyer, Berkeley Physics Course Vol 1, Tata McGraw-Hill Ltd .
2. Mechanics, D.S. Mathur and P.S. Hemne, S. Chand.
3. Properties of Matter, Mathur, S. Chand.
4. Mechanics, J.C. Upadhayaya, Ramprasad publications.
5. Mechanics, Somnath Datta, Pearson.
6. Classical Mechanics, Upadhyaya, Himalaya pub. House.
7. Mechanics, H.D Young and R.A Freedman, Pearson.
8. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
9. University Physics, H.D Young and R.A. Freedman, 12-th Edition, Pearson .

IPH2002: Thermal Physics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes:

After the completion of the course the students shall be able to:
CO1: Explain laws of thermodynamics -zeroth law, first law and second low
CO2: Explain the concept of Ideal gas, heat engine.
CO3: Explain the concepts based on entropy and Maxwell’s equations.
CO4: Define the basics of statistical formulations.
Prerequisites: Basic mechanics, reasoning power, initiative skills and basic mathematics.

Unit I Zeroth Law of thermodynamics

Macroscopic and microscopic points of view. Thermal equilibrium and zeroth law. Concept of temperature. Ideal-gas temperature. Description Thermodynamic system and coordinates. Thermodynamic equilibrium. Equation of state. Hydrostatic system. Intensive and extensive components of common thermodynamics systems.

Microscopic view and assumptions of kinetic theory and its results for monatomic ideal gas.

Unit II First Law of Thermodynamics

Work and its path dependence. Work in hydrostatic systems. Work in quasi-static process. Adiabatic work. Statement of the first law. Internal energy function. Concept of heat. Mathematical form of first law and differential form. Heat capacity.

Summary of the laws of heat conduction and radiation.

Internal energy of an ideal gas and relationship of heat capacities. Equation of adiabatic process.

Unit III Second Law of Thermodynamics

Conversion of work into heat and vice-versa. Heat engine and Kelvin-Planck statement of second law. Refrigerator and Clausius’ statement. Equivalence of the two statements. Reversibility and irreversibility. Conditions for reversibility.

Carnot’s engine and refrigerator. Carnot’s theorem and corollary. Thermodynamic temperature scale. Absolute zero and Carnot’s efficiency. Equality of ideal gas and thermodynamic scales.

Principle of Caratheodory. Entropy and calculation of entropy of ideal gas. TS diagram. Connection of reversibility, entropy and second law. Increase of entropy. Entropy and disorder.

Unit IV Entropy and Maxwell's Equations

Characteristic functions and their differentials. Maxwell's equations. TdS equations, heat capacity equations and internal energy equations. Jule-Thompson expansion and liquefaction of gases. First order phase transition: Clausius-Clapeyron equation. Chemical potential.

Unit V Statistical Mechanics

Fundamental principle of statistical mechanics. Equilibrium distributions. Partition function of canonical ensemble. Relation between entropy and probability. Partition function of ideal monatomic gas and applications. Equipartition of energy. Distribution of speeds in ideal monatomic gas.

Suggested Text-book

1. Mark W. Zemansky, Heat and Thermodynamics, McGraw Hill (2017)

References

1. Enrico Fermi, Thermodynamics, Dover (1936, 2007)
2. Kerson Huang, Introduction to Statistical Physics, CRC Press(2012)
3. Herbert Callen, Therm1odynamics and an Introduction to Thermostatistics, Wiley (2006)
4. Daniel Schroider, An Introduction to Thermal Physics, Pearson (2014)

IPH2003: Basic Electronics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Explain the fundamentals of diodes, circuits and its applications.

CO2: Explain the basics of transistor properties, biasing and circuit design.

CO3: Apply the theory and working of amplifiers and Oscillator circuits.

CO4: Explain the principle, working and application of devices like FET, UJT and operational amplifiers.

CO5: Illustrate the AM and FM modulation and demodulation.

Prerequisites. Basic semiconductor theory and properties, preliminary electrical circuits and basic mathematics

Unit I

Semiconducting diodes and applications:

PN Junction approximations, DC load line analysis, temperature effects, AC equivalent circuits. Zener diode. Diode rectification, DC power supply, power supply performance, Diode voltage regulator, clipper circuits, clamping circuits, DC voltage multipliers.

Unit II

Transistors: Transistor operation, transistor voltages and currents, amplification, characteristics.

DC load line and bias point, voltage divider bias and circuit design, thermal stability of voltage divider bias circuits.

Coupling and bypass capacitor, ac load lines, transistor models and parameters. CE circuit with un bypassed emitter resistor.

Unit III

Transistor circuits: Single stage CE amplifier.

Basic principles of feedback, positive & negative feedback, Advantages of negative feedback, negative feedback circuits

Two stage CE amplifiers Differential amplifiers

Oscillatory Circuits, LC oscillators – Hartley Oscillator, Phase shift Oscillator. Astable and monostable multivibrator

Unit IV

JFET characteristics and parameters, JFET biasing-MOSFET characteristics and parameters .

UJT characteristics and parameters, relaxation oscillator.

OP-amp input modes and parameters, Op-Amp circuits with negative feedback. Basic Op-amp circuits

Unit V

Modulation – Amplitude modulation- Analysis of AM wave – Sidebands –bandwidth- AM Demodulation. AM receiver. Frequency Modulation –Frequency deviation and carrier swing, FM sidebands. FM demodulation.

Suggested Text Books

1. Electronic devices and circuits David A Bell, PHI.
2. Electronic Devices, Thomas L. Floyd, Pearson.
3. Basic Electronics-B.L.Theraja, S Chand.

References

1. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, Prentice Hall.
2. Electronics: A Systems Approach: Neil Storey, 5th ed, Pearson.
4. A Text Book of Applied Electronics-R.S.Sedha, S Chand.
3. Basic Electronics (7th Edition), Malvino and Bates, TMH.
4. Electronics Fundamentals and Applications- D. Chattopadhyay and P.G.Rakshit, New Age International Publishers.
5. Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, Prentice Hall
6. Basic Electronics, Debashis De , Pearson.
7. Basic Electronics, Santiram Kal, PHI.

IPH2009: **Relativity, Waves and Optics**

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes

After the completion of the course the students shall be able to:

CO1: Explain the preliminary concepts of different frame of references.

CO2: Explain the basic concepts of relativity

CO3: Illustrate the superposition of oscillations.

CO4: Explain the nature of travelling waves and stationary waves.

CO5: Explain the details of geometrical optics and optical components.

Prerequisites: Concepts of waves, basic mathematics.

Unit I

Frame of reference: Inertial reference frames, coordinate transformations, Newtonian relativity, Galilean transformations, transformation equations linearly accelerating frame.

Rotating frame of reference: Fictitious force. Centrifuge force. Coriolis force and its effect on falling body and motion of projectiles. Foucault's pendulum.

Unit II

Relativity: Postulates of special theory of relativity, Lorentz transformations, addition of velocities, simultaneity and causality, Minkowski space, four vectors, relativistic dynamics. General theory of relativity (basic idea only).

Unit III

Superposition of Collinear Harmonic oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.

Superposition of N Collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Unit IV

Wave motion: Waves in a continuous medium, wave equation, wave velocities in a continuous medium, energy transport in a travelling wave.

Reflection and transmission of transverse and longitudinal waves, Group and Phase Velocities. Wave pulses, construction of wave pulses.

Unit V

Optical systems: Reflection, refraction, Fermat's principle, total internal reflection, optical properties of metals, The Stokes treatment of reflection and refraction. Geometrical Optics: Lenses, Stops, mirrors, prisms, thick lenses, lens systems.

Suggested Text Books:

1. Intermediate Dynamics, P. Hamill, Jones & Bartlett Learning
2. Mechanics, H S Hans and S P Puri Tata McGraw-Hill Ltd.
3. The Physics of Waves and Oscillations, N.K. Bajaj, Tata McGraw Hill.
4. Optics, E. Hecht, 4th Edition, Pearson.

References

1. Waves, F.S. Crawford Jr, Berkeley Physics Course Volume 3, Tata McGraw-Hill Ltd (2008).
2. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
3. Vibrations and Waves 1st Edition, A. P. French, MIT introductory physics series.
4. Intermediate Dynamics, P. Hamill, Jones & Bartlett Learning.
5. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
6. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.

IPH2010: Basic Electrodynamics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes.

After the completion of the course the students shall be able to:

CO1: Explain the electrostatic fields and potentials of physical systems and electric properties of matter

CO2: Explain the properties of electric steady current and different network theorems.

CO3: Calculate the magneto static field associated with a steady current.

CO4: Explain the magnetic properties of matter.

CO5**:** Differentiate Laplace's equation, method of images

CO6: Distinguish the properties of electromagnetic induction and time dependent fields.

CO7: Explain the properties of time dependent electric circuits.

CO8: Explain the Maxwell's equations and electromagnetic waves.

Prerequisites: Knowledge of vector analysis, vector calculus and fundamentals of electricity and magnetism.

Unit I

Electrostatics – Coulomb's law, charge density, Gauss's law–applications.

The electric potential: Line integral and curl of the electric field, electrostatic potential, potential due to collection of point charges, dipole, potential due to collection of continuous charge distribution, charged wire, ring, Laplace and Poisson equations, energy of the electrostatic field, potential energy.

Electric fields in matter**:** Bulk matter, non-polar and polar dielectrics, Coulomb's law in dielectric, boundary conditions at the interface of dielectrics.

Unit II

Electric currents: Current density, steady current in a conductor, electrical conductivity and Ohm's law, resistors, Network theorems, current and voltage sources, Thevenin's theorem, Norton's theorem, reciprocity theorem, maximum power transfer theorem.

Time dependent circuits: LR and LC circuits, LCR circuits- series and parallel.

Alternating currents: Impedance and reactance, LCR circuits with alternating currents.

Unit III

Magnetic forces and fields: Magnetic force on a current carrying conductor, motion of a charged particle in electric and magnetic field, cyclotron motion, force and torque on a current carrying loop in a field, Biot-Savart's law, properties of B, Ampere's law, magnetic vector potential, existence of vector potential.

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Boundary value problems with B and H.

Unit IV

Potentials: Laplace's equation, boundary conditions, Uniqueness theorem, conductors and second Uniqueness theorem.

Method of images- classic image problem, induced surface charge, force and energy.

Unit V

Electromagnetic induction: Faradays law, Lenz's law, energy in a magnetic field, self and mutual inductance, magnetic energy, circuits with inductance.

Maxwell's equations, electrodynamics before Maxwell, displacement current, Maxwell's equation in free space. Electromagnetic waves in vacuum- wave equation for E and B,

Suggested Text Books:

1. Introduction to Electrodynamics, David J Griffiths –4th Edition , Pearson
2. Electricity, magnetism and electromagnetic theory, S. Mahajan & S R Choudhary . Tata McGraw-Hill Ltd (2012).

References

1. Electricity and magnetism D Chattopadhyay and P C Rakshit , New Central Book Agency.
2. Electricity and Magnetism, Purcell, Berkeley Physics Course Volume 2, Tata McGraw-Hill Ltd.
3. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Electricity and Magnetism, R. Murugeshan, 1stEdition(Revised) 2006, S Chand.
5. Principles of Electromagnetics, Mathew N.O Sadiku- 4th Edition 2009, Oxford.
6. Fundamentals of Magnetism and Electricity, D.N Vasudeva , S Chand.
7. Electricity and Magnetism, KK Tewari, S Chand.
8. Electricity and Electronics, Saxena, Arora and Prakash, Pragati Prakashan.
9. Classical Electromagnetism, Jerrold Franklin, Pearson.
10. Electromagnetic Fields and Waves, KD Prasad, Satya Prakashan.
11. Field and wave Electromagnetics, David K Cheng, Pearson.

IPH2018: Mathematical Physics – I

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes

After the completion of the course the students shall be able to:

CO1: Discuss the solution of first and second order differential equations

CO2: Demonstrate the skills of modelling physical problems in terms of differential equations.

CO3: Describe the theoretical framework of the existence and uniqueness of Solutions

CO4: Describe the behavior nonlinear systems and its stability

CO5: Solve numerically initial value problems described by differential equations.

Prerequisites: Knowledge of basic mathematics

Unit I

First-order Equations. The concept of differential equations and the nature of its solutions are introduced. Topics to be studied are the following: separable, linear exact equations. Orthogonal trajectories and families of curves. Reduction of higher order equations to first order. Applications to mechanics of hanging chain and electrical circuits.

Unit II

Second order linear equations. Topics studied are: the nature of general solution of equation of second order, method of undetermined coefficients and variation of parameters and the use of a known solution to find another. Applications to a fourth order differential equation corresponding to two coupled harmonic oscillator is examined.

Unit III

Qualitative properties and the theory of differential equations. Review of the basics of linear algebra. Vector space, linear independence, bases, inner products and linear transformation in matrix representation. Concept of eigenvalues and eigenvectors. Wronskian. Picard's existence and uniqueness theorem. Sturm separation theorem. Sturm comparison theorem. The concept of Green's function.

Unit IV

Systems of first order equations. Linear systems. Homogeneous linear systems with constant coefficients. Volterra's predator-prey system as an example of nonlinear system. Types of critical points and stability. Application to linear system.

Unit V

Numerical Methods. Method of Euler. Improved. Error term. Euler method. Runge-Kutta method.

Suggested Text-book

1. G. F. Simmons and G. Krantz, Differential Equations: Theory, Technique, and Practice, McGraw Hill (2007). Chapters 1-3, 9-11

References

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley (2004)
2. George Arfken, Mathematical Methods for Physicists, Elsevier (2012)

IPH2019: Classical Electrodynamics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Explain the properties of EMW, interaction in a medium and at interface.

CO2: Understand the details relativistic electrodynamics.

CO3: Able to explain the properties and behavior of different sources of radiation.

CO4: Explain the properties of wave guide, transmission line and guided wave.

Unit I

Electrodynamics

Maxwell's equations, Maxwell's equation in matter, boundary conditions, continuity equation, Poynting theorem, Maxwell's stress tensor, conservation of momentum, Potential formulations, Gauge transformations, .

Unit II

Electromagnetic waves

Electromagnetic waves in conducting and non-conducting medium, Polarization, Reflection and transmission at a plane dielectric boundary (Normal and Oblique incidence), Reflection at conducting surface –Dispersion in Dielectrics, Superposition of waves, Group velocity.

Unit III

Relativistic Electrodynamics

Structure of space-time: Four vectors, Proper time and proper velocity, Relativistic dynamics-Minkowiski force, Magnetism as a relativistic phenomenon, Lorentz transformation of electromagnetic field, electromagnetic field tensor, electrodynamics in tensor notation, Potential formulation of relativistic electrodynamics.

Unit IV

Electromagnetic Radiation

Retarded potentials, Jefimenkos equations, Point charges, Lienard- Wiechert potential, Fields of a moving point charge, Electric dipole radiation, Magnetic dipole radiation, Power radiated by point charge in motion. Radiation reaction, Physical basis of radiation reaction.

Dipole Radiation.

Radiation resistance of a short dipole, Radiation from quarter wave monopole or half wave dipole.

Unit V

Wave Guides & Antenna

Maxwell's equations in phasor notation, waves between parallel conducting plane TE, TM and TEM waves, TE and TM waves in Rectangular wave guides, Impossibility of TEM waves in rectangular wave guides. Antenna parameters

Transmission Lines

Transmission Lines-Principles-Characteristic impedance, standing waves-quarter and half wave length lines

Suggested Text Books:

1 Introduction to Electrodynamics 4^{th} ed, David J. Griffiths, PHI
2 Electromagnetic waves and radiating systems, E.C. Jordan &K.G. Balmain PHI,1968
3 Fields and Wave Electromagnetics, David K Cheng 2^{nd} Edition , Pearson.
4 Electronic Communication Systems, Kennedy and Davis TMH 4^{th} Edition.

References

1 Antennas, J. D Kraus, Tata Mc-Grow Hill.
2 Classical Electrodynamics, J .D. Jackson, Wiley Eastern Ltd.
3 Basic laws of electromagnetism, I E Irodov, CBS Pub 2004.
4 Electromagnetic fields, S. Sivanagaraju, C. Srinivasa Rao, New Age International.
5 Introduction to Classical electrodynamics, Y. K. Lim, World Scientific,1986.
6 Electromagnetic Waves and Fields, V. V. Sarwate, Wiley Eastern Ltd, New Age Inernational
7 The Feymann Lectures in Physics, Vol. 2, R.P. Feymann, R.B. Leighton &M. Sands.
8 Electronic Communication Systems, G. Kennedy & B. Davis, TMH.
9 Antenna and wave guide propagation, K. D Prasad, Satya Prakashan.

IPH2020: Modern Optics

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course outcomes.

After the completion of the course the students shall be able to:

CO1: Analyze the details of interference and interferometry.

CO2: Analyze the details of Fresnel's and Fraunhofer diffraction and its applications.

CO3: Explain the polarization of light and associated properties.

CO4: Explain the coherence nature of optical sources

CO5: Illustrate matrix method for the analysis of optical systems.

Prerequisites: Basic knowledge of optics and Mathematics

Unit I

Interference: Theory of interference, wave front splitting interferometers, amplitude splitting interferometers, types and localization of interference fringes, multiple-beam interference, applications of single and multilayer films, applications of interferometry

Unit II

Diffraction: Diffraction preliminary considerations, opaque obstructions, coherent oscillators.

Fraunhofer diffraction- single, double and multiple slits, rectangular and circular aperture, resolution, grating.

Fresnel Diffraction: Fresnel half period zones, vibration curve, circular aperture and obstacles, Fresnel zone plate, rectangular aperture, diffraction by slit, narrow obstacle.

Unit III

Polarization: Nature of polarized light, polarizers, dichroism, birefringence, scattering and polarization, polarization by reflection, retarders, circular polarizers, polarization of polychromatic light, optical activity, induced optical effects-optical modulators, liquid crystals

Unit IV

Coherence theory: Basics of coherence theory, mutual coherence function and the degree of coherence, temporal and spatial coherence.

Unit V

Matrix method in paraxial optics: Matrix method, imaging by a spherical refracting surface and co axial optical system, unit plane, nodal plane, system of two thin lenses.

Suggested Text Books:

1. Optics, E. Hecht, 4th Edition.) (Chapters 8-13)., Pearson education (2009)
2. Optics, 3rd edition, Ajoy Ghatak. TMH, New Delhi.

References

1. Principles of optics, Max Born and Emil Wolf, Cambridge University press.
2. Optics and Atomic Physics, D P Khandelwal, Himalaya Pub. House
3. Optics, S K Srivastava, CBS Pub. N Delhi
4. A Text book of Optics, S L Kakani, K L Bhandari, S Chand.
5. Introduction. to modern optics by Grant R. Fowles. Dover publications, inc., New York .
6. Fundamentals of Optics , Francis Jenkins and Harvey White, Mc Grow Hill.
7. Optics , Eugene Hecht , Schaum's Outline Series.

IPH2028: Mathematical Physics – II

(Differential Equations - 2)

Lecture: 72, Tutorial: 18, Lab: 0, Credit: 4

Course Outcome

After the completion of the course the students shall be able to:

CO1: Demonstrate the method of power series to solve differential equations

CO2: Discuss the properties of special function

CO3: Understand various partial differential equations in physics and their solutions.

CO4: Demonstrate the skills in applying the methods of Fourier series and Laplace transforms.

CO5: Understand the variational problem and Euler's equation and its applications in physics

Prerequisites: Basic knowledge in Mathematics, differential equation.

Unit I

Power series solutions and special functions. Review of power series. Series solution of first order differential equations. Second-order linear equations: ordinary points. Regular singular points. Frobenius series solution. Gauss's hypergeometric equation and special functions.

Unit II

Fourier series. The idea of Fourier series. Definition and calculation. Convergence. Odd and Even functions. Fourier series on arbitrary intervals. Orthogonality.

Unit III

Partial differential equations. Boundary value problems. Derivation of wave equation. Solution. The heat equation. The Dirichlet problem for a disc. Poisson integral. Sturm Liouville problems.

Unit IV

Laplace Transforms. Definition of Laplace transforms. Application to differential equation. Derivatives and integrals of Laplace transforms. Properties. Convolutions. Abel's mechanical problem. Unit step and impulse functions.

Unit V

Calculus of variations. The variational problem. Isoperimetric problems. Euler's equation. Lagrange multipliers. Side conditions. Hamilton's principle.

Suggested Text-book

1. G. F. Simmons and . G. Krantz, Differential Equations: Theory, Technique, and Practice, McGraw Hill (2007). Chapters 4-8

References

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley (2004)
2. George Arfken, Mathematical Methods for Physicists, Elsevier (2012)

IPH2029: **Basic Quantum Mechanics**

Lecture: 90, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1**:** Analyse the development of quantum mechanics.

CO2: Explain the basics and postulates of quantum mechanics.

CO3: Interpret Schrodinger equation and harmonic oscillators.

CO4: Observe the application of quantum mechanics.

Prerequisites: Student should have essential knowledge of Algebra, Calculus and Newtonian Mechanics.

Unit I

Historical Review – Works of Plank, Einstein, Bohr, Heisenberg and Born – Wave vs particles-The de Broglie hypothesis and the Davisson – Germer experiment. Observables and operators – The postulates of quantum Mechanics-Operators, Eigen functions and Eigen Values

Unit II

Particle in a box – The Bohr correspondence principle – The Dirac notation – Hilbert space – Delta function orthogonality – Hermitian operators -Properties– the momentum and energy operators –– The superposition principle – Ensemble average – Commutation relations in Quantum Mechanics – Linearly independent functions.

Unit III

Time development of state functions (the discrete case) and expectation values –Ehrenfest's principle – Conservation of parity – General properties of one dimensional Schrodinger equation – The Harmonic oscillator – Annihilation and creation operators (Eigen functions not included)..

Unit IV

One dimensional barrier problems, simple step, rectangular barrier, Tunnelling- Finite potential well, periodic lattice, Bloch wave functions, quasi momentum, Eigen states, energy gaps, Bragg reflection, spreading of bound states.

Suggested Text Book:

1. Introductory quantum mechanics 4thed, Richard L Liboff, Pearson.

References

1. Quantum Mechanics-Concepts and Applications- Nouredine Zettili-2nd Edition, Wiley.
2. Quantum Mechanics- L.I Schiff-3rd Edition, TMH.
3. Introduction to quantum Mechanics- David J Griffiths, 2nd Edition Pearson.
4. Quantum Mechanics- Claud Cohen-Tannoudji, Bernard Diu, Franck Laloe, 3rd Edition, John Wiley.
5. Quantum Physics- Gasiorowicz, John Wiely.
6. Quantum Mechanics- V.K Thankappan-2nd Edition, New Age international Publishers.
7. Concept of Modern Physics Arthur Beiser TMH.
8. Introduction to quantum mechanics, P M Mathews and K Venkatesen TMH.
9. Quantum physics, E.H. Wichmann, Berkeley Physics Course Volume 4, Tata McGraw-Hill Ltd (2008).

IPH2037: Mathematical Physics – III

(Complex Variables)

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Define complex numbers and their properties

CO2: Describe the fundamental properties of analytical functions

CO3: Demonstrate the skills in applying contour integrals

CO4: Demonstrate skills in applying Taylor and Laurent series

CO5: Demonstrate the skills in applying residue theorem

Prerequisites : Basic knowledge in mathematics, complex variables.

Unit I

Complex numbers. Definition and algebraic properties of complex numbers. Cartesian and polar coordinates. Powers and roots. Regions in complex plane. Point at infinity.

Unit II

Analytic functions. Functions of a complex variable. Mapping, limit, continuity and derivatives. Cauchy-Riemann equation. Sufficient conditions. CR equations in polar form. Analytic function. Harmonic functions. Elementary functions.

Unit III

Integrals. Derivatives of complex functions w(t). Definite Integrals of Functions w(t). Contours. Contour Integrals. Some Examples. Examples with Branch Cuts. Upper Bounds for Moduli of Contour Integrals. Antiderivatives. Cauchy–Goursat Theorem. Simply Connected Domains. Multiply Connected Domains. Cauchy Integral Formula. Extension of the Cauchy Integral Formula. Applications.

Unit IV

Series. Convergence of Sequences**.** Convergence of Series**.** Taylor Series**.** Proof of Taylor's Theorem**.** Laurent Series**.** Proof of Laurent's Theorem**.** Examples**.** Integration and Differentiation of Power Series**.** Uniqueness of Series Representations.

Unit V

Residues and Poles. Isolated Singular Points**.** Residues**.** Cauchy's Residue Theorem**.** Residue at Infinity**.** The Three Types of Isolated Singular Points**.** Residues at Poles**.** Examples**.** Zeros of Analytic Functions**.** Zeros and Poles**.** Behavior of Functions Near Isolated Singular Points. Evaluation of Improper Integrals**.** Example**.** Improper Integrals from Fourier Analysis**.** Jordan's Lemma**.** Indented Paths**.** An Indentation Around a Branch Point**.** Integration Along a Branch Cut**.** Definite Integrals Involving Sines and Cosines.

Suggested Text-book

1. V. Churchill and J. W. Brown, Complex Variables and Applications, McGraw Hill (2014)

References

1. Edward Saff and Arthus Snider, Fundamentals of Complex Analysis with Applications to Engineering and Sciemce, Pearson (2018)
2. E. Kreyszig, Advanced Engineering Mathematics, Wiley (2004)
3. George Arfken, Mathematical Methods for Physicists, Elsevier (2012)

IPH2038: **Solid State Physics**

Lecture: 90, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes.

After the completion of the course the students shall be able to:

CO1:Explain the basic idea bout crystal structures and X-ray diffraction.

CO2: Identify theories of inter-atomic forces and thermal properties in metals.

CO3: Explain the free electron model, Bloch's theorem & energy bands and theory of semiconductors.

CO4: Explain the dielectric& magnetic properties of materials and superconductivity.

Prerequisites: Basic concepts of Quantum Mechanics and basic mathematics.

Unit I

Crystal structure:

Crystal state, lattice, unit cells, primitive and non-primitive cells, bravais lattice and crystal systems, symmetry, crystal planes, miller indices, examples of crystal structures

X-ray diffraction from crystals- Bragg's law, powder method, reciprocal lattice-properties, reciprocal lattice to sc, bcc and fcc, Bragg's law in reciprocal lattice-Ewald construction.

Unit II

Bonding in solids**:**

Inter-atomic forces, ionic bonding, bond dissociation and cohesive energy, madelung energy, covalent bonding, metallic bonding, hydrogen bonding, van der waals bonding, Lennard-Jones potential.

Lattice vibrations

Elastic waves, Vibration of one dimensional monatomic lattice, phonons, momentum of phonons, inelastic scattering of photons by phonons, lattice specific heat, classical model, Einstein model, Debye model.

Unit III

Free electron theory and elementary band theory **.**

Conduction electron, Free electron gas, electronic specific heat, Fermi surface.

Band theory, Energy spectra in atoms, molecules and solids, bloch theorem, Kronig-Penney model, energy-wave vector relations, different zone schemes, velocity and effective mass of electron, distinction between metals, insulators and semiconductors.

Unit IV

Semiconducting properties of materials

Semiconductors, crystal structure and bonding, band structure, drift velocity, free carrier concentration in intrinsic semiconductors. Fermi level and carrier concentration in intrinsic semiconductors. carrier concentration, conductivity and Fermi level for extrinsic semiconductor. Impurity states. Mobility of charge carriers, electrical conductivity of semiconductors.

Unit V

Dielectric properties of materials.

Polarization and susceptibility, local filed, dielectric constant and polarizability, sources of polarizability, piezoelectricity.

Magnetic properties of materials

Response of materials to magnetic field, classification of magnetic materials, Langevin's classical theory of diamagnetism and paramagnetism, ferromagnetism, Weiss theory, domain theory, antiferromagnetism and ferrimagnetism.

Superconductivity

Origin of superconductivity, response of magnetic field, Meissner effect, super current and penetration depth, critical field and critical temperature, type-I and type –II superconductors, thermodynamic and optical properties, isotope effect, Josephson effect and tunneling- elements of BCS theory-Cooper pairs.

Nanomaterials

Introduction - Nanomaterials (Definition , History and Uses)-Classification of nanomaterails-Emergence of Nanotechnology- bottom-up and top-down approaches-Challenges of Nanotechnology

Suggested Text books:

1. Elementary Solid state physics Ali Omer, Pearson.
2. Solid State Physics by Puri and Babbar, S Chand.
3. Solid state physics structure and properties of materials M A Wahab , (2nd Edition), Narosa.
4. Nanoscience and Nanotechnology, B S Murty, P Shamkar, Baldev Raj, BB Rath and James Murday, Springer

References

1. Solid State Physics, Dekker, A. J., Macmillan (2000).
2. Introduction to Solid State Physics (8th Edition), Charles Kittel, Wiley (2004).
3. Elements of x-ray diffraction (3rd edition), Cullity, B. D. and Stock, Stuart H., Prentice Hall (2001).
4. Elementary Solid State Physics: Principles and Applications, Ali Omar, (1993).
5. The Oxford solid state basics, Simon, Steven, Oxford University Press (2004).
6. Crystallography applied to solid state Physics, AR Verma, ON Srivastava, New age .
7. Solid State Physics, NW Ashcroft, ND Mermin – Cengage Learning.
8. Solid state physics, R L Singal, KNRN &Co.
9. Solid state physics, S O Pillai, New age .

IPH2039: **Atomic and Molecular Physics**

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes.

After the completion of the course the students shall be able to:

CO1**:** Explain the early developments of different atom models and atomic spectra.

CO2: Explain the concept of molecular structure.

CO3: Explain the origin and properties of molecular spectra.

CO4: Illustrate the theory of Raman Spectroscopy

CO5: Illustrate NMR and ESR spectroscopy and its instrumentation.

Prerequisites: Basics courses in Mathematics and Quantum mechanics

Unit I

Atomic Spectroscopy

Earlier atom models, Bhor atom model, energy levels and spectra, Somerfield atom model, Frank Hertz experiment, emission and absorption line spectra,

Vector atom model, angular and magnetic momenta, orbital angular momentum, spin quantum number, total angular momentum, magnetic moment of an orbital electron, magnetic moment due to electron spin, magnetic quantum numbers, spin-orbit interaction, coupling schemes, selection rules, intensity rules, Pauli's exclusion principle, electron configuration of atoms. Spectroscopic notation, fine structure of H_α and Na D lines Zeeman effect , Pachen-back effect, Stark effect.

Unit II

Molecular structure: Molecular bond, electron sharing, Hydrogen molecular ion, Hydrogen molecule, complex molecule.

Unit III

Molecular spectra. Origin of band spectrum, rotation-vibration spectra, rotation-vibration-electronic spectra, Frank-condon principle

Unit IV

Raman, NMR and ESR Spectroscopy

Classical and quantum theories of Raman effect- rotational Raman spectra – Vibrational Raman spectra –Mutual exclusion rule .

Unit V

NMR Spectroscopy, magnetic properties of nuclei, resonance condition, NMR instrumentation, medical applications of NMR.

ESR Spectroscopy- Basic principles and ESR spectrometer.

Suggested Text Books:

1. Molecular structure and spectroscopy, G Aruldas, PHI.
2. Text Books: Modern Physics S L KaKani & S Kakani, Viva pub.
3. Concept of modern Modern Physics Aurther Beiser, TMH, New Delhi

References

1. Spectroscopy Vol 1, B P Staughan and S Walker.
2. Fundamentals of molecular spectroscopy, C N Banwell
3. Introduction to Atomic Spectra, HE White, TMH
4. Elements of spectroscopy, Guptha, Kumar and Sharma ,Pragathi Prakash.

IPH2046: Mathematical Physics – IV

(Linear Algebra and Tensors)

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Discuss basic properties of matrices and linear transformation

CO2: Determine eigenvalues and eigenvectors and its applications

CO3: Understand the definition of tensors and their properties

CO4: Demonstrate skills in describing four vectors in special relativity

CO5: Describe basic framework of tensor calculus and general relativity.

Prerequisites : Basic knowledge in mathematics, algebra

Unit I

Vector spaces and matrices. Vector Space. Inner product space. Schmidt's orthogonalization. Schwartz inequality. Basic Algebraic Operations. Special Matrices. Determinants. Orthogonal and unitary transformation. Partitioning of Matrices. Systems of Linear Equations. Cramer's rule. Linear independent vectors.

Unit II

The Eigenvalue Problem. Eigenvalues and eigenvectors and their properties. Diagonalization. Application to coupled differential equations. Cayley-Hamilton theorem and applications. Bilinear and Quadratic Forms. Functions of a Matrix. Kronecker Sum and Product of Matrices. Matrices in Classical and Quantum Mechanics – discussion.

Unit III

Tensor Analysis. Occurrence of tensors in physics. Definitions and classifications. The Algebra of Tensors. Inner product and contraction. Quotient Law. The Fundamental Tensor. Metric tensor. Cartesian Tensors and applications.

Unit IV

Application to special relativity. Four-Vectors in Special Relativity. Lorentz transformation. Covariant Formulation of Electrodynamics. Fields of a uniformly moving charge.

Unit V

Tensor Calculus. Differentiation of tensor. Christoffel tensor. Covariant derivative. Kinematics in a Riemannian Space. Geodesics. Parallel transport. Curvature of Riemannian space. Einstein's law. Riemann-Christoffel Curvature Tensor.

Suggested Text-book

1. W. Joshi, Matrices and Tensors in Physics, New Age International (2017)

References

1. S. Axler, Linear Algebra done right, Springer (2014)
2. Gilbert Strang, Linear Algebra and its Applications, Thomson (1998)
3. B. Schutz, A first course in general relativity, Cambridge University Press (2012)
4. Albert Einstein, Relativity: The special and general theory, Dover (1924, reprinted in 2015)
5. George Arfken, Mathematical Methods for Physicists, Elsevier (2012)

IPH2047: Nuclear and Particle Physics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Understand the interior of nucleus and interaction between nucleons.

CO2: Explain the theory of radioactivity.

CO3: Understand the interaction of radiation with matter.

CO4: Explain the fundamentals of particle accelerator and nuclear energy.

CO5: Explain on particle physics.

Prerequisites: Basic mathematics and quantum mechanics.

Unit I

Introduction and Basic concepts: The nucleus and its constituents, nuclear mass and energy, nuclear potential and energy levels. Nucleon states, energy levels of nuclei, stability of nuclei. –Nuclear structure- Nuclear forces, semi empirical mass formula, binding energy, nuclear stability, liquid drop model, shell model, spin-orbit potential, parity.

Unit II

Radioactivity and radioactive decay, alpha , Beta & gamma emission, rate of radioactive decay, radioactive decay chain, natural radioactivity. Nuclear collision, cross section, differential cross section, reaction rate, examples of nuclear reaction.

Unit III

Interaction of radiation with matter. Heavy charged partic le, Bethe-Bloch formula, energy dependence, Bragg curve, projectile dependence, stopping medium dependence. Gamma rays, photoelectric effect, Compton scattering, pair production, attenuation. Neutrons-attenuation, neutron moderation,

Unit IV

Accelerators, DC and AC accelerators. Nuclear power. Fission and fission products, Breeder reactors , Fission reactor, Thermonuclear reaction, energy values, cross section, fusion reactor, magnetic confinement.

Unit V

Elementary Particles. Interactions and particles, Leptons, Hadrons, Elementary Particles quantum numbers, Quarks, Field Bosons.

Suggested Text Books:

1. J. S. Lilley, Nuclear Physics: Principles and Applications, John Wiley (2001).
2. Concepts of Modern Physics Arthur Beiser, TMH

References

1. Atomic and Nuclear Physics, S N Ghoshal, S.Chand.
2. Nuclear Physics, D C Tayal, Himalaya Publishing House
3. Nuclear and Particle Physics S L Kakani and Subhra Kakani –Viva Books 2008
4. Elements of Nuclear Physics, M L Pandya and R P S Yadav
5. Modern Physics, Kenneth S Krane, Wiley
6. Nuclear physics an introduction, S B patel, New Age International publishers

IPH2048: Classical Mechanics

Lecture: 90, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Explain Hamiltonian mechanics, variational principle and Lagrange's equations

CO2: Apply small oscillations and rigid body dynamics

CO3: Explain Canonical Transformations, Hamilton-Jacobi theory and -central force problems

CO4: Illustrate Fluid dynamics

Prerequisites: Basic knowledge in mathematics and physics

Unit: I

Hamiltonian Mechanics, Variational Principle and Lagrange's equations

Review of Newtonian and Lagrangian formalisms - cyclic co-ordinates -conservation laws and symmetry properties - velocity dependent potentials and dissipation function - Hamilton's equations of motion – Least action principle - physical significance. Hamilton's principle - calculus of variations – examples - Lagrange's equations from Hamilton's principle.

Unit: II

Small Oscillations and Rigid Body Dynamics

Stable and unstable equilibrium - two-coupled oscillators – Lagrange's equations of motion for small oscillations - normal co-ordinates and normal modes - oscillations of linear triatomic molecules. Angular momentum - kinetic energy - inertia tensor - principal axes - Euler's angles- infinitesimal rotations - rate of change of a vector - Coriolis force -Euler's equations of motion of a symmetric top - heavy symmetric top with one point fixed.

Unit: III

Canonical Transformations

Equations of canonical transformation- examples-harmonic oscillator. Poisson brackets - Lagrange brackets - properties- equations of motion in Poisson bracket form - angular momentum Poisson brackets – invariance under canonical transformations.

Unit IV

Hamilton-Jacobi Theory and Central Force Problems

Hamilton-Jacobi equation for Hamilton's principal function – harmonic oscillator problem - Hamilton-Jacobi equation as the short wavelength limit of Schrodinger equation. Central force problems-Reduction to the equivalent one body problem - equations of motion and first integrals - equivalent one-dimensional problem and classification of orbits - differential equation for the orbits – virial theorem

Unit V

Fluid dynamics

The central problem, equation of state, time rates of change of quantities, equation of continuity, Equations of motion, pressure potential, external force field, equilibrium fluid distribution, Bernoulli's theorem and Applications, Gravity waves and ripples, Two dimensional steady irrotational flow of incompressible fluids, Kelvin's and Helmholtz theorems, Representation of vortices, flow of imperfect fluids

Suggested Text Books.

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.
2. Classical Mechanics, J.C. Upadhyaya, Himalaya, 2010
3. Classical Mechanics, N.C. Rana and P.S. Joag, Tata Mc Graw Hill

References

1. Classical Mechanics, G. Aruldhas, Prentice Hall 2009
2. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranik,TMH.

IPH2055: Advanced Electronics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes.

After the completion of the course students shall be able to

CO1: Studies the fundamentals of op-amp and properties & effect of negative feedback

CO2: .Studies the various applications of Op amp and circuits

CO3: Studies the properties of different transducers and devices using it.

Prerequisites: Basic knowledge in mathematics, electronics and physics

Unit I

Op-amp with Negative Feedback

Open loop configurations- Differential amplifier –Block diagram representation of feed back configurations- Voltage series feedback: Negative feedback – closed loop voltage gain–Difference input voltage ideally zero–Input and output resistance with feed back–Bandwidth with feedback–Total output offset voltage with feed back–Voltage follower. Voltage shunt feedback Amplifier:- Closed loop voltage gain–inverting input terminal and virtual ground - input and output resistance with feedback – Bandwidth with feedback-Total out put offset voltage with feedback–Current to voltage converter- Inverter. Differential amplifier with one op-amp and two op-amps.

Input offset voltage–Input bias current–input off set current–Total out put offset voltage-Thermal drift–Effect of variation in power supply voltage on offset voltage–Change in input offset voltage and input offset current with time- Noise –Common mode configuration and CMRR.

Unit II

General Linear Applications

DC and AC amplifiers– AC amplifier with single supply voltage–Peaking amplifier –Summing , Scaling, averaging amplifiers – Instrumentation amplifier using transducer bridge–Differential input and differential output amplifier – Low voltage DC and AC voltmeter -Voltage to current converter with grounded load and floating load–Current to voltage converter–Very high input impedance circuit–integrator and differentiator**.**

Frequency Response of an Op-amp

Frequency response –Compensating networks – Frequency response of internally compensated and non compensated op-amps–High frequency op- amp equivalent circuit–Open loop gain as a function of frequency–Closed loop frequency response– Circuit stability-slew rate**.**

Unit III

Active Filters and Oscillators

Active filters– First order and second order low--pass Butterworth filter- First order and second order high-pass Butterworth filter-wide and narrow band pass filter - wide and narrow band reject filter- All pass filter – Oscillators: Phase shift and Wien-bridge oscillators–square, triangular and saw-tooth wave generators-Voltage controlled oscillator.

Comparators and Converters

Basic comparator- Zero crossing detector- Schmitt Trigger–Comparator characteristics- Limitations of op-amp as comparators- Voltage to frequency and frequency to voltage converters -D/A and A/D converters- Peak detector –Sample and Hold circuit.

Unit IV

Transducers

Transducers: Classification of transducers - electrical transducer - resistive transducer - strain gauges- piezo-electric and magneto strictive transducers - Hall effect transducers - thermistor inductive transducer - differential output transducers - pressure transducers - pressure cell - photoelectric transducers - photo voltaic cell – thermo electric transducers – mechanical transducers – ionization transducers – digital transducers - electro chemical transducers.

Unit V

Digital Instrumentation

Digital Instrumentation: Digital counters and timers - digital voltmeter – RAMP - voltage to time conversion - voltage to frequency conversion - frequency to voltage conversion - digital multi-meter - digital phase meter - digital frequency meter - time and frequency measurement – tachometer - pH meter.

Suggested Text Books:

1. Op-amps and linear integrated circuits, R.A. Gayakwad, 4th Edn.PHI.
2. Electronic Instrumentation, H.S. Kalsi, TMH (1995)
3. Transducers and instrumentation, D.V.S. Murty, PHI (1995)

References

1. Electronic Devices (Electron Flow Version),9/E Thomas L. Floyd, Pearson
2. Fundamentals of Electronic Devices and Circuits 5th Ed. David A. Bell, Cambridge.
3. Linear Integrated Circuits and Op Amps, S Bali, TMH
4. Electronic instrumentation and measurement techniques, W D Cooper, A D Helfrick, Pearson (2015)
5. Elements of Electronic Instrumentation and Measurement3rd ed, J J Carr, Pearson.

IPH2056: Statistical Mechanics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Understand the foundations of statistical mechanics.

CO2: Explain the classification of identical particles and Maxwell distribution.

CO3: Illustrate the Planck distribution and quantum statistics.

CO4: Explain the characteristics of Phase transitions, fluctuations and interacting systems.

Unit I

Foundations of statistical mechanics

Ideas of probability, axioms of probability theory, statistics and distributions, basic ideas of statistical mechanics, definition of the quantum state of the system, equations of state, the second law of thermodynamics.

Canonical ensemble

System in contact with a heat bath, partition function, entropy, partition function, condition for thermal equilibrium, thermodynamic quantities, expression for heat and work, factorizing the partition function, equipartition theorem, minimizing the free energy.

Unit II

Identical particles

Identical particles, symmetric and antisymmetric wavefunctions, calculating the partition function for identical particles, identical particles localized on lattice sites, identical particles in a molecule.

Maxwell distribution

The probability that a particle is in a quantum state, density of states in k space, single particle density of states in energy, distribution of speeds of particles in a classical gas.

Unit III

Planck's distribution

Blackbody radiation, Rayleigh-Jeans theory, Planck's distribution, derivation of the Planck's distribution, the free energy, Einstein's model, Debye's model.

Grand canonical ensemble- Systems with variable number of particles, condition for chemical equilibrium, chemical potential, grand canonical ensemble, partition function, grand potential.

Fermi and Bose Particles - Statistical mechanics of identical particles, thermodynamic properties of a Fermi gas.

Unit IV

Phase transitions

Phase equilibrium, classification of phase transitions, first order phase transitions, Clausius-Clapeyron equation, second order phase transition.

Ising model, equivalence of Ising mode to other models, Bragg-Williams approximation, one dimensional Ising model.

Unit V

Fluctuations

Energy fluctuations in canonical ensemble, density fluctuations in grand canonical ensemble, Einstein-Smoluchowski theory of Brownian motion, Fokker-Planck equation, Wiener-Khintchine theorem.

Statistical mechanics of interacting systems

Interacting systems, cluster expansion for a classical gas, partition function, equation of state.

Suggested Text books:

1. Introductory Statistical Mechanics, 2nd ed , R. Bowley &M.Sanchez., Oxford
2. Fundamental of Statistical Mechanics: B.B. Laud, New Age Pub (2000).
3. Statistical Mechanics, Kerson Huang.John Wiley
4. Statistical Mechanics, R.K. Pathria.elsevier.

References

1. Introductory Statistical Physics, S.R.A. Salinas, Springer (2000).
2. Fundamentals of Statistical and Thermal Physics, F. Rief, McGraw Hill (1986).
3. Statistical Mechanics, Satyaprakash& Agarwal, Kedar Nath Ram Nath Pub. (2004).
4. Problems and solutions on Thermodynamics and Statistical mechanics, Yung Kuo Lim, World Scientific Pub. (1990)
5. Fundamentals of Statistical Mechanics, A.K. Dasgupta, New Central Book Agency Pub. (2005).
6. Statistical Mechanics: a survival guide, A.M. Glazer and J.S. Warks,Oxford University Press. (2001).
7. An introduction to thermodynamics by Y.V.C. Rao (New Age Pub.)
8. An introduction to Thermal Physics by D.V. Schroeder (Pearson Pub.)

IPH2057: Advanced Quantum Mechanics - I

Lecture: 90, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Explain the basic mathematical tools of Quantum Mechanics

CO2: Explain the theoretical frame work of quantum mechanics

CO3: Illustrate the angular momenta and its addition

CO4: Describe the necessity of approximation methods and time independent techniques

Prerequisites: Basic knowledge in mathematics and physics

Unit: 1

Mathematical tools:

Hilbert space and wave functions-Dirac Notation- Operators-Representation in discrete bases-Representation in continuous bases- Matrix mechanics-Wave Mechanics

Unit: 2

Postulates, Time evolution and symmetry:

Basic postulates of quantum mechanics, state of a system, observables and operators, measurement in Quantum Mechanics, time evolution operator, stationary state, Schrodinger equation and wave packets, conservation of probability-time evolution of expectation values- symmetry and conservation laws- infinitesimal and finite unitary transformations, -connecting quantum to classical mechanics-brackets-Ehrenfest theorem

Unit: 3

Angular momentum:

Orbital angular momentum, general formalism, Matrix representation and general representation of angular momentum, spin angular momentum, Pauli matrices, eigen functions and eigen values of orbital angular momentum(L_z and L^2), spherical harmonics, addition of two angular momenta, calculation of CG co-efficients, coupling of orbital and spin angular momenta

Unit: 4

Approximation methods for stationary states:

Time independent perturbation theory- non degenerate and degenerate cases, fine structure, anomalous Zeeman effect, Variation method-Harmonic oscillator, Hydrogen atom, WKB

Approximation-Bound states for potential wells- no rigid wall, one rigid wall and two rigid walls- tunneling through potential barrier

Suggested Text book :

1. Quantum Mechanics-Concepts and Applications- Nouredine Zettili-2nd Edition, Wiley

References

1. Quantum Mechanics- L.I Schif-3rd Edition, TMH
2. Introduction to quantum Mechanics- David J Griffiths, 2nd Edition Pearson
3. Quantum Mechanics- Claud Cohen-Tannoudji, Bernard Diu, Franck Laloe, 3rd Edition, John Wiley
4. Quantum Physics- Gasiorowicz, John Wiely
5. Quantum Mechanics- Claud Cohen-Tannoudji, Bernard Diu, Franck Laloe, 3rd Edition, John Wiley
6. Quantum Physics- Gasiorowicz, John Wiely
7. Quantum Mechanics- V.K Thankappan-2nd Edition, New Age international Publishers
8. Concept of modern Modern Physics Aurther Beiser TMH.
9. Introduction to quantum mechanics, P M Mathews and K Venkatesen TMH.
10. Quantum physics, E.H. Wichmann, Berkeley Physics Course Volume 4, Tata McGraw-Hill Ltd (2008).

IPH2058: Condensed Matter Physics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course students shall be able to

CO1: Illustrate crystal structure and symmetry

CO2: Explain free electron theory, band theory of materials

CO3: Illustrate imperfections and dislocations in crystals

CO4: Explain Lattice dynamics of solid and magnetic properties of solids.

CO5: Explain details of nanomaterials.

Prerequisites : Basic knowledge in mathematics , physics and solid state physics

Unit I

Free Electron Theory of Metals

Review of Drude-Lorentz model - electrons moving in a one dimensional potential well - three dimensional well - quantum state and degeneracy - density of states - Fermi-Dirac statistics - effect of temperature on Fermi- Dirac distribution - electronic specific heat - electrical conductivity of metals - relaxation time and mean free path - electrical conductivity and Ohm's law - Widemann-Franz-Lorentz law - electrical resistivity of metals.

Imperfections and Dislocations

Types of imperfections in crystals - thermodynamic theory of atomic imperfections – experimental proof – diffusion mechanisms – atomic diffusion theory – experimental determination of diffusion constant – ionic conduction – shear strength of single crystals - slip and plastic deformations. Dislocations - Burgers vectors – edge and screw dislocations – motion of dislocation – climb - stress and strain fields of dislocation – forces acting on a dislocation – stress and strain fields of dislocation – forces acting on a

dislocation – energy of dislocation – interaction – between dislocation densities – dislocation and crystal growth – Dislocation – Frank – Read mechanism - point defects - twinning.

Unit II

Lattice Dynamics

Vibrations of crystals with monatomic basis – diatomic lattice – quantization of elastic waves – phonon momentum.

Anharmonicity and thermal expansion - specific heat of a solid - classical model - Einstein model - density of states - Debye model - thermal conductivity of solids - thermal conductivity due to electrons and phonons - thermal resistance of solids.

Dielectric Properties of Solids

Review of basic terms and relations, ferroelectricity, hysteresis, dipole theory - Curie-Weiss law, classification of ferroelectric materials and piezoelectricity.

Unit III

Energy Bands in Solids

Nearly free electron model. Bloch Theorem. Kronig Penney Model. Wave equation of electron in a periodic potential. Number of orbitals in a band. Band gap in semiconductors. Equation of motion. Intrinsic carrier concentration. Impurity conductivity. Semimetals and superlattices.

Unit III

Magnetic properties of solids

Quantum theory of paramagnetism - cooling by adiabatic demagnetization – Hund's rule – ferromagnetism -spontaneous magnetization in ferromagnetic materials - Quantum theory of ferromagnetism –Weiss molecular field - Curie- Weiss law- spontaneous magnetism - internal field and exchange interaction – magnetization curve – saturation magnetization - domain model.

Unit IV

Superconductivity

Thermodynamics and electrodynamics of superconductors- BCS theory- flux quantization-single particle tunneling- Josephson superconductor tunneling- macroscopic quantum interference

Nanotechnology and Metamaterials

Properties of metal, semiconductor, rare gas and molecular nanoclusters- superconducting fullerene- quantum confined materials-quantum wells, wires, dots and rings- metamaterials- graphene

Suggested Text Books:

1. Introduction to Solid State Physics, C. Kittel, 3rd Edn. Wiley India. (Chapter 4).
2. Introduction to Nanotechnology, Charles P Poole and Frank J Owens, Wiley India
3. Solid State Physics: Structure and properties of materials, M.A. Wahab, Narosa 2nd Edn. 2010, (Chapter 10**)**
4. Solid State Physics, S.O. Pillai, New Age International 6th Edn. 2010,(Chapter 10).

References

1. Crystallography and crystal defects, A. Kelley, G.W. Groves & P.Kidd, Wiley
2. Crystallography applied to Solid State Physics, A.R. Verma, O.N. Srivastava, NAI
3. Solid State Physics, N.W. Ashcroft & N.D. Mermin, Cengage Learning Pub.11th Indian Reprint (2011).
4. Solid State Physics, R.L. Singhal, Kedar Nath Ram Nath & Co (1981)
5. Elementary Solid State Physics, M. Ali Omar, Pearson, 4th Indian Reprint (2004).
6. Solid State Physics, C.M. Kachhava, Tata McGraw-Hill (1990).
7. Elements of Solid State Physics, J. P. Srivastava, PHI (2004)
8. Solid State Physics, Dan Wei, Cengage Learning (2008)
9. Solid State Physics, A.J. Dekker, Macmillan & Co Ltd. (1967)

IPH2062: Mathematical Physics – V

(Advanced topics)

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Understanding of advanced methods of solution of differential equations

CO2: Demonstrate the skills in applying the concepts of special functions.

CO3: Describe partial differential equation in physics and their solutions

CO4: Demonstrate skills in formulating integral equations and their solutions.

CO5: Describe the properties of probability distributions apply statistical tools

Unit I

Eigenfunction method for differential equations. Sets of functions. Adjoint, self-adjoint and Hermitian operators. Properties of Hermitian operators. Sturm-Liouville equation. Superposition of eigenfunctions and Green's functions.

Unit II

Special functions. Legendre functions. Associated Legendre function. Spherical harmonics. Bessel functions. Spherical Bessel functions. Laguerre functions. Hermite functions. Gamma function and Beta function.

Unit III

Partial Differential equations. Important PDE. General form of solution. General and particular solutions. Wave equation. Diffusion equation. Boundary conditions and uniqueness of solutions. Solution methods: separation of variables. Superposition of separated solutions. Separation of variables in polar coordinates. Integral transform methods. Inhomogeneous problem: the Green's function method.

Unit IV

Integral Equations. Obtaining an integral equation from a differential equation. Types of integral equation. Existence of solution. Operator notation. Closed form solution. Nuemann series. Fredholm theory. Schimdt-Hilbert theory.

Unit V

Probability and Statistics. Definition. Venn diagrams. random variables and distributions. Properties. Functions of random variables. Generating functions. Important distributions. Central limit theorem.

Joint distribution. Experiments, samples and populations, sample statistics Estimators and sampling distributions. Data modeling. Hypothesis testing.

Suggested Text-book

1. K.F. Riley and M.P. Hobson, *Essential Mathematical Methods for Physical Sciences*, Cambridge (2011), Chapters 8-11, 13, 16, 17

References

1. 1. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley (2004)
2. George Arfken, *Mathematical Methods for Physicists*, Elsevier (2012)
3. Mary L. Boas, *Mathematical Methods in the Physical Sciences*, Wiley(2006)

IPH2063: Advanced Atomic and Molecular Physics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Explain the theory atomic spectroscopy.

CO2: Explain the theory and application of microwave and IR spectroscopy.

CO3: Explain the theory and instrumentation of Raman spectroscopy and Electronic Spectroscopy of molecules.

CO4: Explain the theory and instrumentation of ESR and Mossbauer Spectroscopy

Prerequisites: Basic knowledge in mathematics, physics and modern physics.

Unit: I

Atomic Spectroscopy:

Vector Atom model –L S coupling & J J coupling, effect of electric & magnetic field on atoms and molecules; Zeeman effect, anomalous Zeeman effect, Paschen Back effect and stark effect.

Unit: II

Microwave and Infrared spectroscopy:

The spectrum of non- rigid rotator, e.g. of HF, spectrum of symmetric top molecule e.g. of CH_3Cl, Instrumentation for Microwave Spectroscopy Stark Modulator, Information derived from Rotational Spectrum: I R Spectroscopy: Born –Oppenheimer approximation, Effect of Breakdown of Born Oppenheimer approximation, Normal modes and vibration of H2O and CO2. Instrumentation for I R Spectroscopy –Fourier transformation I R Spectroscopy

Unit: III

Raman Spectroscopy

Rotational Raman Spectrum of Symmetric top molecules, e.g. of $CHCl_3$ Combined use of Raman & IR Spectroscopy in structure determination e.g. of CO_2, NO_3 and CH_4. Instrumentation for Raman Spectroscopy, Non-linear Raman effects, Hyper Raman effect, stimulated Raman effect and Inverse Raman Effect.

Unit IV

Electronic Spectroscopy of molecules:

Vibrational Analysis of band systems, Deslander's table, Progressions & sequences, Information Derived from vibrational analysis, Franck Condon Principle. Rotational fine structure and P R and R Branches, fortrat Diagram, Dissociation Energy, Example of Iodine molecule, predissociation.

Unit: V

Spin Resonance Spectroscopy:

Interaction of nuclear spin and magnetic field, level population, Larmour precession, Resonance Conditions, Bloch equations, Relaxation times, Spin-spin and spin lattice relaxation. The chemical shift, Instrumentation for NMR spectroscopy, Electron Spin Spectroscopy of the unpaired e, Total Hamiltonian, Fine structure, Electron Nucleus coupling, and hyperfine spectrum ESR spectrometer. Mossbauer Spectroscopy, Resonance fluroscence of γ-rays, Recoilless emission of γ-rays and Mossbauer effect, Chemical shift, effect of magnetic field. Eg. of Fe^{57} Experimental techniques .

Suggested Text Books:

1. Introduction to atomic spectra by H E White, MGH
2. Molecular structure and Spectroscopy, 2nd ed , G.Aruldas, PHI

References:

1. Spectroscopy Volume I, II and III, ed by Straughan and Walker, Science paperbacks

2. Introduction to Molecular Spectroscopy, G.M.Barrow , MGH.

3. Instrumental Methods of Analysis,7th Edition, H.H. Willard, CBS-Publishers, New Delhi.

4. Atomic Spectroscopy –K P Rajappan Nair ,MJP Publishers, Chennai

IPH2064: Advanced Quantum Mechanics - II

Lecture: 90, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Explain the principles of time dependent perturbations.

CO2: Explain the phenomena of scattering in quantum mechanical view.

CO3: Explain relativistic formulations of quantum mechanics.

CO4: Explain the second quantization principles.

Unit: I

Time dependent perturbation theory

Pictures of quantum Mechanics- Schrodinger, Heisenberg and interaction picture, Time dependent perturbation theory- transition probability- constant perturbation and harmonic perturbation, Adiabatic and sudden Approximation, interaction of atom with radiation- classical treatment, quantization of electromagnetic field, transition rates for absorption and emission, dipole approximation, selection rules, spontaneous emission

Unit II

Identical particles and Scattering:

identical particles in classical and quantum physics, exchange degeneracy, symmetrization postulate, symmetric and antisymmetric wave functions, Pauli's exclusion principle, Scattering- cross section, Lab and CM frames, scattering amplitude of spinless particles, differential scattering cross section, Born approximation, Validity condition, Yukawa potential, Partial wave analysis- elastic and inelastic scattering- scattering of identical particles

Unit III

Relativistic Quantum Mechanics:

Klein- Gordon equation, Plane wave solution, Equation of continuity, Probability density, Dirac equation, Dirac matrices, Plane wave solution, significance of negative energy states, spin of Dirac particle, Relativistic particle in central potential-Total angular momentum, Particle in Magnetic field- Spin magnetic moment, properties of gamma matrices, Covariant form of Dirac equation

Unit IV

Quantum Field theory:

Classical field theory, Lagrangian and Hamiltonian form, Euler-Lagrange equation, functional derivatives, Quantization of Schrodinger equation- system of bosons and fermions, quantization of Klein- Gordon equation, quantization of Dirac field.

Suggested Text Books

1. Quantum Mechanics-Concepts and Applications- Nouredine Zettili-2nd Edition, Wiley
2. Quantum Mechanics- L.I Schif-3rd Edition, TMH
3. Quantum Mechanics- V.K Thankappan-2nd Edition, New Age international Publishers

References

1. Introduction to quantum Mechanics- David J Griffiths, 2nd Edition Pearson
2. Quantum Mechanics- Claud Cohen-Tannoudji, Bernard Diu, Franck Laloe, 3rd Edition, John Wiley
3. Quantum Physics- Gasiorowicz, John Wiely
4. Advanced Quantum Physics- J J Saku, Pearson
5. Modern Quantum mechanics, J J Sakurai, JJ Napolitano, Pearson

IPH2065: Astronomy and Astrophysics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1**:** Observe different constellations and classify stars accordingly.

CO2: Explain the basics of seasonal changes.

CO3: Interpret the fundamental equations in stellar evolution.

CO4: Analyze basic theories of formation of solar system.

CO5: Discuss criterion, formation and evolution of stellar objects.

CO6: Understand basics of Milky Way and other extra galactic systems.

Prerequisites: Student should have essential knowledge of Algebra, Calculus, Statistical mechanics and Quantum mechanics.

Unit I

Celestial Sphere and Time: Constellations. The celestial sphere. Equatorial, ecliptic system of co-ordinates. Magnitudes: Direct and Absolute Stellar Magnitudes, Classification of stars, HD classification, Hertz Sprung-Russell (H-R) diagram.

Seasons, Sidereal, Apparent and Mean solar time. Stellar Distances and Magnitudes: Distance scale in astronomy Determination of distances to Planets and stars. Magnitude scale. Atmospheric extinction. Absolute magnitudes and distance modulus. Colour index.

Unit II

Fundamental Equations: The Equation of Mass Distribution. Equation of hydrostatic equilibrium. Equation of energy transport through radiation and convection processes. Equation of thermal equilibrium. State equation. Stellar opacity Stellar energy sources.

Theories of formation of the Solar System. The Sun: Photosphere, chromosphere and corona of the Sun. Sun spots and magnetic fields on the sun. Solar activity, solar wind. Planets and their Satellites: Surface features, atmospheres and magnetic fields of Earth

Unit III

Basics of Star formation & Evolution. The Jean's criterion for gravitational contraction and its difficulties. Pre-main sequence contraction, main sequence stage. Growth and subsequent development of the isothermal core. Formation of super dense objects - White dwarfs, Neutron stars & Pulsars. Black holes.

Stellar models: Overall problem and boundary conditions. Russell Vogt Theory. Dimensional Discussions of Mass Luminosity Law. Polytropic configurations. Homology transitions.

Unit IV

The Milky Way Galaxy & Galaxies beyond: Structure of the Milky Way Galaxy Galactic and globular clusters, Inter Stellar Matter. Position of our Sun and its motion around the galactic center. Rotation of the Galaxy and its mass. Extragalactic Systems: Hubble's classification of galaxies and clusters of galaxies. Galaxy interactions. Elements of Astrobiology.

Introduction to Cosmology: The expanding universe. Big Bang and Steady State models of the universe. Dark matter.

References:

1. H. Karttunen, P Kroger, H Oja. M Poutanen & K. J. Donner editors. Fundamental Astronomy, 5th Edition. Springer-Verlag (2007)
2. Textbook of Astronomy and astrophysics with elements of Cosmology, VB Bhatia, Narosa Publishing House, 2001.
3. Astronomy - Stars and Galaxies, K.D. Abhayankar, University Press, 2001.
4. W.M. Smart: Foundations of Astronomy.
5. M. Schwarzschild: Stellar Evolution
6. S. Chandrasekhar: Stellar Structure
7. Frank H. Shu: The Physical Universe-An Introduction to Astronomy
8. KD Abhyankar: Astrophysics of the Solar System
9. Baidyanath Basu: Introduction to Astrophysics
10. Horneck and Rettberg: Complete Course in Astrobiology, Wiley (2009)
11. Jayant Narlikar: Structure of Universe
12. Cox and Guili: Principles of Stellar Interiors- Vol. I and II
13. R. Bowers and T. Deeming: Astrophysics

Core Physics Practical

1. Practical courses CA

Physics practical

Sl. No	Assessment criteria	Weight
1	Experimental skill	7.5
2	Lab involvement	7.5
3	Record *	2.5
4	Attendance	2.5
Total		20
* Weight given to the record is related to the number of experiment recorded in practical record book.		

2. Practical course SEA

2.1. General experiments.

Components of External Evaluation of practicals: General experiments.	**Weight**
Principle & Procedure	6
Skill	6
Data and analysis	8
Result and conclusion	6
Viva	4
Total	**30**

2.2. Electronic experiments.

Components of External Evaluation of practicals: Electronic experiments.	**Weight**
Principle & Procedure	8
Skill	8
Data and analysis	6
Result and conclusion	4
Viva	4
Total	**30**

2.3. Computer experiments.

Components of External Evaluation of practicals: Computer experiments.	Weight
Algorithm/ flow chart	4
Basic physics of the experiment	7.5
Writing the program	7.5
Execution of the program with the final result& conclusion and printout	7
Viva	4
Total	**30**

Preliminary experiments not for evaluation

1. Calculate the probable error in a given set of observation and reject false observations . Write the result using suitable number of significant figures.

2. Calculate the percentage error in a given set of observation . Write the result using suitable number of significant figures.

3. Vernier Calipers - Volume of a cylinder, sphere and a hollow cylinder
4. Screw gauge - Volume of a sphere, wire and a glass plate
5. Spherometer - Thickness of a glass plate, radius of curvature of a convex surface and a concave surface
6. Beam balance - Mass of a solid (sensibility method.
7. Travelling microscope - Radius of a capillary tube .
8. Spectrometer – Angle of the prism.

(i) Do error calculation of the experiments.

(ii) Students are expected to complete at least 6/8 experiments from the following or similar projects assigned by the instructor.

(iii) Each lab report should be type-setted in LaTeX and formatted as follows: (i) A short-worded title, (b) Name of student, (c) Date of experiment, (d) Objectives (e) Short description of principle/mathematical steps/algorithm, (f) Python source code used, (g) Results including graphs, (h) conclusion. (Use 12 point font size on A4 size paper. (Maximum page per report may be fixed to 5).

Semester I

IPH2006: Physics Lab- Mechanics and Thermal Physics

Lab: 54, Credit: 2

CO1: Demonstrate experiments in mechanics, solid material properties, fluids, thermal Physics, thermal properties.

Minimum number of experiments 8

1. Torsion Pendulum- Rigidity modulus
2. Symmetric Compound pendulum
3. Young's Modulus- non uniform bending- pin and microscope
4. Flywheel – moment of inertia
5. Young's modulus- Cantilever mirror and Telescope
6. Young's modulus- uniform bending-Optic lever- Scale and Telescope.
7. Elastic constants- Searl's method.
8. Liquid lens refractive index of material of lens using known liquid.
9. Viscosity of a liquid- variable Pressure head
10. Newton's law of cooling- Specific heat.
11. Thermal conductivity of bad conductor- Lee's disc.
12. Thermal conductivity of glass using glass tube.
13. Thermal diffusivity of brass.
14. Heating efficiency of electrical kettle with varying voltages.
15. CF Bridge- Temperature co-efficient of resistance.
16. Any two equivalent experiments

References:

1. Advanced course in Practical Physics by D Chattopadhyay
2. Practical Physics, CL Arora, S.Chand
3. Practical Physics Harnam Singh , S Chand

Semester II

IPH2013: Physics Lab - Waves, Optics, Electricity & Magnetism

Lab: 54, Credit: 2

CO1: Demonstrate experiments of sound, waves and Optics & Electricity, magnetism and electrical circuits.

Minimum number of experiments 8

1. Melde's string- frequency
2. Ultrasonic- Determination of frequency
3. AC Sonometer- frequency
4. Liquid Lens- Refractive index of a liquid- parallax method
5. Spectrometer- Prism- Refractive index of glass
6. Dispersive power- Prism- Spectrometer
7. Potentiometer- Resistivity
8. Conversion of Galvanometer into voltmeter/ammeter.
9. Field along the axis of a coil- BH
10. Deflection and vibration magnetometer- m and BH
11. Potentiometer- Calibration of high range voltmeter/ low range Ammeter
12. Determination of magnetic force in a current carrying conductor.
13. Verification of Thevenin's and Norton's theorems bridge method.
14. To study the variation of thermo emf (Seebeck effect) across two junctions of a thermocouple with temperature.
15. To study the variation of junction temperature (Peltier effect) across two junctions of a thermocouple with current.
16. Any two equivalent experiments.

References:

1. Advanced course in Practical Physics by D Chattopadhyay
2. Practical Physics, CL Arora, S.Chand
3. Practical Physics Harnam Singh , S Chand
4. A course of Experiments with He-Ne Laser- R.S Sirohi (2nd Edition) Wiley Eastern Ltd

Semester III

IPH2021: Physics Lab- Computational Physics Lab – I

Lab: 54, Credit: 2

Course Outcome

After the completion of the course the students shall be able to:

CO1: Apply the mathematical concepts to formulate a computational problem

CO2: Demonstrate skills in writing computer programs, executing it and interpreting the results.

Topics for pre-lab lectures:

(a) Architecture of modern computer

(b) LINUX operating system and basic commands for file operation

(c) Tools like vi editor and GNUPLOT

(d) LaTeX typesetting concepts.

(e) Numerical methods involved in the lab programs may be briefly explained.

Lab Requirements:

Students are expected to complete at least 8 experiments from the following or similar projects assigned by the instructor.

Each lab report should be type-setted in LaTeX and formatted as follows: (i) A short-worded title, (b) Name of student, (c) Date of experiment, (d) Objectives (e) Short description of principle/mathematical steps/algorithm, (f) Python source code used, (g) Results including graphs, (h) conclusion. (Use 12 point font size on A4 size paper. (Maximum page per report may be fixed to 4).

List of experiments:

1. To perform a simple search on an array of numbers representing the height achieved by a ball thrown vertically with an initial velocity (say 4 m/s) as a function of time given as an array of 1000 equally spaced instants between 0 and 1 sec.
2. To generate a sequence of uniformly distributed random numbers using ‘uniform’ function and to sort in the increasing order. The program should produce formatted output on screen, both before and after sorting.
3. To numerically integrate a first order differential equation using Euler’s method, and to display graphically the error in evaluating the solution at a point by comparing with exact result. as a function of discretization size.

4. To use Euler's method to solve the equation of motion of a particle under the action of a harmonic oscillator potential, and to plot position-time graph, and position-velocity graph.
5. To solve equation of motion for a harmonic oscillator with damping, and to plot its phase trajectory (position-velocity graph)
6. To apply Runge-Kutta algorithm to solve a second order differential equation (Equation to be given).
7. Apply rectangle rule for integrating a simple function in one variable between two limits, by discretizing the interval into a large number (N) of intervals. The program should display the behavior of the integrals as a function of N.
8. Repeat the above problem using trapezoidal rule, and Simpson's rule.

Suggested Text-book

1. S. Linge and H.P. Langtangen, Programming for Computations – Python, Springer Open (2019) (Open access book)

References:

1. Alex Gezerlis, Numerical Methods in Physics with Python, Cambrideg (2020) and its companion website.
2. Amit Saha, Doing Math with Python, No Starch Press (2015)
3. Mark Newman, Computational Physics (2013)

IPH2022: Physics Lab- Electronics, Modern Optics and Electrodynamics

Lab: 54, Credit: 2

CO1: Demonstrate experiments using semiconducting diodes, transistors, ICs 555, 741 and demonstrate experiments of optics and electromagnetic waves.

Minimum number of experiments 8

1. Half wave and full wave rectifier- Ripple factor and efficiency
2. Voltage multipliers- doubler & tripler.
3. Diode clippers- (positive, negative and biased)
4. CE characteristics of a transistor.
5. Astable and Monostable multivibrator using timer IC 555.
6. OPAMP- adder and subtractor.
7. Regulated power supply using zener diode.
8. Spectrometer- i-d curve.
9. Spectrometer- Cauchy's constant.
10. Air wedge –radius of a thin wire /Thickness of a thin film
11. Newton's Rings- Refractive index of liquid.
12. Spectrometer -Resolving power of grating.
13. Polarization of light and verification of Malu's law.
14. Refractive index measurement of a transparent material by measuring Brewster's angle.
15. Laser- Grating- Determination of wavelength
16. Any two equivalent experiments

References:

1. Advanced Electronics : Lab Manual, Bourgon, Gilles, Algonquin College · 2000
2. Basic Electronics- Experiments Manual by Frank Pugh, Bernard Grob, Wes Ponick · 1998
3. Electronics Laboratory Manual By Martin Feldman · 2001
4. Advanced course in Practical Physics by D Chattopadhyay
5. Practical Physics, CL Arora, S.Chand
6. Practical Physics Harnam Singh , S Chand
7. A course of Experiments with He-Ne Laser- R.S Sirohi (2nd Edition) Wiley Eastern Ltd

Semester IV

IPH2030: Physics Lab- Computational Physics Lab – II

Lab: 54, Credit: 2

Course Outcome

After the completion of the course the students shall be able to:

CO1: Apply the mathematical concepts to formulate a computational problem

CO2: Demonstrate skills in writing computer programs, executing it and interpreting the results.

Pre-lab lectures:

Numerical methods involved in the lab programs may be briefly explained.

Lab Requirements: (As given under Computational Physics Lab – I)

List of experiments:

1. To compute the value of Pi using random number generation. The program should display the dependence of the computed value with number of points used.
2. To apply Monte Carlo method to evaluate to a one dimensional definite integral.
3. To use Monte Carlo method to compute the area of a triangle with vertices at (-1,0), (1,0), and (3,0).
4. To solve a given nonlinear equation in one variable using bisection method.
5. To solve a given nonlinear equation in one variable using Newton's method.
6. To implement and Euler scheme for numerically solve SIR disease spreading model with suitable boundary conditions to display the time evolution of various populations.
7. To compute the derivative of a function and to display both the function and derivative. (Use three point formula)
8. To compute the second order derivative of a polynomial function and to determine the points of maximum and minimum, and to verify it by plotting.

Suggested Text-book

1. S. Linge and H.P. Langtangen, Programming for Computations – Python, Springer Open (2019) (Open access book)

IPH2031: Physics Lab - Mechanics and Basic Quantum Mechanics

Lab: 54, Credit: 2

CO1: Demonstrate experiments in Mechanics, modern physics and basic concepts of quantum mechanics

Minimum number of experiments 8

1. Torsion Pendulum- Rigidity modulus- Equal mass.
2. Static Torsion- Rigidity Modulus.
3. Asymmetric compound pendulum.
4. Young's Modulus- Cantilever-Oscillation Method.
5. Elastic collision-Conservation of kinetic energy and linear momentum.
6. Coefficient of restitution -One dimensional elastic collision.
7. Boltzmann constant using V-I characteristic of PN diode.
8. Planck's constant using LEDs of at least 4 different colors.
9. Measurement of Stefan's constant.
10. To determine e/k using transistor.
11. Photo-electric effect: photo current versus intensity and wavelength of light.
12. e/m of electron
13. Millikan's oil drop experiments. Charge of electron.
14. Frank and Hertz Experiment – determination of ionization potential.
15. To show the tunneling effect in tunnel diode using I-V characteristics.
16. Any two equivalent experiments

References:

1. Advanced course in Practical Physics by D Chattopadhyay
2. Practical Physics, CL Arora, S.Chand
3. Practical Physics Harnam Singh , S Chand Ltd
4. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
6. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Maha

Semester V

IPH2040: Physics Lab- Computational Physics Lab – III

Lab: 54, Credit: 2

Course Outcome

After the completion of the course the students shall be able to:

CO1: Apply the mathematical concepts to formulate a computational problem

CO2: Demonstrate skills in writing computer programs, executing it and interpreting the results.

Pre-lab lectures:

Numerical methods involved in the lab programs may be briefly explained.

Lab Requirements: (As given under Computational Physics Lab – I)

List of experiments:

1. To display the trajectory of a random walker taking N random steps in two dimensions, and to study the variation of square of distance travelled with number of steps N, by taking average of large number of walks.
2. To calculate the correlation coefficient between two sets of data. The data should be read from a text file, and to construct a scatter plot showing the relationship. (Example data to be given, Refer Textbook 1)
3. To write a program to creating sets, checking whether a number is in the set, making Cartesian products and other set operations.
4. To create a frequency table for a given set of number, with table sorted by numbers. The data should be read from a text file.
5. Apply Euler's algorithm for solving the Volterra's predator-prey equations with a suitable initial conditions and visualization of the phase diagram.
6. Solve van der Pol equation using Euler's algorithm and study the phase trajectories under chaotic conditions.
7. To construct a least square fit of data to a straight line. Data may be allotted from experimental results. (Refer Squires, Practical Physics)
8. To compute Fast Fourier Transform of a set of data using FFT tools in Python.

Suggested Text-books

1. Amit Saha, Doing Math with Python, No Starch Press (2015)
2. Linge and H.P. Langtangen, Programming for Computations – Python, Springer Open (2019) (Open access book)

IPH2041: Physics Lab- Solid State Physics and Atomic & Molecular Physics

Lab: 54, Credit: 2

CO1: Demonstrate experiments in solid state physics, semiconductors, conductors, insulators, atomic and molecular spectroscopy.

Minimum number of experiments 8

1. Determination of Dielectric constant of a thin sheet
2. Determination of Band gap using thermistor.
3. X-ray diffraction – lattice constant-Analysis of data.
4. Silicon diode as a temperature sensor.
5. Electrical and thermal conductivity of copper
6. Temperature dependence of a ceramic capacitor and verification of Curie-Wiess law
7. Characteristics of LED
8. Characteristics of solar cell
9. Absorption spectrum –KMnO4 solution / Iodine vapour –
10. Spectrometer- Stoke's formula
11. Spectrometer - wavelength of Sodium D1 and D2 lines
12. Radiation spectrum and Wien's displacement law
13. Construction of photometer and verification of Beer-Lamberts law (LED modulation and filter)
14. Hydrogen spectrum – Rydberg constant
15. Wavelength of prominent lines of the emission spectra of copper, iron and brass
16. Study the emission of light from a hydrogen discharge source.
17. Any two equivalent experiments

References:

1. A course of Experiments with He-Ne Laser- R.S Sirohi (2nd Edition) Wiley Eastern Ltd
2. Advanced course in Practical Physics by D Chattopadhyay
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Maha

Semester VI

IPH2049: Physics Lab- Computational Physics Lab – IV

Lab: 54, Credit: 2

Course Outcome

After the completion of the course the students shall be able to:

CO1: Apply the mathematical concepts to formulate a computational problem

CO2: Demonstrate skills in writing computer programs, executing it and interpreting the results.

Topics for pre-lab lectures:

Numerical methods of solving matrix equations and its applications to partial differential equations shall be discussed. Sample codes and algorithms shall also be discussed.

Lab Requirements as given in the syllabus of Lab – I.

List of Experiments:

1. To use Gaussian elimination for solving a system of linear equations, by developing a function for general N x N system.
2. To solve a system of tri-diagonal matrix equation. A function unit may be developed and used.
3. To use Jacobi's iteration method for solving a system of equations.
4. To apply Gauss-Seidel iteration method for solving system of equation.
5. To solve Laplace equation for distribution of potential in a two-dimensional space with given boundary conditions.
6. To solve one-dimensional wave equations using finite different approach.
7. To solve Poisson equation in one-dimensional space for a given linear charge distribution.
8. To apply Newton interpolation formula

Suggested Text-book

1. Ward Ceney and David Kincaid, Numerical Mathematics and Computing, Cengage (2012)

IPH2050: Physics Lab- Classical mechanics and Nuclear Physics

Lab: 54, Credit: 2

CO1: Demonstrate experiments using GM counter and verification of problems in nuclear physics by numerical techniques and demonstrate experiments in mechanics and computational analysis of mechanical systems.

Minimum number of experiments 8

1. Geiger Mueller counter - draw plateau curve.
2. Geiger Mueller counter- absorption coefficient of β particle.
3. A set of observations of π meson disintegration is given. Fit the values to a graph based on appropriate theory and hence calculate life time τ of π mesons.
4. Draw graphs for radioactive disintegrations with different decay rates for different substances. Also calculate the half-life's in each case.
5. Half-life period of a Radium sample is 1620 years. Analytically calculate amount of radium remaining in a sample of 5g after 1000 years. Verify your answer by plotting a graph between time of decay and amount of substance of the same sample.
6. Plot the trajectory of a α-particle in Rutherford scattering and determine the values of the impact parameter.
7. Kater's Pendulum
8. Coupled Oscillator
9. Cornu's experiment
10. Air Track experiment: Oscillation
11. Air Track experiment: Collisions
12. Determination of viscosity: torsional oscillation
13. Computational analysis of nonlinear dynamical system
14. Simulation of transfer orbits
15. Integration of pedal equation for plotting of orbit
16. Any two equivalent experiments.

References:

1. Mechanical Systems, B Saraf, D P Khandelwaf, B C Mazumdar, Y S Shishodia and R S Tailor, Vikas Publishing House P Ltd.
2. Advanced course in Practical Physics by D Chattopadhyay
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Maha

Semester VII

IPH2059: Physics Lab- Advanced Electronics

Lab: 72, Credit: 2

CO1: Demonstrate experiments using transistors, ICs and simulation of electronic circuits.

1. Minimum number of experiments 6
2. R C Coupled CE amplifier - Two stages with feedback - Frequency response and voltage gain.
3. Differential amplifiers using transistors and constant current source - Frequency response, CMRR.
4. Push-pull amplifier using complementary - symmetry transistors power gain and frequency response.
5. Regulated power supply using zener diode and IC 741
6. Voltage controlled oscillator using transistors.
7. Voltage controlled oscillator using IC 555
8. Differential amplifier - using op-amp.
9. Active filters – low pass and high pass-first and second orderfrequency response and rolloff rate.
10. Band pass filter using single op-amp-frequency response and bandwidth.
11. Wein-bridge Oscillator – using op-amp with amplitude stabilization.
12. Solving differential equation using IC 741
13. Solving simultaneous equation using IC 741
14. Design and simulate a single stage RC coupled amplifier with feedback. Study the frequency response
15. Design and simulate an RC phase shift oscillator using BJT and observe the sinusoidal output waveform.
16. Any two equivalent experiments.

References:

1. Advanced Electronics : Lab Manual, Bourgon, Gilles, Algonquin College · 2000
2. Laboratory manual for Electronic devices and circuits [4th ed.] By David A. Bell · 2001
3. Electronics Laboratory Manual By Martin Feldman · 2001

IPH2060: Physics Lab- Statistical Mechanics Lab (Simulations)

Lab: 72, Credit: 2

CO1: Demonstrate simulations of statistical systems.

Minimum number of experiments 5

1. Monte-Carlo simulation of an ideal gas (Ref. 1)
2. Solution of traveling salesman problem (Ref. 1)
3. Percolation threshold for 2-dimensional lattice (Ref2)
4. Monte Carlo simulation of 2 dimensional Ising model (Ref.2)
5. Simulation of phase transition in Ising model using mean-field model (Ref 2)
6. Dynamics of two particle (one dimensional) interaction through Lennard Jones potential (Ref 2)
7. Molecular dynamics experiments using online tool (Ref. 3)
8. Any two equivalent experiments.

References:

1. Mark Newman, Computational Physics (2012)
2. N. Giordano and H. Nakanishi, Computational Physics, Pearson (2005)
3. Daniel V. Schroeder, Interactive Molecular Dynamics, Am. J. Phys. 83 (3), 210–218 (2015)

Semester VIII

IPH2066: Physics Lab- Condensed Matter Physics

Lab: 72, Credit: 2

CO1: Demonstrate experiments in solid state physics

Minimum number of experiments 6

1. Hall Effect (a) carrier concentration (b) Mobility & (c) Hall coefficient.
2. Resistivity of semiconductor specimen–Four Probe Method
3. Four probe method – energy gap
4. Study of ionic conductivity in KCl / NaCl crystals
5. Thermo emf of bulk samples of metals (aluminium or copper)
6. Study of physical properties of crystals
7. Study of electrical properties of a thin film(sheet resistance)
8. Study of junction capacitance and it's variation
9. Electrical conductivity of metals and estimation of Fermi energy
10. Energy gap of CdS thin films
11. Dielectric constant of ferroelectric materials
12. F-centre in alkali halides
13. Any other equivalent experiments

References:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Maha
4. Introduction to Semiconductor Materials and Devices M. S. Tyagi, Wiely

IPH2067: Physics Lab- Quantum Mechanics (Simulations)

Lab: 72, Credit: 2

CO1: Demonstrate simulations of quantum mechanical systems and principles.

Minimum number of experiments 5

1. Numerical solution of one-dimensional Schrodinger equation by finite difference
2. Solution of radial wave equation for hydrogen atom, and study of probability density of electron in various orbitals.
3. Numerical solution of Schrodinger equation for He atom by considering self-consistent potential.
4. Variational approach for anharmonic oscillator and minimization of energy
5. First and second order perturbation for quantum confined Stark effect (electron in 1D potential well under electric field)
6. Solve the S-wave radial Schrodinger equation for the ground and first excited states of hydrogen atom.
7. Solve the S-wave Schrodinger equation for the ground of an atom with screened Coulomb potential.
8. Study the band structure of one dimensional periodic potential using Kronig-Penney model. Study the variation of gap with potential parameters.
9. Study the band structure of grapheme using tight-binding model.
10. Any two equivalent experiments.

References:

1. Ward Ceney and David Kincaid, Numerical Mathematics and Computing, Cengage (2012)
2. Computational Methods for Physics By Joel Franklin (2013)
3. Mark Newman, Computational Physics (2012)
4. N. Giordano and H. Nakanishi, Computational Physics, Pearson (2005)

Elective Courses

IPH2051A: Flexible Electronics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Categorize the printed electronics and its possibilities in the industry

CO2: Explain varies flexible electronics products and its challenges

CO3: Establish about different derivatives in the process and methods used in flexible electronics

CO4: Describe the opportunities of various flexible electronics applications and products

Prerequisites: Basic physics, solid state physics, semiconductor physics, materials science, electronics, mathematics and chemistry

Unit I

Flexible Devices Fabrication and Materials

Introduction to Flexible and Printed Electronics- Materials Systems, Background and history, emerging technologies, general applications, Review of Semiconductors - Circuit Elements, Carrier transport, doping, band structure, thin-film electronic devices

Organic and inorganic materials for printed electronics. Substrates for printed electronics. Conductor materials. Insulators materials. Semiconductor materials.

Thin-film Deposition Methods for Flexible Devices, CVD, ECVD, PVD, etching, photolithography, low-temperature process integration

Materials for Flexible and Printed Electronics: Nanowire and nanoparticle synthesis, transition metal oxides, amorphous thin films, polymeric semiconductors, paper-based electronics -barrier materials.

Future printed electronics market share. Future predicted products.

Unit II

Printed Electronics

Advantages of printed electronics products from other electronic components – roll to roll production, mass production, flexible products, low price, etc. How printed electronic components are produced with printing process. Printing consideration for printed electronics -Resolution, registration, thickness , holes, materials. Benefits of roll to roll printing.

Printing process challenges – related printing of printed electronics. Material challenge – related printing of printed electronics. Manufacturing challenges

Unit III

Device Printing Technology

Printing parameters. Materials for printed electronics- Conducting materials, semiconducting materials.

Printing techniques-

Screen printing Screen printing for printed electronics. Flat screen and rotary screen. screen printing considerations. Screen printed products of printed electronics.

Inkjet printing, Inkjet printing for printed electronics. Advantages and disadvantages of ink jet printing. Application of printed electronics

Gravure printing.

Gravure printing for printed electronics. Uses of table – top proof presses and laboratory presses. Alignment process and source of error. considerations. Gravure printed products of printed electronics.

Inter connections.

Unit IV

Trends in Flexible Electronics

Flexible displays- OLED displays. Printing for OLED displays, printing requirement for OLED application. Ink formulation and process control, print defects and control.

Printed electronics sensors. Inverted solar cells, RFID, Thin Film Transistors.

References

1. Wong, William S., Salleo, Alberto (Editors) – Flexible Electronics: Materials and Application Springer, U.S./India – 2009
2. Guozhen Shen, Zhiyong Fan (Editor) - Flexible Electronics: From Materials to Devices, World Scientific, U.S. – 2016
3. Takao Someya (Editor) – Stretchable Electronics – Wiley International, U.S. – 2013
4. Katsuaki Suganuma Introduction to Printed Electronics (Springer Briefs in Electrical and Computer Engineering) Springer
5. Ian M. Hutchings And Graham D. Martin (Editors) Inkjet Technology for Digital Fabrication John Wiley & Sons 2013
6. Frances Gardiner Frances Gardiner (Editors) Polymer Electronics –A Flexible Technology Smithers UK 2009
7. *Mario Caironi and Yong-Young Noh (Editors)* Large Area and Flexible Electronics Wiley 2015
8. Wolfgang Bock, Advances in Flexible Electronics Displays , Intertech-Pira, UK 2005

IPH2052A: Physics Lab- Flexible Electronics

Lab: 36, Credit: 1

Course out comes

After the completion of the course students shall be able to

CO1: Develop characterization of optoelectronic devices.

CO2: Design and perform fabrication of energy saving/efficient flexible lamp devices.

1. Characteristics of printed diodes.
2. Characteristics of printed capacitors.
3. Characteristics of photovoltaic cells
4. Characteristics of photodiode
5. Characterization of OLED
6. Characterization of inverted solar cell
7. ESFL circuit design
8. ESFL tooling
9. ESFL blending

References

1. Ian M. Hutchings And Graham D. Martin (Editors) Inkjet Technology for Digital Fabrication John Wiley & Sons 2013
2. Frances Gardiner Frances Gardiner (Editors) Polymer Electronics –A Flexible Technology Smithers UK 2009

IPH2051B: Nanoscience and Nanotechnology

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course outcomes

After the completion of the course the students shall be able to:

CO1: Develop the basics of nanomaterials.

CO2: Illustrate the synthesis of zero, one, two dimensional nanomaterials.

CO3: Illustrate the electronic and photonic application of nanomaterials.

CO4: Illustrate the nanomaterial characterization techniques.

Prerequisites: Basic physics, mathematics and chemistry.

Unit I

Synthesis of Zero dimensional nanostructures: nanoparticles-

(Homogeneous and heterogeneous nucleation)- synthesis of metallic and semiconductor nanoparticles- stabilization of nanoparticles – by Chemical precipitation and co-precipitation, Sol-Gel synthesis, Microemulsions synthesis, normal and reverse micelles formation, Hydrothermal, Solvothermal

Synthesis of one-dimensional nanostructures: Nanowires and nanorods –

Spontaneous growth – (vapour-liquid-solid growth) /(Solid-liquid-solid growth) – Template based – Electrospinning-Lithograpy

Unit II

Synthesis of two-dimensional nanostructures: Thin films –

Fundamentals of film growth-Physical Vapour Deposition- Chemical Vapour deposition- Atomic layer Deposition – self-assembly- Langmuir-Blodgett films - electrochemical deposition - Sol-gel films

Unit III

Electronic and Photonic Applications:

Microelectronics – photolithography – Density of micro-components –molecular electronics – Nanoelectronics – memories – LEDs – Nano-transistors-– Fullerenes - graphene - carbon nanotubes (CNTs) - SWCNT- MWCNT - synthesis - methods of opening, filling and purifying carbon nanotubes – geometrical structure of CNTs – electronic structure of CNTs – metallic and semiconducting CNTsCarbon nanotubes (CNT) in electronic applications – CNT based MOSFET – MEMS and NEMS

– dye sensitized solar cells – CMOS technology-Large Electrochromic Display Devices-low cost Flat-Panel Displays.

Nanomaterials for Photovoltaic Solar Energy Conversion Systems

Principles of photovoltaic energy conversion (PV), Types of photovoltics Cells, Physics of photovoltaic cells, Organic photovoltaic cells, thin film Dye Sensitized Solar Cells, Quntum dot (QD) Sensitized Solar Cells (QD-SSC), Organic-Inorganic Hybrid Bulk Hetero Junction (BHJ-SC) Solar cells, Current status and future trends.

Synthesis, Characterisation and Application of TiO_2, ZnO nanoparticles

Unit IV

Nanostructured Materials Characterization Techniques

X-ray diffraction (XRD), SEM, EDAX, TEM, Elemental mapping, FTIR, UV-Visible-NIR spectrophotometer, Nano-mechanical Characterization using Nanoindentation, Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), TEM, X-ray Photoelectron Spectroscopy (XPS), Electrochemcial Characterization measurements.

References

1. Nanostructures & Nanomaterials-Synthesis, Properties and Applications, G. Cao Imperial College Press, 2004.
2. Nanochemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge UK 2005.
3. Chemistry of Nanomaterials : Synthesis, properties and applications by CNR Rao et.al.
4. Active Metals: Preparation, characterization, applications – A. Furstner, Ed., VCH, New York 1996.
5. Characterization of Nanophase materials – Z.L Wang (ed), Wiley-VCH, New York 2000.
6. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
7. Nanostructured Silicon – based powders and composites – Andre P Legrand, Christiane Senemaud, Taylor and Francis, London New York 2003.
8. Processing & properties of structural naonmaterials - Leon L. Shaw (editor)
9. Elements of X-ray Diffraction by Cullity, B. D.,, 4th Edition, Addison Wiley, 1978.
10. Electron Beam Analysis of Materials by Loretto, M. H., Chapman and Hall, 1984.

IPH2052B: Physics Lab- Nanomaterials

Lab: 36, Credit: 1

Course out comes

After the completion of the course students shall be able to

CO1: Report characterization of nanomaterials.

CO2: Design characterization of nanomaterials.

1. Determination of lattice parameters using XRD for cubic systems
2. Determination of lattice strain and particle size from XRD
3. Preparation of nanoparticles by Sol Gel method
4. Preparation of nanoparticles embedded polymers: optical properties
5. Preparation of thin film by chemical bath deposition: Optical properties.
6. Dip coating - preparation of multilayer films
7. Optical properties of thin films prepared by PVD
8. Any two equivalent experiments.

References

1. Nanostructures & Nanomaterials-Synthesis, Properties and Applications, G. Cao Imperial College Press, 2004.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. Introduction to Semiconductor Materials and Devices M. S. Tyagi, Wiely

Specialization Courses

IPH2069A: Quantum Heterostructures

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcome

After the completion of the course the students shall be able to

CO1: Describe the structure and properties of semiconductor heterostructures

CO2: Apply quantum mechanical ideas to construct band structure.

CO3: Describe the electronic structure of low dimensional systems

CO4: Illustrate the background information for studying quantum transport.

Syllabus

Unit I

Overview of semiconductor band structure. Tight binding method. Application to graphene. K.P theory. Spin-orbit interaction. Measurement of band structure.

Unit II

Envelop function and effective mass approximation. Equation of motion for electros and holes. Band engineering, doping and semiconductor surfaces.

Unit III

Fabrication of semiconductor nanostructures. Growth methods. Lithography. Electrostatics of semiconductor nanostructures. Solution using Green's functions. Induced charges on gate electrode. Total electrostatic energy. Simple model of a split-gate structure.

Unit IV

Hamiltonian for N-electron system. Screening. Single particle approximation. Electrostatics of a GaAs/AlGaAs heterostructure. Electrochemical potential and applied gate voltage. Spatial potential fluctuations and theory of screening. Spin-orbit interaction.

Unit V

Diffusive classical transport in two-dimensional electron gas. Ohm's law, current density and Hall effect. Boltzmann transport equation. Scattering mechanisms. Ionized impurity scattering. Scatering time and cross-section.

Suggested Books

1. Thomas Ihn, Semiconductor nanostructures, Oxford (2010) Chapters 1-10

IPH2070A: Transport in Nanostructures

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcome

After the completion of the course the students shall be able to

CO1: Describe the physics of modern nanoelectronic devices.

CO2: Discuss in detail the transport properties of mesoscopic systems.

CO3: Prepare the student to use advanced computational tools in nanoelectronics.

CO4: Prepare the student to understand the research works in this area.

Unit I

Ballistic electron transport: Experimental observations of conductance quantisation. Current and conductance in ideal quantum wire. Crrent and transmission. Quantum point contact. Diffusive limit. Detailed study of tunneling transport through potential barriers. Conductance matrix. Landauer-Buttiker approach. Transmission matrix.

Unit II

Interference effects: Aharonov – Bohm phase. Berry's phase and adiabatic limit. Diffusive quantum transport: Weak localization effect. Weak coherence. Temperature dependence. Scaling theory of localization. Thoules energy. Weak antilocalization and spin-orbit interaction.

Unit III

Shubnikov- de Haas effect. Electron localization at high magnetic field. Quantum Hall effects: Integral and fractional. Composite Fermions. Laughlin theory.

Unit IV

Quantum dots. Coulomb-blockade effects in quantum dots. Quantum dot states. Capacitance model. Single particle spectrum. Example of two quantum dot helium. Hartree and Hartree-Fock approximation. Electron transport through quantum dots. Coupled quantum dots: capacitance model, finite tunneling coupling. Spin excitations in two electron double dots. Transport in two quantum dots connected in series and parallel.

Unit V

Introduction to NEGF formalism

Suggested Books

1. Thomas Ihn, Semiconductor nanostructures, Oxford (2010) Chapters 11- 19
2. Supriyo Datta, Quantum Transport, Cambridge (2005) Chapter 1

IPH2071A: Nano-Optics and Nanophotonics

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

Course Outcome

After the completion of the course the students shall be able to

CO1.Explain the optical properties of nanao-structures.

CO2.Explain detailed study of emerging areas like photonic crystals and plasmonics

CO3. Develop skills needed to apply computational methods for designing Nano-optical structures.

CO4.Illustrate the research work in Nanophotonics

Unit I

Confinement of photons and electrons. Similarity with optical and electronic structures. Optical tunneling.

Unit II

Light in periodic structures and photonic crystal. Bloch waves and band structure. Properties and applications of photonic crystals. Waveguides based on photonic crystals. Microcavities and microlasers.

Unit III

Near field optics. Optical properties of metals. Plasmons and metals nanoparticles. Metal-dielectric nanostructures and meta- materials. Surface plasmon polaritons in subwavelength guiding.

Unit IV

Semiconductor nanostructures (Quantum wells, wires and dots) and their optical properties. Nanocomposites. Random Lasers. Bio-nano photonics. Discussion of current topics of research.

Suggested Books

1. S.V. Gaponenko, Introduction to Nanophotonics, Cambridge (2010)
2. L.Novotny and B. Hecht, Principles of Nano-Optics, Cambridge (2007)
3. J.D.Joannopaoulos, R.D.Meads, S.C.Johnson, and N.Joshua, Photonic Crystals: Molding the Flow of Light, Princeton Press (2011)

IPH2072A: Physics Lab- Synthesis and Characterization of Nanomaterials

Lab: 54, Credit: 1

Course out comes

After the completion of the course students shall be able to

CO1: Report characterization of nanomaterials.

CO2: Design characterization of nanomaterials.

1. Determination of lattice parameters using XRD for cubic systems
2. Determination of lattice strain and particle size from XRD
3. Determination of resistivity of thin films by four probe set up
4. Preparation of nanoparticles by co-precipitation
5. Preparation of nanoparticles by Sol Gel method
6. Preparation of nanoparticles by self-combustion method: Structural studies by XRD.
7. Preparation of nanoparticles embedded polymers: optical properties
8. Preparation of thin film by chemical bath deposition: Optical properties.
9. Dip coating - preparation of multilayer films
10. Optical properties of thin films prepared by melt spinning
11. Synthesis and optical property studies of silver nanoparticles
12. Effects of temperature on the morphology and the structural properties of ZnS nanoparticles prepared by co-precipitation method.
13. Any two equivalent experiments.

References:

1. Introduction to Semiconductor Materials and Devices M. S. Tyagi, Wiely
2. Optical process in semiconductor, J I Pankove, Dover publications NY.
3. Nano structure and Nanomaterials Synthesis, properties and applications, G Cao, Imperial College press.

IPH2073A: Physics Lab- Nanostructures

Lab: 54, Credit: 1

CO: To learn the skills needed to solve essential practical problems at research level using computational method

Pre-lab lectures:

The instructor should present the outline of the experiments based on the suggested references.

Lab Projects:

1. To simulate the dispersion of surface plasmon polaritons in a metal/dielectric interface by solving the dispersion relation (Ref. 1)
2. To study the photonic bandgap of a one-dimensional photonic crystals using transfer matrix method (Ref 1)
3. To study the quantum confined Stark effect of a quantum well using (Ref 2)
4. To study the working of a resonant tunneling diode (Ref 2)
5. To study the band structure of GaAs using without considering spin-orbit interaction (Ref 2, Chapter 5)
6. To study the effect of spin-orbit interaction (Ref 2, Chapter 5)
7. Determine and plot energy of the two lowest levels of a GaAs quantum well using one-band effective mass model, as a function of well width and in-plane wavevectors. (Ref 2, Chapter 7)
8. Use a one dimensional Schrodinger Poisson solver for studying self-consistently the electron density of MIS capacitor and analys the effect of well width. (Ref 2, Chapter 7)
9. Calculate the transmission versus energy for a quantum wire with multiple sub-bands for various number of scatterers. (Ref 2, Chapter 11)
10. Repeat the above with different types of scattering (Ref 2, Chapter 11)

References:

1. M. S. Wartak, Computational Photonics, Cambridge (2013)
2. Supriyo Datta, Quantum Transport, Cambridge (2005)

IPH2069B: Flexible Electronics Technology

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

IPH2070B: Device Printing Technology

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

IPH2071B: Flexible Displays Devices

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

IPH2072B: Device Printing Technology Lab –I

Lab: 54, Credit: 1

IPH2073B: Device Printing Technology Lab –II

Lab: 54, Credit: 1

IPH2074: Project

Credits: 13 **Total Hours: 576**

Course outcomes.

After the completion of the course the students shall be able to:

CO1. Develop the depth of knowledge in

Physics .

CO2. Evaluate an independent research project.

CO3. Focus the knowledge of contemporary issues in their chosen field of research.

CO4**.** Produce an ability to present and defend their research work to a panel of experts.

1. **Project CA.**

Details of project Internal examination components.

.

Components Internal Evaluation of project	**Weight**
Punctuality	**5**
Experimentation/Data collection	**5**
Knowledge in the topic	**5**
Report	**5**
Total	**20**

2. Project SEA

Details of project evaluation components.

Components of External Evaluation of Project	**Weight**
Relevance of Topic	2.5
Methodology	2.5
Quality of Project Report	2.5
Analysis and Findings	7.5
Project Viva-Voce (External)	15
Total	**30**

IPH2075: Viva Voce

Credit: 2 **Contact Hours:0**

After the completion of the course the students shall be able to:

CO1. Illustrate the Integrated understanding of the knowledge gathered from the various courses in the programme.

CO2. Justify the current knowledge in research and academic field.

CO3. Justify information from different domains and show capability to apply it to research and teaching.

CO4. Produce professional communication skills.

1. viva-voce CA

Details of seminar and viva-voce internal examination.

Components of Internal Evaluation of seminar and viva-voce	**Weight**
Seminar presentation (**Internal)**	5
Knowledge in the topic	5
Viva-Voce Fundamental topics (**Internal)**	5
Viva-Voce advanced topics (**Internal**)	5
Total	**20**

2. Viva-Voce SEE

Details of seminar and viva –voce examination components.

Components of External Evaluation of seminar and viva-voce	**Weight**
Seminar presentation (External)	6
Knowledge in the topic	6
Viva-Voce Fundamental topics (External)	9
Viva-Voce advanced topics (External)	9
Total	**30**

Complementary Courses

IPH2004: Mathematics- I

Trigonometry, Differential Calculus and Matrices

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course outcomes.

After the completion of the course the students shall be able to:

CO1: Explain basic matrix properties, operations, and to solve applications in physical systems.

CO2: Solve problems in differential calculus and its applications.

CO3: Apply partial derivatives.

CO4: Explain application of trigonometric functions and series.

Prerequisites. Basics mathematics.

Unit I

Matrices.

Singular and Non-singular Matrices, transformations, Equivalent matrices, Different types of matrices, Inverse of a matrix by elementary transformations, Rank of a Matrix, Row Canonical form, Normal form, System of linear equations, Solution by Matrix Method , Cramer's rule and elementary transformations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors, Cayley-Hamilton theorem (statement only) and simple applications,

Unit II

Differential Calculus & Applications of Derivatives

Derivative of a function, differentiation rules, the derivative as rate of change, derivatives of trigonometric functions, the chain rule and parametric equations, implicit differentiation, Extreme values of functions, The Mean Value Theorem.

Unit III

Partial Derivatives

Functions of several variables (Definition only), Partial derivatives, The Chain Rule.

Unit IV

Trigonometry

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, $\sin^n\theta$, $\cos^n\theta$, $\sin^n\theta \cos^m\theta$,Circular and hyperbolic functions, inverse circular and hyperbolic function. Separation into real and imaginary parts. Summation of infinite series based on C+iS method. (Geometric, Binomial, Exponential, Logarithmic and Trigonometric series)

Text Books.

1. Calculus Eleventh Edition George B. Thomas, Jr,Thomas' , Pearson, 2008.
2. Plane Trigonometry Part – Ii S.L. Loney;,Aitbs Publishers India, 2009.
3. Matrices-Shaums Outline Series, Tmh Edition Frank Ayres Jr.

References.

1. Differential Calculus, Shanti Narayan, (S Chand)
2. Calculus, George B. Thomas Jr. And Ross L. Finney, Ninth Edition, Pearson Education
3. Engineering Mathematics, Volume 1, 4th Edition, S.S. Sastry, Phi.
4. Advanced Calculus, Muray R Spiegel, Schaum's Outline Series.
5. Matrix Theory , (Allied).

IPH20011: Mathematics- II

Integral Calculus and Fourier Series

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course outcomes.

After the completion of the course the students shall be able to:

CO1: Explain the properties of integral calculus and its applications.

CO2: Illustrate the properties of integrals and use integrals to solve problems in physics.

CO3: Explain the properties and applications of double and triple integrals.

CO4: Illustrate the periodic functions using Fourier series.

Prerequisites : Basic mathematics

Unit I

Integral Calculus

A quick review of indefinite integral as anti derivative. The Definite integral.The fundamental theorem of Calculus.

Unit II

Application of Integrals

Substitution and area between curves, Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution and the theorem of Pappus (excluding proof)

Unit III

Multiple Integrals

Double Integrals, area of bounded region in plane only, Double Integrals in Polar form, Triple integrals in rectangular co-ordinates, Volume of a region in space.

Unit IV

Fourier, Taylor and Maclaurian Series

Periodic Functions, Trigonometric Series, Functions of any period p = 2L Fourier series, Even and Odd functions, Half-range Expansions. Taylor series. Maclaurian series.

Text Books

1. Calculus Eleventh Edition, George B. Thomas, Jr. Thomas' , Pearson, 2008.
2. Advanced Engineering Mathematics, Eighth Edition , Erwin Kreyszig:, Wiley, India.
3. Higher Engineering mathematics, B S Grewal, Khanna publications.

Reference

1. Integral Calculus , Shanti Narayan, P .K. Mittal: (S Chand & Company)
2. A Text Book Of Matrices, Shanthi Narayanan & P.K. Mittal, , S. Chand.
3. David W. Lewis - Matrix Theory (Allied)

4. Complex Variables, M.R Spiegel, , Schaum's Series

IPH2023: Mathematics- III

Vector Calculus, Analytic Geometry and Abstract Algebra

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course outcomes.
After the completion of the course the students shall be able to:

CO1: Apply vector valued functions in the application of physics.
CO2: Apply integrals in physics related applications.
CO3: Explain the properties of analytic geometry and use analytic geometry in physical systems.
CO4: Explain the abstract algebraic functions.
Prerequisites : Basic mathematics

Unit I

Vector Valued Functions

Vector Functions, Arc length and unit Tangent vector **T**, Curvature and unit Normal Vector **N**, Torsion and unit Binomial vector **B,** Directional Derivatives and Gradient Vectors**.**

Unit II

Integration in Vector Fields

Line Integrals, Vector fields and Work, Circulation and Flux, Path independence, Potential Function and Conservation Fields, Green's theorem in Plane (Statement and problems only), Surface area and Surface integral, Parameterised Surface, Stoke's theorem (Statement and Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only).

Unit III

Analytic Geometry

Conic sections and Quadratic equations, Classifying Conic Sections by Eccentricity, Conics and Parametric equations, The Cycloid, polar co-ordinates, Conic Sections in Polar coordinates.

Unit IV

Abstract Algebra

Groups, Subgroups, Cyclic groups, Groups of Permutations, & Vector Spaces. (Definitions, examples and simple properties only)

Text Books.

1. Calculus Eleventh Edition , George B. Thomas, Jr.Thomas, , Pearson, 2008.
2. A First Course In Abstract Algebra 7th Edition, John B Fraleigh, Pearson Education 2007.

References.

1. Vector Calculus, Shanti Narayan, P.K. Mittal, S Chand & Company.
2. An Introduction to Laplace Transforms and Fourier Series, P.P.G Dyke, Springer 2005.

3. Introduction to Vector Analysis, 6th Ed., Harry F. Davis & Arthur David Snider, Universal Book Stall, New Delhi.
4. Vector Analysis, Schaum's Outline Series, Murray R. Spiegel, , Asian Student Edition.
5. Advanced Engineering Mathematics, Merle C. Potter, , Oxford University Press.

IPH2042: Mathematics- IV

Differential Equations, and Complex Analysis

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course outcomes.
After the completion of the course the students shall be able to:

CO1: Explain ordinary differential equation and use it in physics problems.
CO2: Illustrate the properties and application of special functions.
CO3: Explain the properties of partial differential equation and solve problems using it.
CO4: Explain the function of complex numbers and its applications.
Perquisites : Basic mathematics

Unit I
Ordinary Differential Equations
Exact Differential Equation, Linear Equations , Solutions by Substitutions, Equations of first order and not of first degree, First order equations of higher degree solvable for *p*, Equations solvable for *y*, Equations solvable for *x*, Equations of first degree in *x* and *y*, Lagrange's and Clairaut's Equations.
Unit II
Special Functions
Power series method of solving differential equations. Legendre equation and Legendre Polynomials, Rodrigues Formula, Bessel's Equation and Bessel Functions.

Unit III
Partial Differential Equations
Surfaces and Curves in three dimensions, Solution of equations of the form$\frac{dx}{dP} = \frac{dy}{dQ} = \frac{dz}{dR}$Integral curves
of equations, Origin of first order partial differential equations, Linear equations of the first order- Lagrange's equations.

Unit IV
Complex Analysis
Complex numbers –a quick overview , Functions of a complex variable: Definition of analytic functions and singular points- C.R. equations in Cartesian and polar co-ordinates(proof excluded), determination of analytic functions if real or imaginary parts are given, line integral ,Cauchy's integral theorem- Cauchy's integral formula, zeros and singularities, residues- residue, theorem.
Text Books.

1. A First Course In Differential Equations With Applications, A. H Siddiqi, P Manchanada, Macmillan India Ltd 2006.
2. Advanced Engineering Mathematics – 8^{th}Edition, ErwinKreyszig- Wiley India
3. Elements Of Partial Differential Equation, Ian Sneddon , Tata Mc Graw Hill.

References,

1. An Introduction To Differential Equations , R. K. Ghosh, K. C. Maity, , New Central Books.
2. Differential Equation, Shepley L. Ross, , Wiley India.
3. Complex Variables , M R Spiegel, , Schaum's Series.

IPH2005: Chemistry - I

Basic Theoretical and Analytical Chemistry

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Understand the structure of the atom, chemical bonding and intermolecular forces such as hydrogen bonding.

CO2: Explain the periodic properties of atoms and the concept of chemical equilibrium.

CO3: Illustrate the basic principles of Analytical Chemistry including various laboratory operations for qualitative and quantitative analysis, methods of separation and purification, an reporting of analytical data.

CO4: Understand various chromatographic techniques.

Unit I

Atomic Structure and Chemical Bonding

Atomic Structure: Bohr atom model and its limitations, Dual nature of matter and radiation. Photoelectric effect, de Broglie equation, Heisenberg's uncertainty principle, Schrodinger wave equation - Concept of orbital, Quantum numbers, shapes of orbitals (*s*, *p*, *d*), Electronic configuration of atoms - Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.

Chemical Bonding: Introduction – Type of bonds. Ionic bond: Factors favouring the formation of ionic bonds - Lattice energy of ionic compounds and its applications. Covalent bond: Lewis theory - Coordinate bond. VSEPR theory and examples.

Valence bond theory – Hybridisation - sp^3, sp^2 and *sp* (ethane, ethene, ethyne) and shapes of molecules. Molecular orbital theory- bonding, nonbonding and antibondig orbitals. Concept of bond order- molecular electronic configuration of simple homonuclear and heteronuclear diatomic molecules.

Intermolecular forces - Hydrogen bonding in H2O - Dipole-dipole interactions.

Unit II

Fundamental Concepts in Chemistry

Periodic Properties: Modern periodic law – Long form of periodic table. Periodicity in properties: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale). Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency - Equivalent mass. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and millimoles.

Concept of Equilibrium: Acids and Bases - Arrhenius, Lowry-Bronsted and Lewis theories. Ionic product of water - pH and pOH, Strengths of acids and bases - Ka and Kb, pKa and pKb. Buffer solution. Preparation of buffer solution having a known pH. Solvation, solubility, solubility product, common ion effect and their applications.

Unit III

Basic Principles of Analytical Chemistry

Laboratory Operations (*Non-evaluative*): Laboratory safety and first aid. Use of different glassware like pipette, burette, standard measuring flask, distillation apparatus; heating methods, filtration techniques, weighing principle in chemical balance, weighing in electronic balance.

Methods of Analysis:

Qualitative analysis- Intergroup separation of cations- solubility product and principle of precipitation- common ion effect.

Volumetric method of analysis - General principles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point. Acid base, redox and complexometric titrations and corresponding indicators.

Microanalysis and its advantages. Double burette method of titration: Principle and advantages.

Gravimetric method of analysis: General principles and various steps involved.

Reporting of Analytical Data: Units, significant digits, rounding, scientific and prefix notation, graphing of data - Precision and accuracy – Types of errors – Ways of expressing precision – Methods to reduce systematic errors.

Separation and Purification Techniques: Recrystallisation, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.

Unit IV

Chromatographic Techniques

Chromatography - Principle of differential migration. Classification of chromatographic methods. Basic principle and uses of Thin layer chromatography (TLC), Paper chromatography (PC), Rf value, Column chromatography, Gas chromatography(GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

References

1. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. Co., 2008.

2. C. N. R. Rao, *University General Chemistry*, Macmillan, 2009.

3. Manas Chanda, *Atomic Structure and Molecular Spectroscopy.*

4. .J. D. Lee, *Concise Inorganic Chemistry,* 5th ed., John Wiley & Sons, 1999.

5. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.

6. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th edn. Pearson Education (2003).

7. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi.

IPH2012: Chemistry - II

Basic Organic Chemistry

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Understand the fundamental concepts in organic chemistry and structure of organic molecules.

CO2: Explain various types of organic reactions and their mechanisms in brief.

CO3: Understand stereochemistry and conformation of some simple organic molecules

CO4: Familiarize with natural and synthetic polymers, biodegradability and environmental hazards.

Unit I

Fundamental Concepts of Organic Chemistry

Introduction: Origin of organic chemistry – Uniqueness of carbon – Homologous series. IUPAC nomenclature of alkyl halides, alcohols, aldehydes, ketones, carboxylic acids and amines. Structural isomerism: Chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism. Arrow formalism in organic chemistry. Bond fission - homolytic and heterolytic fission. Types of reagents - Electrophiles and nucleophiles. Polarity of bonds. Reaction Intermediates: Carbocations, carbanions and free radicals (preparation, structure, hybridization and stability). Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions (definition and one example each).

Unit II

Mechanisms of Organic Reactions

Meaning of reaction mechanism. Polarity of bonds. Electron Displacement Effects: Inductive effect - Definition - Characteristics - +I and -I groups. Applications: Explanation of substituent effect on the acidity of aliphatic carboxylic acids. Mesomeric effect: Definition – Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene and phenol. Hyperconjugation: Definition – Characteristics. Applications: Baker-Nathan effect, Comparison of stability of 2-methyl-1-butene & 2-methyl-2-butene. Steric effect (causes and simple examples).

Substitution reactions: nucleophilic substitution of alkyl halides- SN1 and SN2 mechanisms. Electrophilic substitutions in benzene - reaction mechanism. Addition reactions: electrophilic addition to alkene sand alkynes - Markwonikoff's rule, Peroxide effect. Elimination reactions: E1 and E2 mechanisms.

Unit III

Stereochemistry of Organic Compounds

Stereoisomerism: Definition – classification- examples.

Geometrical Isomerism: Definition – Condition – Geometrical isomerism in but-2-ene and but-2-ene-1,4-dioic acid. cis and trans, *E* and *Z* configurations. Methods of distinguishing and interconversion of geometrical isomers.

Optical Isomerism: Optical activity – Chirality – Enantiomers - Meso compounds - Diastereoisomers – Optical isomerism in lactic acid and tartaric acid - Racemisation and resolution (elementary idea only).

Conformations: Newman projection, Saw-horse projection. Conformations of ethane, no butane, and cyclohexane - Relative stability and energy diagrams. Conformation of methyl cyclohexane.

Unit IV

Natural and Synthetic Polymers

Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions. Typical examples: Polyethylene, polypropylene, PVC, phenol-formaldehyde and melamine-formaldehyde resins, polyamides (nylons) and polyesters. Natural rubber: structure, latex processing methods, vulcanization and uses. Synthetic rubbers: SBR, nitrile rubber and neoprene. Biodegradability of polymers, environmental hazards. Recycling of plastics.

References

1. I. L. Finar, Organic Chemistry Vol. I , 6th edn. Pearson.
2. M.K. Jain, S.C. Sharma, *Modern Organic Chemistry*, Vishal Publishing Co. 2010.
3. S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International Pvt. Ltd, 2006.
4. S. Sengupta, *Basic Stereochemisty of Organic Molecules,* 2014.
5. E. L. Eliel, S.H. Wilen, *Sterechemistry of Organic Compounds,* Wiley, 1994.
6. Peter Sykes, *A Guide Book to Mechanism in Organic Chemistry*, 6th edn. Orient Longman, 1988.
7. S. M. Mukherji, S.P Singh*, Reaction Mechanism in Organic Chemistry*, Macmillan, 3rdedn., 2003.
8. V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, *Polymer Science*, 2ndedn., New Age International Pvt. Ltd., 2015.

IPH2024: Chemistry - III

Advanced Physical Chemistry – I

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 3

After the completion of the course the students shall be able to:

CO1: Explain solid state chemistry including symmetry, crystal structure, magnetic, conductivity and optical properties of solids.
CO2: Understand chemistry of the liquid state, colligative properties and properties of liquid crystals. Explain the behaviour of gases and gas laws.
CO3: Illustrate surface phenomena such as adsorption and properties & applications of colloids.
CO4: Explain phase equilibria, distribution law and its applications.

Unit I

Solids and crystalline State

Classification of solids: amorphous, crystalline – differences. Lattice, lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of atoms in a unit cell, calculation of lattice parameters of cubic unit cell. Theories of Solid: band theory, conductors, semiconductors and insulators, mention of super conductors. Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.
Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, crystallographic point groups, Schoenflies symbol. Symmetry elements in crystals - The seven crystal systems – Weiss and Miller indices - Bravais lattices – Bragg's equation (derivation required) and its applications (mention only), structure determination of NaCl by X-ray diffraction.

Unit II

Liquid State and solutions

Liquids: Intermolecular forces, liquids compared with gases and solids (qualitative idea only), viscosity, surface tension (method of determination not expected), structure of liquids (a qualitative description). Liquid crystals – the intermediate phase between solid and normal liquid phases, thermographic behaviour, classification, structure of nematic and cholesteric phases.
Solutions: Kinds of solutions - Solubility of gases in liquids – Henry's law and its applications - Colligative properties - Osmotic pressure - Reverse osmosis and its applications - Determination of molecular mass using colligative properties.

Gaseous State

Gaseous State: Introduction - Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities – Average velocity, RMS velocity and most probable velocity (derivations not required) – Boyle's law – Charles's law – Ideal gas equation – Behaviour of real gases – Deviation from ideal behavior - Van der Waals equation (derivation not required).

Unit III

Surface Chemistry and Colloids

Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required).

True solution, colloidal solution and suspension. Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples. Purification of colloids by electrodialysis and ultrafiltration. Properties of colloids: Brownian movement – Tyndall effect – Electrophoresis. Origin of charge and stability of colloids – Zeta potential – Coagulation - Hardy Schulze rule – Protective colloids - Gold number.Emulsions. Applications of colloids: Delta formation, medicines, emulsification, cleaning action of detergents and soaps.

Unit IV

Phase Equilibrium

The phase rule, definition, equilibrium between phases, one component system – water system, two component systems: solid- liquid equilibrium – simple eutectic, lead-silver system, solid solution. Distribution law, partition coefficient, applications.

References:

1. B.R. Puri, L.R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 40thedn. Vishal Pub. Co. Jalandhar (2013)
2. B. R. Puri, L.R. Sharma and K.C. kalia, *Principles of Inorganic Chemistry*, Milestone Publishers New Delhi. 2013.
3. J.A. K. Tareen and T.R. N. Kutty, *A basic course in Crystallography*,University Press, 2000.
4. Anthony R West, Solid State Chemistry and its Applications", Wiley Eastern
5. Walter J. Moore, Physical Chemistry, 4thEdn. Longmans Green and Co.Ltd.
6. P. W Atkins, "Physical Chemistry", Oxford University Press.
7. R. J Silby and R.A Alberty, "Physical Chemistry", John Wiley & Sons.

IPH2032: Chemistry - IV

Advanced Physical Chemistry – II

Lecture: 72, Tutorial: 0, Lab: 0, Credit: 4

After the completion of the course the students shall be able to:

CO1: Understand principle and applications of various spectroscopic methods such as rotational, uv-visible and infrared spectroscopy.

CO2: Explain first, second and third laws of thermodynamics including their significance.

CO3: Explain fundamental concepts of kinetics, catalysis and photochemistry.

CO4: Understand principles of electrochemistry including conductance in solutions, conductometric titrations, galvanic cells, fuel cells, emf measurements and potentiometric titrations.

Unit I

Introduction to Spectroscopy

Interaction of electromagnetic radiation with matter, electromagnetic spectrum, quantization of energy, electronic, vibrational and rotational energy levels, Boltzmann distribution of energy (formula only), population of levels.

Rotational Spectroscopy: diatomic molecules, determination of bond length.

Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending, calculation of force constant, concept of group frequencies-frequencies of common functional groups in organic compounds, Fingerprint region in IR spectra.

UV- Visible Spectroscopy: UV spectrum, wavelength maximum, chromophore, auxochrome, red shift, blue shift, types of transitions.

Unit II

Laws of Thermodynamics

System and Surrounding. First law of Thermodynamics: Internal energy, Significance of internal energy change, enthalpy, Second law of Thermodynamics: free energy, Entropy and Spontaneity, Statement of second law based on entropy, Entropy change in Phase transitions (No derivation required)-entropy of fusion, entropy of vaporization, entropy of sublimation. The concept of Gibbs's free energy- Physical significance of free energy, conditions for equilibrium & spontaneity based on ΔG values.Effect of temperature on spontaneity of Reaction. Third law of Thermodynamics

Unit III

Kinetics, Catalysis & Photochemistry

Kinetics: Rates of reactions - Factors influencing rate of reactions - Order and molecularity - Zero, first, second and third order reactions - Derivation of integrated rate equations for first order and second order reactions (single reactant only) - Half life period for first order reaction - Units of rate constants - Influence of temperature on reaction rates - Arrhenius equation - Calculation of Arrhenius parameters - Collision theory of reaction rate, Activated complex theory-basic concepts-no derivation required.

Catalysis: Types of catalysis – Homogeneous and heterogeneous catalysis. Theories of catalysis: Outline of intermediate compound formation theory and adsorption theory.

Laws of photochemistry, Grothus Draper law, Stark-Einsten's Law, Beer Lambert's Law.Photochemical equivalence and quantum explanation for low and high quantum yields.Photosensitization,Jablonski diagram- Fluorescence and phosphorescence, flash photolysis and chemiluminescence.

Unit IV

Electrochemistry

Introduction- Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, Specific conductance, equivalent conductance and molar conductance - Variation of conductance with dilution - Kohlrausch's law - Degree of ionization of weak electrolytes - Application of conductance measurements –Determination of degree of dissociation of weak electrolytes, conductometric titrations involving strong acid- strong base, strong acid-weak base, weak acid-strong base, and precipitation titration.

Galvanic cells - Cell and electrode potentials - IUPAC sign convention, Types of electrodes: Reference electrodes – Standard hydrogen electrode and calomel electrode, Indicator electrodes-metal-metal ion electrodes, Quinhydron electrode and Redox electrodes. Standard electrode potential - Nernst equation, electro chemical series.Gibb's Helmholtz equation and EMF of a cell. Fuel cells- H_2-O_2 fuel cell.

Potentiometric titrations of acid-base reactions, redox reactions and precipitation reactions.

References:

1. Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to spectroscopy 3rd edn, Thomson Brooks/Cole, 2001.
3. K.K. Sharma and L.K. Sharma, *A Textbook of Physical Chemistry*, 5th Edition, Vikas Publishing House, New Delhi, 2012.
4. B. R. Puri, L.R. Sharma, M. S. Pathania, *Elements of Physical Chemistry*, 40th edn. Vishal Pub. Co. Jalandhar (2003).
5. G. M. Barrow, *Physical Chemistry*, 5th Edition, Tata McGraw Hill Education, New Delhi, 2006.
6. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997)
7. GurdeepRaj, Photochemistry, 6th Edn, Goel Publishing House, 2014.

Chemistry Practical Course

Evaluation scheme

1. **Practical courses CA.**

Sl. No	Assessment criteria	Weight
1	Experimental skill	5
2	Lab involvement	7.5
3	Record *	5
4	Attendance	2.5
Total		20
*Weight given to the record is related to the number of experiment recorded in practical record book.		

2. **Chemistry practical courses SEA**

2.1. Volumetric analysis

Components of External Evaluation of practical Volumetric Analysis	**Weight**
Procedure	6
Tabulation& Calculation	6
Result (Based on % error)	14
Viva-voce	4
Total	**30**

2.2. Organic Chemistry Practical

Components of External Evaluation of practical Organic Chemistry Practical	**Weight**
Detection of elements	6
Aliphatic or Aromatic	3
Saturated or unsaturated	3
Tests for functional groups	11
Derivative	3
Viva	4

Total	**30**

2.3. Physical Chemistry Practical

Components of External Evaluation of practicals Physical Chemistry	**Weight**
Principle & Procedure	6
Tabulation& Calculation	6
Result (Based on % error / graph)	14
Viva-voce	4
Total	**30**

Semester II

IPH2014: Chemistry Lab- I

Volumetric Analysis & Organic Chemistry

Lab: 54, Credit: 2

After the completion of the course the students shall be able to:

CO1: Perform quantitative analysis using volumetric estimations.

CO2: Carry out characterization of organic compounds using physical and chemical methods.

Part A

(Standard solution must be prepared by the student)

1. Acidimetry and Alkalimetry

i. Standardization of HCl with standard Na_2CO_3 solution

ii. Standardization of NaOH with standard oxalic acid solution

iii. Estimation of any acid using standard NaOH

iv. Estimation of any alkali using standard HCl.

2. Permanganometry

i. Standardization of KMnO4 using (i) oxalic acid (ii) Mohr's salt

ii. Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard KMnO4 solution.

Part B

1. Tests for elements: Nitrogen, Halogen and Sulphur
2. Determination of Physical Constants of Organic Compounds
   1. Melting Point
   2. Boiling Point

3. Study of reactions of common functional groups.

4. Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: Naphthalene, anthracene, chlorobenzene, benzyl chloride, phenol, α-naphthol, β-naphthol, benzaldehyde, acetophenone, benzophenone, benzoic acid, phthalic acid, cinnamic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, nitrobenzene and glucose. (minimum of six compounds to be analysed).

References:

1. I Vogel, *A Text Book of Practical Organic Chemistry*, Longman, 1989.
2. F. G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th Edn., Pearson Education.India, 2009

3. K. Ahluwalia and S. Dhingra, Comprehensive Practical Organic Chemistry, Universities Press.
4. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson
5. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education. Ltd.
6. G. D. Christian, Analytical Chemistry, JohnWiley and Sons
5. R.D Day, A.L. Uderwood, Quantitative analysis,6th Edn., Prentice Hall of India Pvt. Ltd.

Semester IV

IPH2033: Chemistry Lab- II

Physical Chemistry Practical

Lab: 54, Credit: 2

After the completion of the course the students shall be able to:

CO1: Do chemical characterization of substances using various physico-chemical parameters such as viscosity, CST, transition temperature, heat of solution etc.

CO2: Perform various instrumental techniques such as potentiometry, conductometry and colorimetry

Set A

1. Viscosity-percentage composition of sucrose solution.
2. Transition temperature of salt hydrates, eg. Sodium thiosulphate Sodium acetate etc.
3. Critical solution temperature of phenol water system
4. Phase diagram of two component systems such as naphthalene-biphenyl.
5. Heat of Solution KNO_3, NH_4Cl
6. Determination of molecular weight by Rast's method. (Using naphthalene, or biphenyl as solvenet and acetanilide, p–dichlorobenzene etc.as solute)

Set B

1. Determination of equivalent conductance of an electrolyte
2. Conductometric titration of strong acid Vs. strong base
3. Potentiometric titrations : Fe^{2+} Vs. $Cr_2O_7^{2-}$ and Fe^{2+} Vs. KMnO4
4. Calibration of pH meter and measurement of pH of solutions.
5. Colorimetric estimation of iron and chromium.

References

1. W. G. Palmer: 'Experimental physical chemistry', Cambridge University Press.
2. J. B. Yadav: Advanced Practical Physical Chemistry, 36th ed., Krishna Prakashan, 2016.
3. R. C. Das and B. Behra; 'Experiments in Physical Chemistry' , Tata McGraw hill.
4. K. K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi
5. Gurtu, J.N. and Gurtu, A. Advanced Physical chemistry experiments, 6th ed., Pragati Prakashan, 2014.
6. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson
7. Vogel's Textbook of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd.

Common Courses

ICE2001: English Language Skills – I

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

Course Outcomes:

After completing this course, students should be able to:

CO1: Identify the distinct sounds in English words

CO2: Choose the right words while writing/talking about everyday life

CO3: Use expressions appropriate for various social occasions

CO4: Articulate words and sentences clearly stressing the right syllables

Unit I

Pronunciation

Introduction--speech sounds-vowels-consonants-basics of word/sentence stress- intonation – mother tongue interference

Unit II

Vocabulary

Introduction - synonyms-collocations-phrasal verbs-idiomatic expressions- vocabulary in everyday life

Unit III

Speaking Skills

Social communication: introduction - sounding very polite- making a point/persuading- giving opinions/preferences-encouraging/comforting- making suggestions/regrets - complimenting - guessing-telephoning in English.

Academic communication: Discussion skills - presentation skills-debating skills

Study materials based on the syllabus will be provided.

Suggested Reading:

1. Sanghita Sen, Alankrita Mahendra and Priyadarshi Patnaik. *Communication and Language Skills.* Cambridge University Press, 2015
2. Joan Van Emden and Lucinda Becker. *Effective Communication for Arts and Humanities Students*. Palgrave Macmillan
3. Balasubramanian, T. *A Textbook of English phonetics for Indian students.* Macmillan Publishers India Limited, 2015

ICC2002: English Language Skills- II

Lecture: 36, Tutorial: 0, Lab: 0, Credit: 2

Course Outcomes:

After completing this course, students should be able to:

CO1: Write sentences adhering to tense rules

CO2: Correct common errors such as punctuation and capitalization

CO3: Identify the key points in a piece of writing

CO4: Write CVs and cover letters

Unit I

Grammar

Introduction- major tenses-modals-questions – negatives-frequently used constructions- dealing with common mistakes

Unit II

Reading Skills

Introduction -effective reading comprehension skills-understanding generic/specific ideas /factual information -vocabulary in context- implications/tone/attitude/viewpoint

Unit III

Writing for Professional Purposes

Writing CVs - Letter writing: Transmittal and cover letters -emails - Writing summaries-Writing memos-Writing blogs- Etiquette in writing

Study materials based on the syllabus will be provided.

Suggested Reading:

1. Sanghita Sen, Alankrita Mahendra and Priyadarshi Patnaik. *Communication and Language Skills.* Cambridge University Press, 2015
2. Glendinning, Eric H. and Beverly Holmstrom. Study Reading*: A Course in Reading Skills for Academic Purposes*. New Delhi: CUP
3. Joan Van Emden and Lucinda Becker. *Effective Communication for Arts and Humanities Students*. Palgrave Macmillan
4. Dr. George, Jacob and Dr. Anwar Sadath. *Writing for Academic and Professional Success*. Calicut University Edition, 2017.
5. Osmond, Alex. *Academic Writing and Grammar for Students* .SAGE, 2013

IPH2015: Environmental Science

Lecture: 36, Tutorial: 0, Lab: 0, Credit: 2

Course outcomes.

After the completion of the course the students shall be able to:

CO1: Illustrate the importance of ecosystems, biodiversity and its conservation.

CO2: Illustrate the details of environmental pollution, social issues and the environment

CO3: Illustrate different types of non-renewable and renewable energy sources solar energy

Prerequisites: Basic concepts of Physics, Chemistry, Biology and Social Science.

Unit I

Multidisciplinary nature of environmental studies, Scope and importance Need for public awareness.

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

Forest resources- Water resources -Mineral resources-Food resources -Energy resources -Land resources:

Role of individual in conservation of natural resources Equitable use of resources for sustainable life styles.

Unit II

Ecosystems

Concept of an ecosystem -Structure and function of an ecosystem-Producers, consumers and decomposers- Energy flow in the ecosystem -Ecological succession -Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given ecosystem:- Forest ecosystem

Biodiversity and its conservation, Bio-geographical classification of India

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India

Unit III

Environmental Pollution- Causes, effects and control measures of: - Air pollution- Water pollution- Soil pollution- Marine pollution- Noise pollution- Thermal pollution -Nuclear hazards

Waste Management- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution- Pollution case studies

Disaster management: floods, earthquake, cyclone and landslides.

Unit IV

Social Issues and the Environment

Urban problems related to energy -Water conservation, rain water harvesting, watershed management

Resettlement and rehabilitation of people: its problems and concerns, Case studies

Environmental ethics: Issues and possible solutions

Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents .

Consumerism and waste products

Environment Protection Act- Air (Prevention and Control of Pollution) Act -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act

Issues involved in enforcement of environmental legislation -Public awareness

Unit V

Non-renewable and Renewable Energy Sources

Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy.

Renewable energy sources: Biomass energy- Biogas plant - Fixed dome type and moving dome type; Wind energy; Wave energy; Tidal energy; Hydroelectricity; Geothermal energy conversion; Ocean thermal energy conversion; Fusion energy; Hydrogen energy- Production (electrolysis) and storage; Merits and demerits of each renewable energy sources; Storage of intermittently generated renewable energy (qualitative); Fuel cell.

References

1. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)
2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)
4. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
7. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
8. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
17. WangerK.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)

(M) Magazine (R) Reference (TB) Textbook

18. Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari K. C. Singal Rakesh Ranjan - PHI Learning Pvt. Ltd, 2011.
19. Solar energy - M P Agarwal - S Chand and Co. Ltd.
20. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

IPH2034: Research Methodology in Science

Lecture: 54, Tutorial: 0, Lab: 0, Credit: 3

After the completion of the course the students shall be able to:

CO1**:** Explain the history of science, philosophy of science and scientific facts.

CO2: Explain the meaning of research, design, development and analysis of research.

CO3: Define hypothesis and research methods..

CO4:. Do to data collection, sampling and statistical analysis

CO5:. Prepare scientific reports, journal papers and project proposals.

CO6:. Explain the environmental and ethical impacts, IPR, plagiarism citation and acknowledgement.

Prerequisites: Basic sciences

Unit I

Science and Research:

Definition – History – Evolution of Scientific Inquiry – Verification versus falsification – Objectivity : Facts, theory and concepts – Philosophy of Science and Technology, Epistemology of sciences – Construction of scientific facts.

Unit II

Introduction to Research Methodology

Meaning and importance of Research – Types of Research – Selection and formulation of Research Problem

Research Design – Need – Features – Inductive, Deductive and Development of models

Developing a Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Designs.

Analysis of Literature Review – Primary and Secondary Sources, Web sources –critical Literature Review

Hypothesis – Different Types – Significance – Development of Working Hypothesis

Research Methods: Scientific method vs Arbitrary Method, Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive – Inductive logical process – Different types of inductive logical methods.

Unit III

Data Collection and Analysis

Sources of Data – Primary, Secondary and Teritary – Types of Data – Categorical, nominal & Ordinal.

Methods of Collecting Data : Observation, field investigations, Direct studies – Reports, Records or Experimental observations.

Sampling methods – Data Processing and Analysis strategies- Graphical representation – Descriptive Analysis – Inferential Analysis- Correlation analysis

Least square method - Data Analysis using statistical package – Hypothesis – testing – Generalization and Interpretation – Modeling.

Unit IV

Scientific Writing

Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables – Bibliography, Referencing and foot notes – Oral presentation – Planning – Preparation and practice – Making presentation – Use of visual aids – Importance of Effective Communication.

Conventions and strategies of Authentication – Citation Style - sheet

Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN.

Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification

Unit V

Application of Results and Ethics

Environmental Impacts - Ethical Issues – Ethical Committees – Commercialization – copy right

royalty – Intellectual Property rights and patent law – Track Related aspects of intellectual property Rights – Reproduction of published material – Plagiarism – Citation and Acknowledgement – Reproducibility and accountability.

References:

1. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.

3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.

4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270 p.

5. Day RA (1992) How to write and publish a scientific paper. Cambridge University press. London

6. Hempel,C. Philosophy of Natural science Englewood Cliffs, N.J: Prentice Hall, 1966.

7. Burtt, E.A. The Metaphysical Foundations of Modern Science. London, 2003.

8. Latour, B. & Woolgar. 3. Laboratory Life. The construction of scientific facts. 2nd Edition. Princeton: Princeton University Press.1986

9. Gupta S.P. (2008). Statistical Methods. 37th ed. (Rev)Sultan Chand and Sons. New Delhi. 1470 p.

10. Sundar Sarukkai (2008)Indian Philosophy and Philosophy of Science, Motilal Banarsidass Publishers Pvt.Ltd. New Delhi.

11. Kozak A, Kozak R.A., Staudhammer C.L., and Watts S.B. (2008). Introductory probability and Statistics; Applications for forestry and Natural sciences.CAB International, UK.408p.

12. Downine N.M Basic Statistical Methods. New York:¨Harper and Health Row Publishers,…….

13. Frank, Harry. Statistics. Concepts and Applications. Cambridge. Althoen, Steven Cambridge University.

14. Leon & Leon (2202). Internet for everyone, Vikas Publishing House.

15. Wadehra, B.L.2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

IPH2043: Human Rights

Lecture:54, Tutorial: 0, Lab: 0, Credit: 2

Course outcomes

After the completion of the course the students shall be able to:

CO1: Analyse the development of human rights and different human right act in UN

CO2: Analyse the human rights in Indian scenario

CO3: Analyse the and impact of environment and human rights.

CO4: Analyse the Conservation of natural resources and human rights

Prerequisites: Basic concepts of Social Science.

Unit I

Human Rights:

An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Human Rights and United Nations: Contributions, main human rights related organs - UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Unit II

Human Rights in India:

Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit III

Environment and Human Rights:

Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Unit IV

Conservation of natural resources and human rights:

Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

References

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)

3. Law Relating to Human Rights, Asia Law House, 2001.
4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
5. S.K.Khanna, Children andthe Human Rights, Common Wealth Publishers, 1998. 2011.
6. Sudhir Kapoor, Human Rights in 21st Century, Mangal Deep Publications, Jaipur, 2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

Non-Credit/ Extra Credit Courses

1. Evaluation of non-credit/ extra credit courses.

1.1. Non-credit courses (Both theory and activities)

Components of Evaluation of Non Credit Theory/activity courses	**Weights**
Attendance	2.5
Activities	7.5
Report (**Internal**	5
Test/Viva Voce	5
Total	**20**

Summer Project Non Credit

Components of Evaluation of Non Credit summer project	**Weights**
Punctuality	**5**
Experimentation/Data collection	**5**
Knowledge in the topic	**5**
Report	**5**
Total	**20**

IPH2007: Latex Programming

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course outcomes

After the completion of the course the students shall be able to:

CO1: Write ordinary text, mathematical formulae as equations

CO2: Organize texts using formatting

CO3: Illustrate insertion of symbols and operators in texts

CO4: Create array, table, header, font bibliography.

Unit I

Preparing an Input File--Sentences and Paragraphs- Quotation Marks- Dashes - Space After a Period - Special Symbols - Simple Text-Generating Commands- Emphasizing Text - Preventing Line Breaks -Footnotes - Formulas -The Document - The Document Class -The Title "Page" -Sectioning - Displayed Material- Quotations - Lists - Displayed Formulas-Declarations - Running TEX.

Carrying On - Changing the Type Style- - Symbols from Other Languages-- Accents - -Symbols- - Mathematical Formulas -Some Common Structures- Subscripts and Superscripts- Fractions - Roots - Mathematical Symbols- Greek Letters- Calligraphic Letters - Mathematical Symbols -Log-likeFunctions

Unit II

Arrays- The array Environment - Vertical Alignment – Delimiters - Over-and Underlining-Accents - Type Style -Math Style- Figures and Other Floating Bodies - Figures and Tables - Marginal Notes - Lining It Up in Columns

Moving Information Around - The Table of Contents - Cross-References- Bibliography and Citation - Using BIBTEX- Making an Index -Producing an Index -Other Document Classes - Books - Slides – Notes -Other Text - Letters .

Unit III

Latex Activities

1. Preparation of a Document - Article
2. Preparation of a Document with Inserting The Title Page , Abstract and bibliography
3. Preparation of a Document with Custom Style and Page Styles.
4. Preparation of a Document with Line and Page Breaking - Numbering -Length, Spaces, and Boxes- Centring and "Flushing" .
5. Preparation of a Document with Pictures and Colours.
6. Preparation of a Document with The picture Environment -Picture Objects- Text. '-Boxes - Straight Lines – Arrows-Curves - Grids -
7. Preparation of a Document with The graphics Package.
8. Preparation of a Document - different Class Options, books, conference, report and letter.
9. Preparation of a Latex Slides using Beamer presentation

References

1. Latex “a document preparation system”, Leslie Lamport, second edition, Pearson Education, 2008.

2. LaTeX: A document preparation system, 2nd Edition, Leslie, Lamport, Addison-Wesley, 1994.

3. The LaTeX Companion: 2nd Edition, Fittelbach, M. Goossens. et.al., 2004.

IPH2008: Programming in Python-I

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Understand the structure of a python program and how it works

CO2: Understand the basic control structures

CO3: Apply the structure of a python program and how it works, basic control structures
Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

This unit will introduce the structure of a Python program and how it is executed. Concepts of variables and objects, formatting of text, string, numbers, and arrays are considered. Arithmetic operations,
parenthesis and rounding of errors shall be discussed. Method of plotting in Python shall be introduced.

Unit II

Basic control constructs are introduced in this unit. Syntax of 'if', 'else', and 'elif' are introduced. The method using functions is explained. The 'for' and 'while' loops are introduced. The use of list and tuples and the method of reading from and writing to files are also considered.

Unit III

Lab Exercises

1. Understand the basics of Python:

1.1. Data types,

1.2. Loops,

1.3. Conditional Statements,

1.4. Functions

1.5. Modules.

Suggested Text-books

1. S. Linge and H.P. Langtangen, *Programming for Computations – Python*, Springer Open (2019) (Open access book)
2. Amit Saha, *Doing Math with Python*, No Starch Press (2015). Chapters 2-5, and 7 (Relevant topics only)

IPH2016: Life Inspiring Skills

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course outcomes

After the completion of the course the students shall be able to:

CO1: Develop communication competency and report writing skills

CO2: Practice interview & group discussion

CO3: Develop critical thinking process and problem solving skills

CO4: Formulate better team dynamics, ethics and human values

Unit I:

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Unit II:

Ethics, Moral & Professional Values: Human Values, Civic Rights, Environmental Ethics, Global Issues.

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking.

Unit III:

Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Leadership Skills: Leadership, Levels of Leadership, Making of a leader, Types of leadership.

References

1. Communication skills, Sanjay Kumar, Pushp Lata. 2nd ed,Oxford Univ. Press.
2. Communication and team work, Hali R Keeler, Marie Keen Shaw, Rowman & Littlefield.
3. Theories of personality, Calvin S Hall, Gardner Lindzey, John B Camphall, Wiely publications.
4. Facing group discussion and interview, Trilok Kumar Jain, Altantic pub. And distribution.

IPH2017: Programming in Python-II

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course Outcomes:

After the completion of the course the students shall be able to:

CO1: Demonstrate how Python can handle U data using statistical methods

CO2: Describe how set theory operations can be done using python

CO3: Perform representative task in practice.

CO4: Apply the structure of a python program and handle data using statistical methods ,set theory operations

Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

Basic statistical operation on data is considered in this unit. Finding mean, median and mode, construction of frequency distribution, comparison and calculation of correlation between sets of data are introduced. The use of SymPy is introduced and its use in doing calculus and plotting is also discussed.

Unit II

The construction of sets and set operation are discussed here. The use of set constructs in simulating random phenomena and probability are considered. Creation of Venn diagrams to visualize relation between sets are introduced. Generation of uniform and non-uniform random numbers are also explained.

Unit III

Lab exercises

1. Exploring Python Statistical Library:

1.1. Scipy :library for scientific computing based on NumPy

1.2. Scipy.stats for statistical analysis.

2. Mathplotlib Library:Library for data visualization and some example visualization using Scipy.

3. Implementing the Concepts of Sets and Set Operations:

3.1. Set Operations

3.2. Creating and Customizing the Venn Diagram,

4. Generation of Random Numbers: Generating Uniform and non Uniform Random Numbers

Suggested Text-books

1. S. Linge and H.P. Langtangen, *Programming for Computations – Python*, Springer Open (2019) (Open access book)
2. Amit Saha, *Doing Math with Python*, No Starch Press (2015). Chapters 2-5, and 7 (Relevant topics only)

IPH2025A: Summer Project - I

Credit 0

After the completion of the course the students shall be able to:

CO1. Identification of research/industrial/academic problem, preparation of methodology of work, time bound planning.

CO2. Report the use of sophisticated instrumentation/software and enhance academic scenario through practical experience.

CO3. Develop the ability to analysis data collection, interpretation of observation and capability to make inferences

CO4. Develop new knowledge and experience to contribute in the startup programs..

IPH2026: Yoga Exercises for Sound Health

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course Outcome

After the completion of course students will be able to

CO1. Apply idea about Yoga

CO2. Illustrate limits and methods in five aspects: Food, Work, Sleep, Sex and Thought

CO3. Practice a whole body exercise and Kayakalpa

CO4. Practice different Pranayam and Mudras

Unit I

History of Yoga- Meaning of Yoga – Yoga as science – Yoga as art -Yoga for modern age- Importance of physical exercises : Maintenance of the cell structure –The three circulations : Blood, heat and air circulations- Uniform circulation of bio magnetism - Causes for disease : Natural and artificial causes – Immunity -Limits and methods in five aspects :Food, Work, Sleep, Sex and Thought force- Food as a medicine : Natural food – impact of food on cure of diseases – food plan

Unit II

Rules for exercises: Time, Place, Dress, Age, Posture and Breath

Physical Exercises: Hand exercises- Leg exercises – Breathing exercises- Eye exercises- Ear exercise- Kapalabathi -Makarasana Part I- Makarasana Part II –– Suryanamaskar- Body Massage- Acupressure-Relaxation – Benefits

Unit III

Pranayama :Naddisuddi - Seettali- Seethkari - Kapalapathi

Mudras :Aswini mudra- Kesari mudra- Aadhi mudra- Gnana mudra (Chin mudra)- Vaayu mudra –Shunya Mudra- Prithvi mudra-Prana mudra – Apana mudra – Apanavaayu mudra – Varuna mudra – Suriya mudra – Linga mudra

Kaya Kalpa Exercise: AswiniMudhra – Moola Bandha – Ojas Breath

Intensification of bio magnetism: Lamp gazing and Mirror gazing

Text Books

1. **Simplified Physical Exercises** – Thathuvagnani Vethathiri Maharishi, The World Community Service Centre, Vethathiri Publications, 101, Iraniyan Street, KarurByePass Road, Opp. Manickavasakar Colony, Erode-638002
2. **Yoga Practice II** – Thathuvagnani Vethathiri Maharishi, The World Community Service Centre, Vethathiri Publications, 101, Iraniyan Street, Karur Bye Pass Road, Opp. Manickavasakar Colony, Erode-638002. Vethathiri Publications

3. **Kayakalpa Yoga** – Thathuvagnani Vethathiri Maharishi, The World Community Service Centre, Vethathiri Publications, 101, Iraniyan Street, Karur Bye Pass Road, Opp. Manickavasakar Colony, Erode-638002

References

1. **Sound health through yoga** – Dr. K. Chandrasekaran, PremKalyan Publications

IPH2027: Machine Learning using Python - I

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course outcomes:

After the completion of the course the students shall be able to:

CO1: Understand the general features of machine learning

CO2: Understand how python tools necessary for numeric, visualization and manipulation of data
CO3: Apply the general features of machine learning, python tools necessary for numeric, visualization and manipulation of data

Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

Introduction to the concept of machine learning. General discussion on the problems (Classification, regression and clustering) and types of machine learning algorithms (supervised and unsupervised learning).

Unit II

Review of Python tools for numerical methods and array manipulation (NumPy), data visualization (Matplotlib) and manipulation of tabular data using Pandas.

Lab Excercises

1. Exploring manipulation of Tabular data using matplotlib Library and Pandas
    1.1. Getting to Know your Data
    1.2. Pandas' Data Structure.
    1.3. Accessing Series Element and Data Frame Elements
    1.4. Querying Dataset, Grouping and Aggregating Data.
    1.5. Combining Multiple Dataset

Suggested Text-book

1. Wei-Meng Lee, *Python Machine Learning*, Wiley (2019)

References

1. M. Pradhan and U. Dinesh Kumar, *Machine Learning using Python*, Wiley (2019)
2. Thomas Haslwanter, *An Introduction to Statistics with Python*, Springer (2016)

IPH2035: Health & Emergency Care

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course outcomes

After the completion of this course students will able to:

CO1: Understand the importance of physical activities on health.

CO2: Observe and identify different types of injuries.

CO3: Able to do different life saving first aids like 1. CPR, 2. Heimlich Maneuver.

Unit I

Physical Activity, Health & Chronic Diseases: cardiovascular disease, hypertension, diabetes mellitus, obesity & over weight, metabolic syndrome, musculoskeletal diseases & disorders.

Effect of physical activities on health obesity, diabetics, heart related disease etc.

Unit II

Introduction to First Aid: The role of the first aider, Managing an emergency, Communication and casualty care, Primary survey, Extremes of heat and cold, managing a casualty outdoors.

Cardiopulmonary Emergencies, Head & Neck Injuries, Anaphylactic shock, Medical emergencies, Superficial bleeding, Fractures, Dislocations, Soft Tissue Injuries, Burns, Snake bite.

Unit III

Activities based on module 1 and 2.

1. Introduction to different types of physical activity workouts.
2. Resuscitation (adult and child CPR).
3. Bandaging.
4. Wrapping.
5. Heimlich maneuver.
6. Shifting, moving injured person.

References.

1. Sports Medicine prevention, assessment, management & rehabilitation, Richard Irvin, Pub; Prentice Hall
2. Advanced fitness assessment & exercise prescription. Vivian H Heyward, Human kinetic pub.

IPH2036: Machine Learning using Python - II

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course outcomes:

After the completion of the course the students shall be able to:

CO1: Apply Scikit-lear dataset

CO2: Describe how linear and polynomial reUression is performed

CO3: Perform representative computational task in practice.

CO1: Apply the general features of machine learning, linear and polynomial regression is performed

Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

Introduction to Datasets with Scikit-learn as example. Functions in Scitik-learn with examples. Linear Regression Class. Plotting the linear regression line and interpreting. Data Cleansing with examples.

Unit II

Detailed study of linear and polynomial regression by taking an example (Boston dataset in Scikit-learn). Data cleansing, multiple regression training of the model, evaluation of the model for prediction are to be examined. Now polynomial regression is studied from concept to application in Scikit-learn for understanding bias and variance using the same Boston data set.

Unit II

Lab Excercises

1. Implementation of numerical methods and array manipulation using NumPy
   1.1. Numerical Operations on Numpy Arrays
   1.2. Changing the Dimensions of Arrays, Sorting the Arrays
2. Implementing basics of machine learning using scikit-learn Library.
3. Preprocessing the data
   3.1. Data clensing with example database
4. Practicing Linear and Polynomial regression in Python
   4.1. Linear Regression
   4.2. Polynomial Regression

Suggested Text-book

1. Wei-Meng Lee, *Python Machine Learning*, Wiley (2019)

References

3. M. Pradhan and U. Dinesh Kumar, *Machine Learning using Python*, Wiley (2019)
4. Thomas Haslwanter, *An Introduction to Statistics with Python*, Springer (2016)

IPH2025B: Summer Project - II

Credit 0

After the completion of the course the students shall be able to:

CO1. Identification of research/industrial/academic problem, preparation of methodology of work, time bound planning.

CO2. Report the use of sophisticated instrumentation/software and enhance academic scenario through practical experience.

CO3. Develop the ability to analysis data collection, interpretation of observation and capability to make inferences

CO4. Develop new knowledge and experience to contribute in the startup programs..

IPH2044: Foundation Course in Reasoning

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course Outcomes

After the completion of course students will be able to:

CO1. Develop proficiency in formulating and solving problems in diverse fields.

CO2. Develop the logical reasoning ability of students.

CO3. Develop the arithmetic reasoning ability of students.

CO4. Develop the verbal reasoning ability of students.

CO5: Improves the non-verbal reasoning ability of students

Unit I

Arithmetic Reasoning

Ratio and Proportion, Problems on Ages, Percentages, Profit & Loss, Partnership, Number system, GCD & LCM, Averages and Mixtures, Time & Work, Time and Distance, Problems on Trains, Races, Boats & Streams, Mensuration, Simple Interest & Compound Interest, Data Interpretation, Data Sufficiency, Permutation &Combinations, Probability.

Unit II

Logical Reasoning

Understanding the structure of arguments; statements and arguments, evaluating and distinguishing deductive and inductive reasoning; Verbal analogies: Word analogy – Applied analogy; Verbal Classification; Reasoning Logical Diagrams: Simple diagrammatic relationship, multi-diagrammatic relationship; Venn diagram; Analytical Reasoning. Direction Sense, Coding and Decoding, Eligibility Test, Blood Relation, Input – Output, comparison of ranks, arrangement and puzzles, syllogism.

Unit III

Verbal Reasoning

Number series, Analogy, Classifications, Blood relations, Coding-decoding, Puzzle test, Machine input, Inequalities, Decision making, Syllogism, Sitting arrangement, Sequential , output tracing, Direction sense test, Logical Venn diagram, Alphabet test, Alpha-numerical sequence puzzle, Mathematical operations, Numbers, ranking & time sequence test, Logical sequence test, Arithmetical operations, Inserting the missing characters, Data Sufficiency

Non-Verbal Reasoning

Series, Analogy, Classification, Analytical reasoning, Mirror-image, Water-image, Spotting out the embedded figures, Completion of incomplete pattern, Figure matrix, Paper folding, Paper cutting, Rule detection, Grouping of identical figures, Cubes and dice, Dot situation,
Construction of squares and triangles.

Suggested Text Books

1. Models of strategic reasoning, John Von Benthen, Sujata Gosh, Rineke Verbruge, Springer.
2. How to crack test of reasoning, Jaikishan, Premkishan, Arihant Pub.
3. Business Mathematics and Statistics, N. D. Vohra, 2013, McGraw Hill Education India Pvt Ltd.
4. Mathematics for Business Studies, J.K. Thukral, 1899, Mayur Publications
5. Business Mathematics, J. K. Singh, 2013, Himalaya Publishing House
6. Business Mathematics, J K Sharma, 2016, I K International Publishing House Pvt. Ltd

IPH2045: Machine Learning using Python - III

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course outcomes:

After the completion of the course the students shall be able to:

CO1: Describe classification problem

CO2: Understand Classification using support vector machines

CO3: Apply Classification using support vector machines

Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

Logistic Regression and Classification. Introduction to Logistic regression. Logit and Sigmoid functions and curves. Illustration using standard data sets. Prediction using logistic regression. Predicting by training the model. Testing the model and evaluating the quality of prediction.

Unit II

Classification using Support Vector Machine. Support vectors and Scikit-leran tools for support vector machines. Visualization by plotting 3D hyperplanes. Making predictions. Linear, Gaussian and polynomial kernels. Illustration of the concept using data set.

Unit III

Lab Excercises

1. Supervised and Unsupervised Classifications in machine learning.
   - 1.1. Logistic Regression and Classification.
     - 1.1.1.Logistic Regression
     - 1.1.2.Classification using MNIST database
     - 1.1.3.Measuring Model Performance (Precision,Recall,F1 Score,ROC)
     - 1.1.4.Displaying Confusion Matrix
   - 1.2. Classification using Support Vector Machine.
     - 1.2.1.Support Vectors and Optimal Hyperplane.
     - 1.2.2.Kernal Tricks.
     - 1.2.3.Use and effect of different Kernels in SVM

Suggested Text-book

1. Wei-Meng Lee, *Python Machine Learning*, Wiley (2019)

References

1. M. Pradhan and U. Dinesh Kumar, *Machine Learning using Python*, Wiley (2019).
2. Thomas Haslwanter, *An Introduction to Statistics with Python*, Springer (2016)

IPH2053: Plant Propagation

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course out comes.

After the completion of the course students will be able to

CO1. Identify and asses the quality of different types of soils.

CO2. Develop an understanding of propagation techniques.

CO3. Practice different types of artificial propagation techniques like layering, grafting and budding.

Unit I

Soil: origin, properties and types .Components of soil - soil air, soil water, soil microbes, field capacity, permanent wilting percentage, pH, organic and inorganic components of soil.

Plant growth regulators in horticulture, uses of growth regulators - natural and synthetic regulators, growth regulators used for inducing rooting, flowering, breaking seed and bud dormancy

Garden Tools and Implements, Fertilizers and Manures- organic manure –farmyard manure, leaf mould, bone meal, oil cakes compost making - green manuring.

Unit II

Introduction to plant propagation, definition, different methods of plant propagation - natural Natural methods of plant propagation. Sexual method of propagation, Vegetative Propagation.

Artificial methods of plant propagation. Cuttings: stem, root and leaf cuttings, factors affecting rooting of cuttings..Layering , types of layering ground layering . Grafting. Budding- shield (T & I) and patch budding, green budding, chip budding - advantages and disadvantages.

Unit III

Activities

1. Collection and identification of different types of soil from the locality.
2. Estimation of soil pH using pH meter.
3. Determination of water content of different types of soils.
4. Collect and identify some natural vegetative propagules.
5. Identification and uses of various garden tools and implements .Work experience based on these tools.
6. Preparation of potting mixtures of known combinations.
7. Practice different types of grafting
8. Practice different type of budding
9. Practice different type of layering
10. Visit a Plant Propagation Nursery and prepare a report.

References

1. Introduction to Horticulture, Kumar N, 1997, Rajalekshmi Publication, Nagercoil.
2. Horticulture and Plant breeding, Kumaresan V. 2014, Saras Publication, Nagercoil.
3. Text Book of Horticulture, Manibhushan Rao K.N 2005, Macmillan India, Ltd.
4. Plant Propagation, Sadhu M. K . 1996, New Age International (P) Ltd.

IPH2054: Machine Learning using Python - IV

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 1

Course outcomes:

After the completion of the course the students shall be able to:

CO1: Apply classification using K-means

CO2: Describe Unsupervised learning using K-means

CO3: Perform typical computational task related to the units practically

CO4: Apply Classification using support vector machines

Prerequisites : Basic computer science, programming, physics and mathematics

Unit I

Classification using K-nearest neighbors (KNN). Introduction to KNN algorithm and implementation using Python. Making predictions. Optimizing k and minimizing the miscalculations.

Unit II

Unsupervised learning using K-means. Clustering in K-Means. Implementation in Python. K-Means by Scikit-learn. Evaluating cluster size using the Silhousette coefficient. Illustration using real-life problems.

Unit III

1.1. Classification using K-nearest neighbour Classifier.
    1.1.1. Preparing the Dataset
    1.1.2. Determining the Neighbours
    1.1.3. The weighted Nearest Neighbour Classifier.
1.2. Unsupervised Learning using K-means Clustering.
    1.2.1. Use of different distance functions
    1.2.2. Representing the clusters.
1.3. Factors affecting clustering techniques.

Suggested Text-book

1. Wei-Meng Lee, *Python Machine Learning*, Wiley (2019)

References

1. M. Pradhan and U. Dinesh Kumar, *Machine Learning using Python*, Wiley (2019).
2. Thomas Haslwanter, *An Introduction to Statistics with Python*, Springer (2016)

IPH2025C: Summer Project - III

Credit 0

After the completion of the course the students shall be able to:

CO1. Identification of research/industrial/academic problem, preparation of methodology of work, time bound planning.

CO2. Report the use of sophisticated instrumentation/software and enhance academic scenario through practical experience.

CO3. Develop the ability to analysis data collection, interpretation of observation and capability to make inferences

CO4. Develop new knowledge and experience to contribute in the start-up programs.

IPH2061: Observational Astronomy

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course outcomes.

After the completion of the course students will be able to

CO1. Visualize an idea about astronomy and optical telescopes

CO2. Visualize an idea about celestial objects like Stars, Galaxies and the Universe

CO3. Visualize the evolution of universe.

CO4. Practice to identify different planets, stars and constellations

Unit I

Observational Astronomy

Concept of Celestial Sphere-cardinal points, celestial equator, ecliptic, equinoxes, Summer solstice and winter solstice-ceelstial co-ordinate system-Right ascension and declination

Astronomical distances- AU, Parsec and light year. Objects visible in the sky- typical distances to them. Bright stars in the sky. Constellations, Typical star clusters in the sky.

Optical Telescopes-type of telescopes-refracting and reflecting-newtonian and cassegrain telescopes, Hubble Space Telescope

Unit II

Stars, Galaxies and the Universe

Type of Stars : Main Sequence, Red giant, white dwarf, Nerutron stars, Black Holes (qualitative ideas)-Sun as a main sequence star-structure of the Sun-photosphere, Chromospherd and Corona, Energy production in Sun.

Galaxies- Our Galaxy Milky way, local group of galaxies, galaxy clusters and Superclusters-web structure of the universe-filaments and voids

Origin of the Universe- Big Bang theory, expansion of the universe-red shift- Hubble law, age of the Universe.

Unit III

Observational activities

1. Watching the constellations and prepare reports about it
1.1. Orion
1.2. Canis Major
1.3. Taurus
1.4. Gemini
1.5. Pegasus Square

2. Watching the planets and prepare reports about it
2.1. Mercury
2.2. Venus

2.3. Mars

2.4. Jupiter

2.5. Saturn

3. Watching the stars and prepare reports about it

4. Watching the moon using the telescope and studying the craters

5. Watching the Jupiter and its moons and marking the relative position of its satellites

6. 3, Watching the Pleiades star Cluster.

7. Marking the waxing and waning of Venus, by studying its image over the days

References:

1. Astronomy – A beginners guide to the Universe – Chaisson (Mc Millan)

2. Astronomy: A self teaching guide – Dinah L Moche

IPH2068: Finishing School

Lecture: 18, Tutorial: 0, Lab: 18, Credit: 0

Course Outcomes

After the completion of course students will be able to

CO1. Develop the capacity to confidently face interviews, GD and secure placements in reputed companies

CO2. Develop the essential professional skills that will help students to lead a successful career.

Course Content

Unit I

CV and Bio Data - Types - Properties of good CV/Bio Data - Preparation -Inclusions and Exclusions Cover Letters. Time and Stress Management. Entrepreneurship - Leadership Essentials. Aptitude test- Essentials of Competitive exams - Exam Practice

Unit II

An understanding of Corporate Psychodynamics - Understanding Corporate Expectations, Business & Profits. Persona building and Self Grooming. Ethics, Values, Attitudes. Team Work – Interpersonal skills. Communication Skills – Oral and Written communication, Presentation skills Telephone Strategies Choosing the Right Job.

Unit III

Interview Types - Mock Interview Sessions - Level 1 - Pre-Interview Research – Pre-Interview Self-Assessment - Interview Attire - Reading the Recruiter's Mind - First Impression - Rapport Building - Body Language - Mock Interview Sessions. Level 2 - Questions and Types - Answering Questions - Asking Questions - Illegal Questions - Money Questions - Mock Interview Sessions. Level 3 - Post Interview

Group Discussions and Sessions

References:

1. Personality development and soft skills, Barun K Mitra, Oxford Univ. press.
2. Theories of personality, Calvin S Hall, Gardner Lindzey, John B Camphall, Wiely publications.
3. Facing group discussion and interview, Trilok Kumar Jain, Altantic pub. And distribution.