Maharaja's College Ernakulam

A GOVERNMENT AUTONOMOUS COLLEGE

Re-Accredited by NAAC with 'A Grade'
Affiliated to Mahatma Gandhi University
Centre of Excellence under Govt. of Kerala
Identified by UGC as College with Potential for Excellence

POST GRADUATE AND RESEARCH

DEPARTMENT OF PHYSICS

Estd. 1875

Under Graduate Curriculum and Syllabus

(Choice Based Credit Semester System)

B.Sc. PHYSICS

For 2020 Admission Onwards

MAHARAJA'S COLLEGE

ERNAKULAM

(A Government Autonomous College affiliated to Mahatma Gandhi University)

CURRICULUM AND SYLLABUS -2020 ADMISSION ONWARDS

for

Bachelor of Science Programmes

in

Physics (MCUSCPY09)

&

Physics-Instrumentation (MCUSCPI10)

under Choice Based Credit System (CBCS)

PREFACE

The meeting of the Board of Studies of the Dept. of Physics, Maharaja's College held on 23.11.2019 at the Dept. Staff Room at 2.00 pm recommended refinements in the existing syllabus (2016 syllabus) of BSc Physics and BSc Physics Instrumentation Programs. Recommendations were to address the content overload, to correct the sequential ordering of the topics to improve the lucidity, to include the course on Environmental Science and to incorporate the elements of Outcome Based Education.

The following members were present for the meeting.

1. Robin Francis, Head and Chairman of the Board of Studies, Dept. of Physics
2. Dr. Prasanth R., Subject expert
3. Smt. Sreeja R., Internal member
4. Smt. V. Sheeja, Internal member
5. Dr. Dann V.J., Internal member
6. Smt. Sheeba P.X., Internal member
7. Dr. Sreekumar R., Industry expert

Recommendations/Decisions of the Board of Studies were the following:

1. The core course of semester I BSc physics and BSc physics instrumentation programs 'Methods of Physics' is to be modified to reduce the content overload and it should have a module on the methodology of science.
2. The course 'Environmental Physics and Human rights' is to be included in semester V of the Programs.
3. Special Relativity may be made a part of Mechanics course of BSc physics; Astrophysics may be excluded from the syllabus of BSc physics.
4. Slight modifications in the syllabus of the complementary courses may be made so that it is supporting the core courses of the complementary students.
5. 'Nuclear and Particle Physics' of BSc physics instrumentation may be removed to include 'Environmental Physics and Human rights'.

I sincerely thank Dr. Prasanth R., Smt. V. Sheeja, Dr. Dann V.J., Smt. Sheeba P.X., Smt. Sreeja R. and Dr. R. Sreekumar for their valuable suggestions/recommendations in modifying the syllabus. Also, I wish to express my thanks to my colleagues Dr. Gishamol Mathew, Smt. Viji C., Dr. Wilson K.C., Sri. Prasad K.A., Sri. Sajeev K.F., Smt. Rekha S., Dr. Manoj R., Dr. Sivakumar C., Smt. And Mary Linsa K.S. and the Teachers of Physics Instrumentation for their great efforts in preparing the syllabus in the light of the suggestions of the Board of Studies. Also, I am thankful to Dr. Krishnakumar K., Member Secretary, Academic Council, Maharaja's College for the necessary directions in drafting the new syllabus.

Robin Francis

Head & Chairman of the Board of Studies

Dept. of Physics

Maharaja's College, Ernakulam

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1.Board of Studies in Physics (Under Graduate Programme in Physics)

Maharaja's College, Ernakulam (A Government Autonomous College, Affiliated to Mahatma Gandhi University, Kottayam)

Sl. No.	Name of Member	Designation
1	**Sri. Robin Francis**	Chairman, BoS, Physics
2	**Smt. Sreeja R.**	Internal Member
3	**Smt. V. Sheeja**	Internal Member
4	**Dr. Sivakumar C.**	Internal Member
5	**Dr. Dann V. J.**	Internal Member
6	**Smt. Viji C**	Internal Member
7	**Smt. Sheeba P. X.**	Internal Member
8	**Dr. N. Shaji**	Subject Expert (External member)
9	**Dr. Prasanth R.**	Subject Expert (External member)
10	**Dr. Sreekumar R.**	Industry Expert (External member)
11	**Sri. Sabu Thomas**	Alumni Member (External member)
12		University Nominee (External member)

2. REGULATIONS FOR UNDER GRADUATE PROGRAMMES 2020

(under Choice Based Credit System)

MAHARAJA'S COLLEGE, ERNAKULAM
(A GOVERNMENT AUTONOMOUS COLLEGE)

1. TITLE

1.1. These regulations shall be called "**MAHARAJA'S COLLEGE (AUTONOMOUS) REGULATIONS FOR UNDER GRADUATE PROGRAMMESUNDER CHOICE BASED CREDIT SYSTEM 2020**"

2. SCOPE

2.1 Applicable to all regular Under Graduate Programmes conducted by the Maharaja's College with effect from 2020 admissions

2.2 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

2.3 The provisions herein supersede all the existing regulations for the undergraduate programmes to the extent herein prescribed.

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. **'Choice Based Course**' means a course that enables the students to familiarize the advanced areas of core course.

3.3. ***'College Coordinator'*** is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

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

3.5 ***'Common Course II'*** means additional language.

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

3.6. ***'Core course'*** means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.7. ***'Course'*** means a portion of a subject to be taught and evaluated in a semester (similar to a paper under annual scheme).

3.8. *'**Credit'*** is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme**.**

3.9. ***'Department'*** means any teaching department in a college.

3.10. ***'Department Coordinator'*** is a teacher nominated by a Department Council to co- ordinate the continuous evaluation undertaken in that department.

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

3.12. ***'Faculty Advisor'*** means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.

3.13. ***Grace Marks*** shall be awarded to candidates as per the University Orders issued from time to time**.**

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

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

3.16. ***'Parent Department'*** means the department which offers core course/courses within an undergraduate programme.

3.17. ***'Programme'*** means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

3.18. ***'Semester'*** means a term consisting of a minimum **90** working days, inclusive of tutorials, examination days and other academic activities within a period of six months**.**

3.19. ***'Vocational Course'*** **(Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University/ State Government in this regard, from time to time.

5. DURATION

5.1 The duration of U.G. programmes shall be ***6 semesters***.

5.2 There shall be two Semesters in an academic year, the "ODD" semester commences in June and on completion, the "EVEN" Semester commences. There shall be two months' vacation during April and May.

5.3 No student shall be allowed to complete the programme by attending more than 12 continuous semesters.

6. REGISTRATION

6.1. The strength of students for each programme shall be as per the existing orders, as approved by the University.

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

7. SCHEME AND SYLLABUS

7.1. The U.G. programmes shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Choice based course**.**

7.2. There shall be Two Choice Based course (Elective Course) in the fifth and sixth semesters. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

7.3. Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one college to continue their education in another college without break.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D Grade**

or above within the permitted period. The college shall allow credit transfer, subject to the approval of the concerned board of studies and Academic Council.

7.5. Students discontinued from previous regulations CBCSS 2016, can pursue their studies under the new regulation "Regulations for Under Graduate Programmes under Choice Based Credit System 2020"after obtaining readmission.

7.6. The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which need to conduct practical examinations at the end of odd semesters.

8. Programme Structure

Model I/II BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	74
f	Choice Based Core Course	8
g	Minimum attendance required	75%

Model I or Model II B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120

c	Credits required from Common Course I	14
d	Credits required from Common Course II	8
e	Credits required from Core and Complementary/Vocational courses including Project	90
f	Choice Based Core Course	8

g	Minimum attendance required	75%

Model III BA/B.Sc./B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	112
e	Minimum attendance required	75%

BA Honours

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	16
d	Credits required from Common Course II	8
e	Credits required from Core + Complementary + Vocational Courses including Project	93

f	Choice Based Core Course	8
g	Minimum attendance required	75%

8. EXAMINATIONS

9.1 The evaluation of each paper shall contain two parts:

i. Internal or In-Semester Assessment (ISA)
ii. External or End-Semester Assessment (ESA)

9.2. The internal to external assessment ratio shall be 1:4.
Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	S Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B^+ Good	7
55 to below 65	B Above Average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

9. CREDIT POINT

AVERAGE Credit Point (CP) of a paper is

calculated using the formula:- *CP = C × GP, where*

C is the Credit and GP is the Grade point

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

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course. TC is the total credit of that category of course

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

GPA	**Grade**
9.5 and above	**S Outstanding**
8.5 to below 9.5	**A+ Excellent**
7.5 to below 8.5	**A Very Good**
6.5 to below 7.5	**B+ Good**
5.5 to below 6.5	**B Above Average**
4.5 to below 5.5	**C Satisfactory**
3.5 to below 4.5	**D Pass**
Below 3.5	**F Failure**

10. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

The external theory examination of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

11.1 For all courses without practical

1.a) Marks of external Examination : 80

1.b) Marks of internal evaluation : 20

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5=10) (Marks of test paper shall be average)	**10**
Total	**20**

11.2 For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

For all courses with practical

2.a) Marks of external Examination : 60

2.b) Marks of internal evaluation : 15

Components of Internal Evaluation	**Marks**
Attendance	**5**
Seminar/Assignments/Viva	**2**
Test paper (2x4)	**8**
Total	**15**

c. For practical examinations total marks for external evaluation is 40 for internal evaluation is 10

Components of Internal Evaluation (Practicals)	**Marks**
Attendance	**2**
Test (1x4)	**4**
Record*	**4**
Total	**10**

*Marks awarded for Record should be related to number of experiments recorded

11.3 Project Evaluation

Components of Project evaluation	**Marks**
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce(end Semester)	30

Components of Project Internal evaluation *

Components of internal evaluation	Marks
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory for projects.

Marks of external evaluation : 80

Marks of internal evaluation : 20

Components of External Evaluation of Project	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

*Marks for dissertation may include study tour report if proposed in the syllabus.

Components of internal Evaluation of Project	Marks
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

12. ASSIGNMENTS

Assignments are to be done from 1st to 6th Semesters. At least one assignment should be done in each semester for all courses.

13. SEMINAR/VIVA

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

Two test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

15. Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Department Level:

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

Level 2: College level

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

The internal evaluation marks/grades in the prescribed format should reach the Controller of Examination before the 4th week of October and March in every academic year.

16. External Examination

The external theory examination of all semesters shall be conducted by the Controller of Examinations at the end of each semester.

16.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the subcommittee of the college council on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission upon the recommendations of the head of the department and college council

16.2 All students are to do a **project in the area of core course.** This project can be done individually or in groups (not more than three students). for all subjects which may be carried out in or outside the campus. The projects are to be identified during the V semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the College.

16.3 There shall be supplementary exams only for fifth semester. Notionally registered candidates can also apply for the said supplementary examinations. For reappearance/ improvement for other semesters the students can appear along with the next batch.

16.4 A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

16.5 A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

16.6 A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the external

examination for the same semester, subsequently. **There shall be no improvement for internal evaluation**.

17. All courses shall have unique alphanumeric code.

18. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions Papers

(a) Without practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	**Short Answer/problem type**	2	10/12	20
2	**Short essay/problem**	5	6/9	30
3	**Essay/problem**	15	2/4	30
			Total	80

(b) With practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	**Short Answer/problem type**	1	10/12	10
2	**Short essay/problem**	5	6/9	30
3	**Essay/problem**	10	2/4	20
			Total	60

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will decided by the concerned Board of Studies/Expert Committees.

19. MARK CUM GRADE CARD

The College shall issue to the students a MARK CUM GRADE CARD on completion of the programme.

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a paper. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual papers. If a candidate secures **F Grade** for any one of the paper offered in a Semester/Programme **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D GRADE** or above within the permitted period.

20. There shall **be 2 level monitoring** committees for the successful conduct of the scheme. They are -

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior- most teachers as members.
2. College Level Monitoring Committee (CLMC), comprising Principal, Secretary Academic Council, College Council secretary and A.A/Superintendent as members.

3. Graduate Attributes/Outcomes for UG Programmes (POs)

After successfully completing any three-year under graduate program, a student is expected to achieve the following attributes.

1. **Scientific temper and critical thinking.** Mindset which enables one to follow a way of life that focuses upon the scientific method of understanding reality and the capability to think rationally and reflectively.
2. **Inclusiveness**. Constant exposure to and interaction with disparate social strata for an inclusive mindset, ethical sensibility and greater social sensitivity and empathy.
3. **Democratic practice and secular outlook**. As envisioned by the Constitution of India.
4. **Sense of equality, equity and environment**. Ability to differentiate between pure equality, social equity and a heightened awareness of how humans dialectically interact with environment.
5. **Synergetic work culture**. Capacity to work in groups and the attitude to consider larger goals greater than personal ones.
6. **Emancipatory and transformative ideals**. Attainment of cherished ideals of education for the eventual empowerment of humanity.

4.Programme Structure of UG Programmes under CBCS

4.A. BSc Physics (Model I)

Semester	Title of the course	Number of Hours per week	Number of credits	Total credits	Total hours/semester	Exam duration(hours)	Weightage ratio	
							ISA	ESA
1	English I	5	4	4	90	3	1	4
	English/Common course I	4	3	3	72	3	1	4
	Second Language I	4	4	4	72	3	1	4
	PHY1COR01-Methods of Physics Practical-PHY1P01	2 2	2 1	3	36 36	3	1	4
	Complementary I(Chemistry/Statistics) Practical (If no practical 4hrs with 3 credits)	2 2	2 1	3	36 36	3	1	4
	Complementary II(Mathematics)	4	3	3	72	3	1	4
2	English II	5	4	4	90	3	1	4
	English/ Common course II	4	3	3	72	3	1	4
	Second Language II	4	4	4	72	3	1	4
	PHY2COR02- Properties of Matter Practical-PHY2P02	2 2	2 1	3	36 36	3	1	4
	Complementary I(Chemistry/Statistics) Practical (If no practical 4 hrs with 3 credits)	2 2	2 1	3	72	3	1	4
	Complementary II (Mathematics)	4	3	3	72	3	1	4
3	English III	5	4	4	90	3	1	4
	Sec.Language/ Common course I	5	4	4	90	3	1	4
	PHY3COR03- Basic Electronics Practical-PHY3PO3	3 2	3 1	4	54 36	3	1	4
	Complementary I (Chemistry/Statistics) Practical (If no practical 5hrs with 4 credits)	3 2	3 1	4	90	3	1	4
	Complementary II(Mathematics)	5	4	4	90	3	1	4

4	English IV	5	4	4	90	3	1	4
	Sec. Language/Common course II	5	4	4	90	3	1	4
	PHY4COR04-Electricity, Magnetism & Electrodynamics Practical-PHY4P04	3 2	3 1	4	54	3	1	4
	Complementary I(Chemistry/Statistics) Practical (If no practical 5 hrs with 4 credits)	3 2	3 1	4	90 36	3	1	4
	Complementary II(Mathematics)	5	4	4	90	3	1	4
5	PHY5COR05- Mechanics Practical-PHY5P05	3 2	3 1	4	54 36	3	1	4
	PHY5COR06- Thermal & Statistical Physics Practical-PHY5P06	3 2	3 1	4	54	3	1	4
	PHY5COR07- Quantum Mechanics and Spectroscopy Practical-PHY5P07	3 2	3 1	4	54 36	3	1	4
	PHY5COR08- Environmental Physics and Human Rights Practical - PHY5P08	3 2	3 1	4	54 36	3	1	4
	PHY5CBP01-Choice based course I- Optics and Photonics	4	3	3	72	3	1	4
	PHY5D01- Project	1	1	1	18			
6	PHY6COR09- Nuclear & Particle Physics Practical-PHY6PO9	3 2	3 1	4	54 36	3	1	4
	PHY6COR10- Numerical methods & Computational Physics Practical-PHY6P10	3 2	3 1	4	54 36	3	1	4
	PHY6COR11- Condensed Matter Physics Practical-PHY6P11	3 2	3 1	4	54 36	3	1	4
	PHY6COR12-Advanced Electronics Practical-PHY6P12	3 2	3 1	4	54 36	3	1	4
	PHY6CBP01-Choice based courseII-Material Science & Nanotechnology	5	4	4	90	3	1	4

4.B. Complementary Physics for BSc Mathematics (Model 1) and BSc Chemistry (Model 1)

Semester	Title of the course	Number of Hours per week	Number of credits	Total credits	Total hours/semester	Exam duration(hours)	Weightage ratio	
							ISA	ESA
1	PHY1CMC01 – Condensed Matter Physics (for chemistry)	2	2	3	36	3	1	4
	Practical-PHY1CP01	2	1		36			
	PHY1CMM01 – Classical Mechanics (for maths)	2	2	3	36	3	1	4
	Practical-PHY1CP01	2	1		36			
2	PHY2CMC02 – Electricity, Optics and Lasers (for chemistry)	2	2	3	36	3	1	4
	Practical-PHY2CP02	2	1		36			
	PHY2CMM02 – Electricity and Optics (for maths)	2	2	3	36	3	1	4
	Practical-PHY2CP02	2	1		36			
3	PHY3CMC03 – Properties of Matter and Thermodynamics (for chemistry)	3	3	4	54	3	1	4
	Practical-PHY3CP03	2	1		36			
	PHY3CMM03 – Properties of Matter, Thermodynamics and Statistical Physics (for maths)	3	3	4	54	3	1	4
	Practical-PHY3CP03	2	1		36			
4	PHY4CMC04 – Quantum Mechanics and Nuclear Physics (for chemistry)	3	3	4	54	3	1	4
	Practical-PHY4CP04	2	1		36			
	PHY4CMM04 - Quantum Mechanics, Nuclear Physics and Particle Physics (for maths)	3	3	4	54	3	1	4
	Practical-PHY4CP04	2	1		36			

4.C. BSc Physics-Instrumentation (Model III)

Semester	Title of the Course	No. of hours per week	No. of Credits	Total Credits	Total hours	Exam Duration (Hrs)	Weightage ratio	
							ISA	ESA
1	English I	5	4	4	90	3	1	4
	INS1COR01- Basics of Mechanical Engineering	3	3	3	54	3	1	4
	INS1COR02-Basic Instrumentation Instrumentation Practical – INS1P01	3 2	3 1	4	90	3	1	4
	PHY1COR01- Methods of Physics Physics Practical – PHY1P01	2 2	2 1	3	72	3	1	4
	Complementary-Mathematics I	4	3	3	72	3	1	4
	Complementary- Electronics I – INS1CMP01 Electronics Practical – INS1CP01	2 2	2 1	3	72	3	1	4
2	English II	5	4	4	90	3	1	4
	INS2COR03- Basic Measurements	3	2	2	54	3	1	4
	INS2COR04-IndustrialInstrumentation I Instrumentation Practical – INS2P02	2 2	2 1	3	72	3	1	4
	PHY2COR02-Properties of Matter Physics Practical – PHY2P02	2 2	2 1	3	72	3	1	4
	Complementary- Mathematics II	4	3	3	72	3	1	4
	Complementary- Electronics II – INS2CMP02 Electronics Practical – INS2CP02	2 2	2 1	3	72	3	1	4
3	INS3COR05-Industrial Instrumentation II	5	4	4	90	3	1	4
	INS3COR06- Transducers and Signal Conditioners Instrumentation Practical – INS3P03	3 2	3 1	4	90	3	1	4
	PHY3COR03- Basic Electronics Physics Practical – PHY3P03	3 2	3 1	4	90	3	1	4

	Complementary-Mathematics III	5	4	4	90	3	1	4
	Complementary- Electronics III – INS3CMP03 Electronics Practical – INS3CP03	3 2	3 1	4	90	3	1	4
4	INS4COR07- Process Control Instrumentation Instrumentation Practical – INS4P04	3 2	3 1	4	90	3	1	4
	INS4COR08-Biomedical Instrumentation	5	4	4	90	3	1	4
	PHY4COR04- Electricity, Magnetism & Electrodynamics Physics Practical – PHY4P04	3 2	3 1	4	90	3	1	4
	Complementary- Mathematics IV	5	4	4	90	3	1	4
	Complementary- Electronics IV – INS4CMP04 Electronics Practical – INS4CP04	3 2	3 1	4	90	3	1	4
5	PHY5COR05-Classical Mechanics and Spectroscopy Physics Practical – PHY5P05	3 2	3 1	4	90	3	1	4
	PHY5COR06 - Thermal& Statistical Physics Physics Practical – PHY5P06	3 2	3 1	4	90	3	1	4
	PHY5COR07- Quantum Mechanics Physics Practical – PHY5P07	3 2	3 1	4	90	3	1	4
	PHY5COR08- Environmental Physics and Human Rights Physics Practical - PHY5P08	3 2	3 1	4	90	3	1	4
	PHY5CBP01-Choice based course I- Optics and Photonics	4	3	3	72	3	1	4
	PHY5D01- Project	1	1	1	18	3		
	On Job Training	0	2	2				
6	INS6COR09 - Microprocessors& Microcontrollers Instrumentation Practical – INS6P05	3 2	3 1	4	90	3	1	4
	PHY6COR10 - Numerical methods and Computational Physics Physics Practical – PHY6P10	3 2	3 1	4	90	3	1	4
	PHY6COR11- Condensed Matter Physics Physics Practical – PHY6P11	3 2	3 1	4	90	3	1	4
	INS6COR10- Industrial Automation	3	3	4	90	3	1	4

	Instrumentation Practical – INS6P06	2	1					
	INS6CBP01-Choice based course II - Analytical Instrumentation	5	4	4	90	3	1	4

4.D. Complementary Physics for BSc Environmental Chemistry and Water Management (Model III)

Semester	Title of the course	Number of Hours per week	Number of credits	Total credits	Total hours/semester	Exam duration(hours)	Weightage ratio	
							ISA	ESA
1	PHY1CMC01 – Condensed Matter Physics Practical-PHY1CP01	2 2	2 1	3	36 36	3	1	4
2	PHY2CMC02 – Electricity, Optics and Lasers Practical-PHY2CP02	2 2	2 1	3	36 36	3	1	4
3	PHY3CMC03 – Properties of Matter and Thermodynamics Practical-PHY3CP03	3 2	3 1	4	54 36	3	1	4
4	PHY4CMC04 – Quantum Mechanics and Nuclear Physics Practical-PHY4CP04	3 2	3 1	4	54 36	3	1	4

5. PSOs, COs and Syllabi of Core Courses (Theory)

5.A. Programme Specific Outcomes (PSOs) for BSc-Physics (Model I)

- PSO1: Understand what scientific method is, how science is developed, what the importance of mathematical logic in science is and why/how science is experimentally limited.
- PSO2: Learn and understand the concepts and facts about the mechanical, electric, magnetic and thermodynamic properties of matter, the principles of electronics and the theoretical basis of classical and quantum mechanics, relativity, nuclear and particle physics, electrodynamics, optics and statistical mechanics and to apply the knowledge for analysing and solving problems.
- PSO3: Understand the physics of condensed matter and the basics of material science and nanotechnology.
- PSO4: Apply the concepts of Electronics in the designing of analogue and digital circuits.
- PSO5: Understand the fundamentals of Programming to apply it to solve numerically the theoretical problems.
- PSO6: Apply and verify the theoretical concepts and facts by laboratory experiments.
- PSO7: Understand the facts about the environmental issues from a scientific point of view.
- PSO8: Understand human rights for being a better social animal.

5.B. Course Outcomes and Syllabi

[Common to BSc Physics-Instrumentation (Model-III)]

PHY1COR01 : METHODS OF PHYSICS

Credits-3 (theory-2, practical-1)

Contact hours-36

CO1. Understand the features, methods and limitations of science

CO2. Learn and understand how Quantum physics was developed / how a theory in physics is developed

CO3. Get introduced to the concept of vectors and learn its application in classical mechanics.

CO4. Understand the possible errors in measurements and apply the knowledge in the calculation of error.

CO1: PSO1, CL-U, KC-C, F

CO2: PSO1, CL-U, KC-F

CO3: PSO1, CL-U, Ap, KC-C

CO4: PSO1, CL-U, Ap, KC-C, F

Module I

Methodology of Science:

Science as facts, science as generalisation, some distinctions when describing science, science as a social activity, scientific revolutions and paradigms, science and pseudo-science, limitations of science, fundamental questions on reality, scientific prediction, hypothesis, theory and law, verification, falsification, acceptance, scientific reporting, peer review in science.

[Book 1, section: 2.2-2.8, 3.1-3.3, 4.1-4.4, 7.1] [9 Hrs]

Module II

History of development of Quantum Theory:

Important events in the history of development of Quantum Physics: Electromagnetic waves, Black body radiation and the Ultraviolet catastrophe, Planck's hypothesis, Einstein's explanation for photoelectric effect using Planck's hypothesis, Compton effect, Dual nature of light, de Broglie's hypothesis of dual nature of material particles and its verification- Davisson-Germer experiment.

[Book 2, section: 2.1-2.7, 3.1-3.5] [8 Hrs]

Module III

Vectors and its application in mechanics:

Vector operations- addition of two vectors, subtraction of a vector from another, multiplication by a scalar, dot product of two vectors, cross product of two vectors. Equality of two vectors. Vector algebra: Component form. Triple products- scalar triple product, vector triple product.

[Book 3, section: 1.1.1,1.1.2,1.1.3]

Ordinary derivative and partial derivative, Gradient, the operator del, divergence and curl and their geometrical interpretations.

[Book 3, section: 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5]

Application of vectors in mechanics- mechanics of a particle (position vector of a particle, velocity vector, linear momentum, Newton's second law, conservation of linear momentum, angular momentum, torque, conservation of angular momentum, work, conservation of energy)

[Book 4, section:1.1]

[11 Hrs]

Module IV

Experimental methods and Error analysis:

Experimental methods, least count of instruments, Precision and accuracy of measurements, Source of error in measurements, Necessity of estimating errors, Types of errors: instrumental error, calibration error, random error, systematic error, personal error, Significant digits, Order of magnitude,

Significant figure-rounding off, Absolute error and relative error, Calculation of error in sum, difference, product, quotient and power. Standard deviation.

[Book 5, section:1.1-1.6] [8 Hrs]

Text Books:

1. *Research Methodology: The Aims, Practices and Ethics of Science*, Springer, 2016, Pruzan, Peter
2. Beiser, Arthur, *Concepts of Modern Physics*, Tata Mc Graw Hill Education Pvt Ltd, Sixth edition
3. Griffiths, David J., *Introduction to Electrodynamics*, PHI, third edition
4. Goldstein, Herbert, Classical Mechanics, Third edition, Pearson Education, 2009
5. Chattopadhyay, D., Rakshit, P.C., *Advanced course in Practical Physics*, New Central Book Agency, 2011

Semester II

PHY2COR02-PROPERTIES OF MATTER

Credits- 3 (theory 2 + Practical 1)

Contact hours-36

	Course Outcomes	PSO	CL	KC
CO1	Basic understanding on mechanical properties of matter and hence to analyze the bending of beams and cantilevers	1,5	U, AP,An	C,F
CO2	To understand surface tension, surface energies origin of capilary rise. Also familiarise with the surface tension measurement techniques.	1,4,5	U, AP,An	C,F
CO3	Familiarise with the viscosity of fluids and gases also to understant the basic theorems associated with the viscosity	1,4,5	U, AP,An	C,F
CO4	Understand the working of devices applies theorems related to viscoty also familier to th measurement of viscosity	1,4,5	U, AP	C,F
CO5	To understand kinetic theory of gases.	1,5	U, AP	C,F
CO6	Familiaise with the working and theory of vacuum pumps and measuring guages	1,4,5	U, AP	C,F

Module I

Elasticity:

Elasticity, stress, strain, Hooke's law, Young's modulus, bulk modulus, rigidity modulus, stress strain plot for loaded wire, Poisson's ratio, work done in deforming a body, relation connecting Y, K, σ, relation connecting σ, η, Y, twisting of a cylinder, torsion pendulum- measurement of rigidity modulus of the material of a given wire, bending of beams, bending moment, cantilever, nonuniform bending of beam.

[11 hours] [Chapter 6, Book 1]

Module II

Surface Tension:

Cohesion, adhesion, explanation of surface tension, surface energy and surface tension, pressure difference across a spherical surface, excess pressure inside a liquid drop and soap bubble, difference of pressure across a curved surface, angle of contact, capillarity, expression for surface tension, determination of surface tension of water

[8 hours] [Chapter 8, Book 1]

Module III

Viscosity and fluid dynamics:

Streamline motion and rate of flow, equation of continuity, energy of a liquid in motion, Bernoulli's theorem, applications of Bernoulli's theorem- venturimeter Viscosity, Newton's law of viscosity, Stoke's formula, Derivation of Poiseuille's formula and measurement of viscosity of liquid, viscosity of gases.

[10 hours] [Chapter 7, Book 1]

Module IV

Kinetic theory of gases

Kinetic theory of gases- postulates, derivation of pressure exerted by gas, Energy of gas, energy of gas molecule, deduction of gas laws, Avogadro's hypothesis.

Production of low pressure- Air pump, Rotary oil pump and Mercury diffusion pump.

Measurement of low pressure (qualitative) - McLeod gauge, Pirani gauge and Knudsen gauge.

[7 hours] [Chapter 7, Book 1]

Text Books:

1. Properties of matter, Brijlal and Subrahmanyam, S Chand

2. Elements of properties of matter, 11th Edition, D. S. Mathur, S Chand

Semester III

PHY3COR03- Basic Electronics

Credits-4(Theory 3+ Practical 1)

Contact hours- 54

	COURSE OUTCOME	PSO	CL	KC
CO1	Understand and distinguish between ac and dc signals,	PSO2 & PSO5	U, An	C,F
CO2	Understand and distinguish between rms and Instantaneous values of voltage and cutrrent.	PSO1 & PSO5	U, An,	C,F
CO3	Analyse circuts using Thevenin's theorem and Norton's Theorem	PSO1 & PSO5	U, An,	C,F
CO4	Understand and distinguish between a diode and a zener diode.	PSO1 & PSO5	U, An,	C,F
CO5	Understand the working of the diode and use it to construct half waverectifiers, full wave rectifiers : center tapped and bridge	PSO1 & PSO5	U, An,	C,F
CO6	To understand , differentiate and analyze various Number systems	PSO1 & PSO5	U, An	C,F

MODULE I

Analog circuits and signals:

Analog electronics – Linear equations, AC resistance, Conventional current versus electron flow – Analog and Digital signals – Periodic signals, Frequency and period – Instantaneous, peak, average and effective (rms) values of a sinusoidal wave - Thevenin's theorem, Norton's theorem, (Problems are to be worked out)

[12 hours] [Book 1]

MODULE II

Diode theory and applications:

Ideal diode – Semiconductor materials – Energy levels – Extrinsic materials – semiconductor diode – Resistance levels – Diode equivalent circuits – Zener diode – Load line analysis – Diode testing

Power supplies – Half wave, Full wave, Center tapped, Bridge rectifier circuits – Filter circuits – Voltage regulator – Circuit protection devices.

Wave shaping circuits– Clipper - Positive, negative and biased clipping circuits Clampers - Biased clampers - Voltage multipliers - Doubler, Tripler and Quadrupler.

[10 hours] [Chapter 2, Book 2]

Bipolar Junction Transistors:

Transistor construction, operation – CB, CC, CE configurations – Alpha, Beta, relationship – Biasing - Limits of operation – Transistor testing – DC biasing – Operating point –Fixed bias circuit – Emitter stabilized bias circuit – Voltage divider bias – DC bias with voltage feedback

[10 hours] [Chapter 3, Book 2]

Module III

Power Amplifiers:

Series fed, transformer coupled class-A amplifiers – Class-B operation, amplifier circuits – Amplifier distortion – Power transistor heat sinking – Class-C and D amplifiers

Amplifier coupling (RC, impedance, transformer) – Amplifier applications – Direct coupled amplifiers (simple, two stage, Darlington arrangement, differential arrangement)

[6 hours] [Chapter 2, Book 1; Chapter 16, Book 2]

Operational Amplifiers:

Symbol and terminals – The ideal op-amp, practical op-amp – The differential amplifier, basic modes of signal operation (single-ended input, double ended differential input, double ended output, common mode, CMRR) – Op-amp circuits (inverting, non-inverting, unity follower, summing amplifier, integrator, differentiator)

[6 hours] [Chapter 6, Book 1; Chapter 14, Book 2]

Module IV

Digital Electronics:

Number systems – Decimal, Binary, Octal, Hexadecimal – 1's and 2's complement of binary numbers
Binary coded decimal (BCD), ASCII – Parity method for error detection
Logic gates – AND, OR, NAND, NOR and Exclusive OR gates
Boolean algebra – Laws and rules of Boolean algebra, De' Morgan's theorems
Boolean expressions – SOP and POS forms – Simplification of Boolean expressions – Karnaugh map

[10 hours] [Book 3]

Text Books:

1. Electronics: Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, Prentice Hall

2. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, Prentice Hall
3. Digital Logic and Computer Design, M. Morris Mano

Semester IV

PHY4COR04 ELECTRICITY, MAGNETISM AND ELECTRODYNAMICS

Credits 4 (Theory 3+ Practical 1)

Contact hours 54

Course Outcome	PSO	CL	KC
CO1: Understand and apply the concepts of scalar and vector fields and their role in electrodynamics.	PSO2	U, Ap	C, P
CO2: Understand the basics of electrostatics and apply them to discrete charges and charge distributions..	PSO2	U, Ap	C,P
CO3: Understand the behavior of matter in the presence of electric fields.	PSO2	U	C
CO4: Understand the basics of magnetostatics and apply them to currents and moving charges in magnetic fields.	PSO2	U,Ap	C,P
CO5: Understand the behavior of matter in the presence of magnetic fields.	PSO2	U	C
CO6. Understand the dynamics of time varying fields, Maxwell's equations and their plane wave solutions in vacuum and linear media.	PSO2	U	C
CO7: Understand the variation of current in RC , LC and LCR circuits and AC circuits	PSO2	U, Ap	C,Ap

Module I

Electrostatics:

Scalar and vector fields, Gradient, divergence and Curl and their physical significance, Electric Field, Continuous charge distribution, Divergence and curl of electrostatic fields, Gauss' Law, Applications, Electric potential, Poisson's equation and Laplace's equation, The potential ofa localized charge distribution, Work and Energy in electrostatics, The work done to move a charge, Energy of a point charge distribution and continuous charge distribution, Conductors.

Basic properties.

[12 hours] [Chapter 2, Book 1]

Electric Fields in Matter:

Induced charges, Surface charge and force on a Capacitor, Electric Fields in Matter, Dielectrics, Induced dipoles, alignment of polar molecules, polarization, Bound charges, The field inside a dielectric, The

electric displacement and Gauss's law in the presence of dielectrics, Linear dielectrics, susceptibility, permittivity and dielectric constant.

[8 hours] [Chapter 4, Book 1]

Module II

Magnetostatics:

Lorentz force law, Magnetic force on a line current, surface current and volume current, The Biot-Savart law, The divergence and Curl of B, Ampere's law and applications, Magnetic vector potential.

[5 hours] [Chapter 5, Book 1]

Magnetic fields in matter:

Magnetization, torques and forces on magnetic dipoles, the field of a magnetized object, bound currents, Ampere's law in magnetized materials, linear materials, magnetic susceptibility and permeability.

[4 hours] [Chapter 6, Book 1]

Module III

Electrodynamics and Maxwell's equations:

Electromotive force, Ohm's law, Motional emf, Faraday's law, Induced electric field, Inductance, Energy in magnetic fields, Maxwell's equations: Electrodynamics before Maxwell, Modified Ampere'a law and Maxwell's equations in free space and Maxwell's equations in Matter, Equation of continuity, Boundary conditions, Poynting'stheorem, Electromagnetic waves in vacuum, Monochromatic plane waves, Electromagnetic waves in matter, propagation in linear media.

[12 hours] [Chapters 7, 8 & 9, Book 1]

Module IV

Varying Currents:

Growth and decay of current in an inductive circuit, charge and discharge of a capacitor through a resistance, measurement of high resistance by capacitor leak method, DC applied to LCR series circuit(charge case), discharging of capacitor through LR circuit(discharge case).

[8 hours] [Chapter 3, Book 2]

Alternating currents & Circuit theory, RMS and peak values, AC through series LCR (acceptor circuit) and parallel LCRcircuit(rejecter circuit), Q factor, power in AC, power factor, measurement of power in AC circuit, AC watt meter

[5 hours] [Chapter 5 & 6, Book 2]

Text Books:

1.Introduction to Electrodynamics, David J Griffiths, PHI

2 Electricity and Magnetism, 2 nd Edition, J.H.Fewkes& John Yarwood, University Tutorial Press

3. Fundaments of Magnetism and Electricity ,12th Edition, D N Vasudeva, S. Chand

4.Electricity and Magnetism, 2008, R Murugeshan, S Chand.

Reference:

1 Electricity and Magnetism, Berkely Physics Course, 1965, E. M.Purcell, Mc Graw Hilln

2 Electromagnetics, 4th Edition, Matthew N Sadiku, Oxford,

3 Electromagnetics :Schaum's series, 2 nd Edition, J A Edminister, TMH

4 A Text book of Magnetism and Electricity, N. S. Khare,Atma Ram & Sons, Delhi

4 Sears and Zemansky's University Physics:Electricity and Magnetism, Vol. II, 12th Edition,Hugh D. Young,Roger A. Freedman, Pearson, India.

Semester V

PHY5COR05 - MECHANICS

Credits-4 (Theory 3+ Practical 1)

Contact hours – 54

CO		PSO	CL	KC
C01	Understand and learn the Newtonian concepts of mechanics	PS05	CL - U, Ap	KC – F, C
C02	Understand the Lagrange's and Hamiltonian formalisms of mechanics, and apply the knowledge to analyse simple systems	PS05	CL - U, Ap	KC – F, C
C03	Examine the link between symmetry properties and conservation laws.	PS05	CL - An, Ap	KC – C
C04	Understand the physics of rotational motion of rigid bodies	PS05	CL - U, Ap	KC – F, C
C05	Learn and realize the concept of Einstein's special theory of relativity, and its consequences in machanics	PS05	CL - U, Ap	KC – F, C

Module I

Fundamentals of Newtonian mechanics:

Mechanics of a particle- Newton's Laws of motion- conservation of linear momentum, angular momentum and torque, conservation of angular momentum, work done by a force, conservative force, conservation of energy, motion under a constant force- motion under constant electric and magnetic fields.

[7 hours] [Chapter 1, Book 1]

Module II

Lagrangian and Hamiltonian dynamics:

Constraints, classification of constraints, degrees of freedom, generalized co-ordinates, configuration space, principle of virtual work, generalized forces, D'Alembert's principle, Lagrangian, Lagrange's equations, cyclic co-ordinates, simple applications of Lagrange's equations- free particle, linear harmonic oscillator, simple pendulum, conservation laws and symmetry properties- homogeneity and isotropy of space, homogeneity of time.

Hamiltonian function – Hamiltonian conservation theorem, Hamilton's variational principle- deduction from D'Alembert's principle, variational principle for a conservative system, Hamilton's equations of motion, derivation of Hamilton's equations from variational principle, energy integrals of Hamilton's equations, simple applications of hamilton's equations – free particle, simple pendulum.

[21 hours] [Chapters 3, 4 & 6, Book 1]

Module III

Rigid body rotation:

Linear and angular velocities, torque, angular momentum, fundamental equation of motion of a rigid body, component of angular momentum of rigid body along the axis of rotation- moment of inertia of rigid body, radius of gyration of rigid body, parallel axis theorem and perpendicular axes theorem, Derivation of moment of inertia of thin rod, ring, disc and sphere, angular acceleration of rigid body, conservation of angular momentum, kinetic energy of a rotating body, flywheel- determination of moment of inertia

[12 hours] [Chapter10, Book 2]

Module IV

Special Relativity:

Inertial and non-inertial frames, Galilean transformation, invariance of Newton's laws of motion, postulates of Special Relativity, Lorentz transformation, consequences of Lorentz transformation- Lorentz-Fitzgerald contraction, time dilation, relativity of simultaneity, Lorentz transformation for the

components of velocity, relativity of mass, mass- energy equivalence, energy-momentum relation, massless particle

[14 hours] [Chapter10, Book 1]

Text Books:

1. Classical Mechanics, 1 st Edition, G. Aruldhas, PHI

2. Mechanics, D. S. Mathur, S Chand

References:

1. Classical Mechanics, 3 rd Edition, Goldstein, Poole &Safko, Pearson

2. University Physics, Harris Benson, Wiley

3. Physics for scientists and engineers with modern physics, 9 th Edition, J.W. Jewett, R.A. Serway, Cengage

Semester V

PHY5COR06-Thermal and Statistical Physics

Credits-4 (Theory 3+ Practical 1)

Contact hours – 54

	COURSE OUTCOME	PSO	CL	KC
CO1	To understand the concept of heat , zeroth and first law of thermodynamics to get knowledge of various thermodynamic processes and thermal conductivity.	PSO5	U, An, Ap	C, F
CO2	To understand, analyse and apply the concepts and facts about the basic ideas behind different heat engines	PSO5	U, An, Ap	C,F
CO3	To understand, analyse and apply the concepts and facts of entropy, thermodynamic potentials, maxwell's thermodynamic relations and phase transitions.	PSO5	U, An, Ap	C,F
CO4	To understand and analyse some of the basic concepts of statistical physics.	PSO5	U, An,Ap	C, F

Module I

Equation of state of a gas:

Kinetic theory of gas , derivation of ideal gas equation, behavior of real gases, Van der Waals equation of state, limitation of Van der Waals equation.

[4 hours] [Chapter 1&2 ,Book 2]

Temperature:

Macroscopic point of view-Microscopic point of view-Macroscopic vs. Microscopic-Scope of thermodynamics-Thermal equilibrium and the Zeroth law-Concept of Temperature

[3 hours][Chapter 1, Book 1]

Heat and First Law of thermodynamics:

Thermodynamic equilibrium-Equation of state- Work-Quasi-Static process-PV diagram. Work a path dependent funtion- Internal Energy Function- First Law of thermodynamics- Concept of Heat-Differential form of the first law of Thermodynamics- Applications of First law of thermodynamics-The indicator diagram-Work done during an isothermal process-Work done during an adiabatic process-Slopes of Adiabatics and isothermals-Relation between adiabatic and isothermal elasticities- Cooling due to adiabatic reversible process.

[Chapter 4, Book 2]

Heat Conduction- Coefficient of Thermal conductivity- Thermal Conductivity of conductors, bad conductors and liquids (Lee's Disc)

[Chapter 10, Book 3]

[11 hours]

Module II

Engines, Refrigerators and the Second Law of Thermodynamics:

Reversible and Irreversible process- Heat Engines - Definition of Efficiency – Carnot's Ideal Heat Engine-Carnot's Cycle- Effective way to increase efficiency-Carnot's engine and refrigerator-Coefficient of performance-second law of thermodynamics-Carnot's theorem-steam engine - Internal combustion engine (Otto cycle)-Internal combustion engine (Petrol engine)- Diesel engine

[10 hours] [Chapter 4, Book 2]

Module III

Entropy:

Concept of entropy- change in entropy- Change in entropy in adiabatic process- Change in entropy in reversible and irreversible processes- principle of increase of entropy- TS diagram- Carnot cycle-Entropy of a perfect gas- Third law of thermodynamics- Zero point energy- Heat death of universe.

[5 hours] [Chapter 5, Book 2]

Thermodynamic Potentials:

Thermodynamic potentials- Significance of thermodynamic potentials- Maxwell´s thermodynamic relations- The TdS equations- Internal Energy Equations- Heat-Capacity Equations- First order phase transitions:Clausius –clapeyron equation

[Chapter 9, Book 1, Chapter 6, Book 2]

Clausius – Clapeyron equation using Maxwell's relations- Clausius – Clapeyron equation using Carnot's cycle- Applications of the equation.

[9hours] [Chapter 6, Book 2]

Module IV

Statistical Mechanics:

Statistical distributions-Concepts of Phase space – Maxwell-Boltzmann statistics (no derivation)-Distribution of molecular energies in an ideal gas-Average molecular energy- Equipartition theorem-Maxwell-Boltzmann speed distribution law-Expressions for RMS speed, most probable speed and mean speed.

Bose Einstein and Fermi Dirac distribution laws (no derivations)-Fermi energy- Application of BE distribution law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-White dwarfs- Neutron stars- Black holes.

[12 hours] [Relevant topics from Chapter 2 and Chapter 9, Book 4]

Text Books:

1. Heat and Thermodynamics,8th Edition, Mark.W.Zemansky, Richard H Dittman, adapted by Amit K Chattopadhyay, McGraw Hill Education
2. Heat Thermodynamics and Statistical Physics, Revised Edition, Brij Lal, N.Subramanyam, P.S.Hemne, S.Chand and Company
3. Heat and Thermodynamics,D.S. Mathur, S Chand
4. Concepts of Modern Physics – Arthur Beiser, McGraw-Hill

References:

1. Thermodynamics and Statistical Mechanics, Greiner, Springer
2. Berkeley Physics Course Volume 5
3. Statistical Physics; Frederick Reif, McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.
5. Statistical Mechanics, 3rd Edition, R.K. Pathria, Pergamon press, Oxford
6. An Introduction to Thermal Physics, Daniel V.Schroeder, Addison Wesley Longman
7. Concepts in Thermal Physics, Stephen J. Blundell and K.M.Blundell, Oxford university press
8. The Principles of Thermodynamics, N.D. Hari Dass, CRC Press, Taylor and Francis, LLC

Semester V

PHY5COR07 – QUANTUM MECHANICS AND SPECTROSCOPY

Credits – 4 (Theory 3 + Practical 1)

Contact hours – 54

COURSE OUTCOMES				
C01	Understand the dual nature of light and matter, and apply the duality to physical examples	PS05	CL - U, Ap	KC – F, C
C02	Learn the fundamental concepts of quantum mechanics	PS05	CL – U, An	KC – F, C
C03	Realize the vector atom model, and examine various coupling schemesfor angular momentum	PS05	CL – An, Ap	KC – C
C04	Analyse the rotational, vibrational and electronic spectra of molecules	PS05	CL – An	KC – C
C05	Understand the quantum theory of Raman effect	PS05	CL - U	KC – F

Module I

Duality of light and matter:

Black body radiation, ultraviolet catastrophe, Planck's radiation formula, photoelectric effect, Einstein's theory of photoemission, compton effect, Bohr's quantum theory of atom- postulates, H-atom- radius of the electron orbit, velocity of electron and energy, derivation of Rydberg's formula, De Broglie waves, De Broglie wavelength and Bohr's Quantization condition, Born's probability interpretation, phase velocity and group velocity, Davisson- Germer experiment

[12 hours] [Book 1]

Module II

Fundamentals of Quantum Mechanics:

Normalization of wave function, well-behaved wave functions, time dependent and steady state forms of Schrödinger equation, Hamiltonian operator, Schrödinger equation as an eigen value equation, linearity and superposition, linear operators of Quantum Mechanics, commutators, postulates of Quantum mechanics, expectation values, uncertainty principle, particle in a box, linear harmonic oscillator, zero-point energy

[14 hours] [Book 1]

Module III

Quantum mechanical atom:

Electron spin, spatial quantization, Vector atom model, quantum numbers of an atomic electron, Exclusion principle, Stern-Gerlach experiment, atomic structures, spin-orbit coupling, angular momentum operator, commutation relations, total atomic angular momentum, LS coupling and jj coupling, Term symbols, selection rules for the transition of atom, fine structure of H-alpha line and sodium D-line, Zeeman effect- normal and anomalous, Stark effect

[14 hours] [Book 1]

Module IV

Quantum mechanics of molecules:

Molecular bond, electron sharing- the mechanism of covalent bond, diatomic molecule as a rigid rotator, rotational energy levels of a diatomic molecule, rotational spectra, vibrational levels of a diatomic molecule, vibrational spectra, vibration-rotation spectra, electronic spectra of molecules- fluorescence and phosphorescence, Raman effect- quantum theory of Raman effect

[14 hours] [Book 1]

Text Book:

1. Concepts of modern physics, 6th Edition, Arthur Beiser, Tata Mcgraw-Hill

References:

1. A text book of Quantum mechanics, P. M. Mathews & Venketesan, Mcgraw-Hill
2. Modern physics, G. Aruldhas and P. Rajagopal, PHI

Semester V

PHY5COR08: ENVIRONMENTAL PHYSICS AND HUMAN RIGHTS

Credits-4 (theory-3, practical-1)

Contact hours-54

CO1. Understand water resources and the importance of its management.

CO2. Understand environmental pollution, waste management and the monitoring and assessment of the environment.

CO3. Understand the different renewable and non-renewable energy sources and their merits and demerits.

CO4. Understand human rights and its universality in the national and international perspectives.

CO1: PSO7, CL-U, KC- C,F

CO2: PSO7, CL-U, KC-C,F

CO3: PSO7, CL-U, KC-C,F

CO4: PSO8, CL-U, KC-C

Module I:

Water resources and its management:

Water resources: use and over-utilization of surface and ground water, floods, drought, dams-benefits and problems. Rain water harvesting and its importance in Kerala.

[3 Hrs]

Remote sensing:

Remote sensing principles, spectral reflectance of earth's surface features, remote sensing satellites, aerial photography, applications of remote sensing in environmental monitoring and assessment.

[5 Hrs]

Environmental pollution:

Environmental pollution-Primary and secondary pollutants, air pollution-sources, effects and control/treatment methods, Ozone layer depletion, greenhouse gases, global warming, water pollution-sources, effects and control/treatment methods, ground water pollution, marine pollution, soil pollution, consumerism and waste products, e-waste-an emerging environmental threat.

[6 Hrs]

Module II

Waste management:

Waste minimisation and resource conservation: source reduction, recycling, value added products, waste minimisation promotional methods- awareness generation, control methods and economic benefits, benefits of waste minimisation, management of solid wastes, hazardous solid waste- characteristics and management.

[4 Hrs]

Environment Impact Assessment and Control:

Basic ideas of environment impact assessment, environment ethics, environmental laws and constitutional provisions to control air pollution and water pollution in India, forest conservation.

[3 Hrs]

Module III

Non-renewable and Renewable energy sources:

Non-renewable energy sources: Coal, Oil, Natural gas, nuclear energy, merits and demerits of Non-renewable energy sources, Renewable energy sources: Biofuels, Biogas plant- fixed dome type and moving drum type, wind energy, wave energy, tidal energy, hydroelectricity, geothermal energy conversion, ocean thermal energy conversion, solar energy, solar water heater- direct and indirect systems, solar dryer- direct and indirect type, solar cooker, solar heating of buildings, solar green houses, merits and demerits of non-renewable energy sources.

[16 Hrs]

Module IV

Human rights:

Human rights- meaning and concept, universality of human rights- Basic International Human Rights Documents- UDHR, ICCPR, ICESCR- Value dimensions of human rights. Human rights national perspective- human rights in Indian constitution- fundamental rights- constitutional context of human rights- directive principles of state policy and human rights- human rights of women and children and minorities, science, technology and human rights, human rights awareness in education.

[17 Hrs]

Text Books & References:

1.Erach, Bharucha, *Text book of Environmental studies for Undergraduate Courses*, University Press, 2nd edn, 2013

2.Clark, R.S., *Marine Pollution*, Clanderson Press Oxford

3.*Down to Earth*, Centre for Science and Environment

4.Jadhav H. & Bhosale, V.M., *Environmental Protection and Laws*, Himalaya Publishing House, Delhi, 1995

5.Miller, T.G. Jr., *Environmental Science*, Wadsworth Publishing Company

6.Rao, M.N. & Datta, A.K., *Waste water Treatment*, Oxford & IBII Publication Co. Pvt. Ltd.

7.Rajagopalan, R., *Environmental Studies from Crisis and Cure*, Oxford University Press, 2016

8.Wanger, K.D., *Environmental Management*, W.B.Saunders Co., Philadelphia, USA

9.Kothari, D.P., Singal, K.C. & Ranjan, Rakesh, *Renewable Energy sources and Emerging Technologies*, PHI Learning Pvt. Ltd., 2nd edn, 2011

10.Sen, Amartya, *The Idea Justice*, Penguin Books, New Delhi, 2009

11.Law Relating to Human Rights, Asia Law House, 2001

12.Khanna, S.K., *Children and Human Rights*, Common Wealth Publishers, 2011

13.Kapoor, Sudhir, *Human Rights in the 21st Century*, Mangal Deep Publications, Jaipur, 2001

14.United Nations Development Programme, Human Development Report, 2004

Semester V: Choice Based Core Course

PHY5CBP01- Optics and Photonics

Credits- 4 (Theory 4)

Contact hours- 72

CO	COURSE OUTCOME	PSO	CL	KC
CO1	To understand the nature of light - particle and wave nature of light on the basis if interference, diffraction, polarization	PSO2	U	C, F
CO2	To study the characteristic properties of light using the phenomenon of interference	PSO2	U,Ap, An	C, F, P
CO3	To study the theory of diffraction and polarization of light and their applications in devising optical elements and also to understand the techniques for modulating polarized light.	PSO2	U, Ap, An	C, F, P
CO4	To understand the theory, construction and working of microscopes and telescopes	PSO2	U, Ap, C	C, F, P
CO5	To understand the theory of lasing and the construction and working of solid state lasers, gas lasers and semiconductor lasers	PSO2	U, An	C, F
CO6	To understand the theory and applications of holography and fiber optics	PSO2	U, An, Ap	C, F
CO7	To understand and analyse different optical elements using matrix method of optics	PSO2	U, An	C, F
CO8	To understand the working and fabrication of photo detectors and photovoltaic devices	PSO2	A, An	C, F

Module I

Interference

Superposition of light waves, coherence. Interference by division of wavefront –Youngs double slit experiment. Interference by division of amplitude – parallel thin films in reflected light. Theory and applications - fringes of air wedge and newtons rings.

Michelson interferometer – principle, closely spaced spectral lines, refractive index of film.

[9 hours][Book 1]

Diffraction

Fresnel diffraction – Theory of zone plate, comparison with convex lens. Fresnel diffraction at straight edge. Fraunhofer diffraction – single slit, N slits, theory of transmission grating, wavelength

determination. Dispersive power of grating. Rayleigh criterion for the limit of resolution - Resolving power of grating and prism.

[9 hours][Book 1]

Module II

Polarization

Polarized light, production of linearly polarized light. Birefringence, quarter and half wave plates. Generation and detection of circular and elliptical polarization. Optical activity - specific rotation, Laurent's half-shade polarimeter.

[8 hours] [Book 1]

Optical instruments

Camera, size of an object, simple magnifier, field of view, objective and eyepiece - Huygen's eyepiece - Ramsden eyepiece – comparison. Compound microscope – magnifying power, numerical aperture. Telescopes – refracting astronomical telescope, Newton's telescope. Constant deviation spectrometer.

[10 hours] [Books 1]

Module III

Matrix Method in optics

Introduction to matrix method – translation, refraction, imaging by a spherical refracting surface, imaging by a co-axial optical system.

[9 hours] [Book 3]

Lasers

principle of laser action, properties, optical resonators, three and four level lasing - , laser systems – ruby laser, He-Ne laser, Nd-YAG laser, semiconductor laser, laser applications.

[9 hours] [Book 1]

Module IV

Photonics - I

Holography – principle, coaxial and off-axis holography, Holograms – properties and applications.

Fiber Optics – total internal reflection, critical angle and acceptance angle, fractional refractive index change, numerical aperture, Classification of fibres - step index and graded index fibres, multimode and single mode fibers – V number, Dispersion mechanisms – intermodal and intramodal dispersions, qualitative study of optical fibre communication system (qualitative study only).

[8 hours] [Book 1 and 2]

Photonics - II

Photodetectors – principle of p-n junction photodiode, quantum efficiency and responsivity, PIN photodiode – operation and speed, avalanche photodiode-responsivity.

Photovoltaic devices – solar energy spectrum, principle of solar cell and I-V characteristics.

Light emitting diodes – principles, device structures.

Modulation of polarized light: Pockel's effect – Principle of light transmission through Pockel's cell, Faraday effect – Verdet's constant, principle of optical isolator.

[10 hours] [Book 2]

Text Books:

1. A Text book of Optics, N Subrahmanyam and Brijlal, S Chand & Co.Ltd. New Delhi
2. Optoelectronics and Photonics: Principles and Practises, S O Kasap, Pearson.
3. Optics, Ajoy Ghatak, TMH Publishing Co. Ltd, New Delhi.

Reference:

1. Optics, Eugene Hecht, Pearson
2. Fundamentals of Photonics, Textbook by Bahaa E. A. Saleh, Wiley
3. Fundamental of Optics, Devaraj Singh, PHI Learning Ltd, New Delhi.

Semester VI

PHY6COR09-Nuclear and Particle Physics

Credits – 4(Theory 3 + Practical 1)

Contact hours- 54

CO	COURSE OUTCOME	PSO	CL	KC
CO1	To understand the structure of nucleus, various properties and their measurements and to study different nuclear models	PSO2	U, Ap, An	C, F, P
CO2	To study transformations of nuclei and the phenomenon of radioactivity, nuclear transformations leading to fission, fusion and the schematic design of nuclear reactors.	PSO2	U, An, Ap	C, F, P
CO3	To study the purpose and design of radiation detectors and particle accelerators	PSO2	U, An, Ap	C, F, P
CO4	To study the interactions between elementary particles and quark model	PSO2	U, An, An	C, F
CO5	To study about cosmic rays and different effects of cosmic rays	PSO2	U, An, An	C, F, P

Module I

Nuclear structure:

Nuclear composition - isotopes, atomic mass unit. Nuclear Properties - radii, spin and magnetic moment. Nuclear mass measurement using Bainbridge's mass spectrograph, Stable Nuclei - minimum energy configurations. Nuclear forces – properties, Meson theory of nuclear forces, Binding Energy, Models of Nuclear Structure - Liquid drop model, Features of shell model.

[15 hours] [Book 1 and 2]

Module II

Nuclear Transformations:

Radioactive decay– laws of radioactivity, Soddy's displacement law, Activity, half-life and mean life - radiometric dating, Radioactive series, Successive disintegrations, Radioactive equilibria – transient and secular.

Alpha decay – Gamow's theory, Beta decay – neutrino theory, Gamma decay, Internal conversion.

Nuclear fission, Nuclear reactors - Power and breeder reactors, Nuclear fusion in stars - formation of heavier elements.

[15 hours] [Books 1 and 3]

Module III

Detectors of Nuclear Radiations and Particle Accelerators:

Interaction of energetic particles with matter.

Detectors of Nuclear radiations - ionization chamber, proportional counter, GM counter.

Particle Accelerators - Van de Graaff generator, linear Accelerator, cyclotron and betatron.

[12 hours] [Book 3]

Module IV

Elementary Particles and Cosmic Rays:

Classification of particles, Particles and anti-particles, Four fundamental interactions. Elementary particle quantum numbers – identification of interactions.

Quark model – composition of hadrons, colored quarks and gluons.

Cosmic rays- Origin of cosmic rays, primary, secondary and showers, Latitude effect, east-west effect and altitude effect – explanation for the effects.

[12 hours] [Books 1 and 3]

Text Books:

1. Concepts of Modern Physics (5th edition)- Arthur Beiser, Tata McGraw Hill.

2. Nuclear Physics – S N Ghoshal, S Chand and Co.

3. Modern Physics (Revised edition) – R Murugeshan and Er. KiruthigaSivaprasath, S Chand and Co.

References:

1. Nuclear Physics, D C Tayal (Himalaya Publishing)

2. Atomic and Nuclear Physics, Subrahmanyam and Brijlal (S Chand)

3. Concepts of Nuclear Physics, Bernard L Cohen (Tata McGraw Hill)

4. Nuclear Physics, Irving Kaplan (Addison – Wesley)

5. Introduction to nuclear Physics – Herald A Enge(Addison-Wesley Pub. Co., 1966).

Semester VI

PHY6COR10- Numerical Methods and Computational Physics

Credits – 4 (Theory 3 + Practical 1)

Contact hours- 54

	COURSE OUTCOME	PSO	CL	KC
CO1	Understands the importance of computers in physics.Understands definition,properties and development of algorithm.Understands the concept of flowchart.Compares different control structures like sequential,branching and looping. Understands the errors of computation.Learns to write algorithm and flow chart for certain problems	PSO 1,6	U,An,Ap,C	F,P
CO2	Understands the basics of python programming.Compares python with other languages.Writes python programs.Understands Inputs and Outputs , Variables, data types, operators, expressions and statements, Strings, Lists, Tuples, and Dictionaries, Conditionals, Iteration and looping - Functions and Modules - File input and Output, Pickling.Scientific Python - Numpy, scipy, Pylab and matplotlib etc	PSO 6	U,An,Ap,C	F,P
CO3	Learn about various numerical methods to solve problems numerically	PSO 1,6	U,An,Ap,C	F,P
CO4	Learns to write python programs for different problems	PSO 6	U,An,Ap,C	F,P

Module I

Introduction:

Importance of computers in Physics, paradigm for solving physics problems for solution. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart – control structures (sequential, branching and looping), symbols, guidelines, types.

[6 hours]

Examples:

Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of

sin(x) as a series, algorithm for plotting trajectory of a projectile thrown at an angle with the horizontal. **[6 hours]**

Module II

Basics of Python Programming:

Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs – Variables, data types, operators, expressions and statements, Strings, Lists, Tuples, and Dictionaries, Conditionals, Iteration and looping - Functions and Modules - File input and Output, Pickling.Scientific Python - Numpy, scipy, Pylab and matplotlib.

[14 hours]

Module III

Numerical Methods:

General introduction to numerical methods, Comparison between analytical and numerical techniques - Curve Fitting: Principle of least squares, fitting a straight line - Interpolation: Finite difference operator, Newton's forward difference interpolation formula, Solution of algebraic equations: Newton Raphson method - Numerical differentiation and integration: Difference table, Trapezoidal and Simpson's (1/3) method - Solution of differential equations: Euler method, Runge -Kutta method (Second order).

[14 hours]

Module IV

Scientific Programming with Python - Algorithm and programs:

1. To find the product of two matrices
2. To find a set of prime numbers and Fibonacci series.
3. Print out the wavelengths of hydrogen lines
4. Convert from polar to Cartesian coordinates
5. To find the roots of a quadratic equation.
6. To print out all natural even/odd numbers between given limits.
7. To find maximum, minimum and range of a given set of numbers
8. Calculate and display the interference pattern generated by two circular sets of waves
9. Bisection method– finding the root on an equation
10. Solving equation using Newton – Raphson method
11. Evaluate an integral using the trapezoidal rule
12. Simpson’s rule – program to evaluate a definite integral with n subdivisions.
13. Numerical Integration with Euler method
14. Numerical Integration with RK 2

[14 hours]

Text Books:

1. Computational Physics, V.K. Mittal R.C. Verma S.C. Gupta, Ane Books.
2. Computational Physics with Python, M. Newman.
3. Computational Physics with Python, E. Ayars.
4. How think like a computer scientist – Learning with Python, Allen Downey, Jeff Elkner and Chris Meyers.
5. Software Carpentry – Programming with Python, http://software-carpentry.org/lessons.html
6. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn, 2012, PHI Learning Pvt. Ltd.

References:

1. The Nature of Mathematical Modelling, Neil Gershenfeld,
2. An Introduction to Computational Physics, Tao Pang
3. Computational Physics, Rubin H. Landau and Manuel J. Paez
4. Introduction to Computer Simulation Methods by H. Gould, J Tobocnik and W. Christian
5. Effective Computation in Physics, Kathryn Huff and Anthony M. Scopatz, O'Reilly Media
6. A Primer on Scientific Programming with Python, Hans PetterLangtangen, Springer
7. A first course in Numerical Methods, U. M. Ascher and C. Greif, 2012, PHI Learning
8. Elementary Numerical Analysis, K. E. Atkinson, 3rdEdn, 2007, Wiley India Edition.

Semester VI

PHY6COR11 – CONDENSED MATTER PHYSICS

Credits – 4 (Theory 3 + Practical 1)

Contact hours – 54

COURSE OUTCOMES		PSO	CL	KC
C01	Understand and learn the crystal structures	PS05	CL - U, Ap	KC – F, C
C02	Examine and study the X-ray diffraction methods	PS05	CL - An, Ap	KC – C
C03	Understand the free electron theories of metals	PS05	CL - U	KC – F
C04	Analyse the dielectric and magnetic properties of materials	PS05	CL – U, An	KC – F, C
C05	Understand and realise superconductivity and its applications	PS05	CL - U, Ap	KC – F, C

Module I

Crystal Structures:

Space lattice- crystal lattice-symmetry considerations-point group symmetry-translational symmetry of crystals-unit cell, primitive cell, Wigner Seitz cell- Bravais lattice-space lattice of cubic system-Calculation of lattice constant - HCP, Sodium chloride, Cesium chloride and Zinc blende structures, lattice planes and Miller indices-Inter planar spacing.

[Chapter 2, Book 1]

Braggs's law of X-ray diffraction-Reciprocal lattice-Advantages of reciprocal lattice, geometrical construction of reciprocal lattice, Rules for constructing reciprocal lattice, graphical demonstration of reciprocal lattice in two dimensional space, Definition of reciprocal lattice- Reciprocal lattice vector- The Von Laue equations, Bragg's law from Laue equations, comparison of Bragg's law and Laue approaches, X-ray Diffraction methods- The Laue method, Rotating crystal method, powder method

[Chapter 3, Book 1]

[14 hours]

Module II

Conduction in metals:

Classical free electron theory of metals- electrical conductivity, drift velocity and charge mobility, mean free lifetime, mean free path, relaxation time, Boltzmann transport equation- Boltzmann transport equation for electrons-Lorentz solution of Boltzmann transport equation for the electron, Sommerfeld's theory of electrical conductivity, Thermal conductivity (no derivation), Wiedemann-Franz law, Merits and Demerits of free electron theory, Quantum theory of free electrons-electrical conductivity, Free electron gas in one dimensional box –Fermi level, Fermi energy, density of states, Average kinetic energy in the ground state

[Chapter 7, Book 1]

Formation of energy bands, periodic potential in a crystalline solid - energy bands in sodium crystal, Bloch theorem (no proof), Kronig Penny model (no derivation).

[Chapter 8, Book 1]

[15 hours]

Module III

Dielectric and Magnetic Properties of materials:

Polar and Non-polar molecules-Polar molecules in absence of electric field, polar dielectric in presence of electric field, Dilelectric polarization, Terms and definitions, derivation of $D = \varepsilon_o E + P$, Measurement of relative dielectric constant, the local filed (Lorentz method), Dielectric constant and polarizabiliy, Polarization process- Electronic polarization, Ionic polarizabilty, Dipolar or orientational polarizability, Space charge polarizability, Langevin-Debye equation, Clausius-Mosotti equation, Debye equation, refractive index, effect of temperature on dielectric constant, Application of dielectric materials, Qualitative ideas of Ferrolectricity, Antiferroelectricity, Pyrolectricity and Piezoelectricity.

[Chapter 12, Book 1]

Terms and definitions in Magnetism, Classification of magnetic materials, the quantum numbers, origin

of magnetic moment- Orbital magnetic moment of electrons, Spin angular momentum of electron, why g is called Splitting factor, Nuclear spin magnetic moment, Diamagnetism, Langevin's theory of Diamagnetism, Qualitative ideas of paramagmetism, ferromagnetism, anti-ferromagnetism.

[Chapter 13, Book 1]

[17 hours]

Module IV

Superconductivity:

Introduction and historical developments, Electrical resistivity, Perfect diamagnetism or Meissner effect, Supercurrents and penetration depth, Critical field and critical temperature, Type I and Type II Superconductors, Isotope effect, Flux quantisation, The Josephson effects and tunneling, BCS theory (qualitative ideas only), High temperature ceramic superconductors, Applications.

[Chapter 10, Book 2]

[17 hours]

Text Books:

2. Essentials of Solid State Physics, (2013) S. P. Kuila, New Central Book Agency (P) Ltd, London
3. Solid State Physics, R. K. Puri and V. K. Babbar, S. Chand & Company Pvt. Ltd

References:

3. Elementary Solid State Physics – Principles and Applications, M. A. Omar.
4. Solid State Physics – Structure and Properties of Materials, M. A. Wahab, 2nd edition, Narossa Publishing House.
5. Introduction to Solid State Physics, 7th Edition, Kittel, Wiley & Sons
6. Solid State Physics, J. S. Blakemore, Cambridge
7. Solid State Physics A. J. Dekker, Macmillan

Semester VI

PHY6COR12- Advanced Electronics

Credits – 4(Theory 3+ Practical 1)

Contact Hours- 54

	COURSE OUTCOME	PSO	CL	KC
CO1	Understand and distinguish the working of semiconductor devices like JFET,MOSFET,Varactordiodes,Tunneldiodes,photodiodes,photo conductive cells etc.	PS05	U,An,Ap,C	F,P
CO2	Apply the basic ideas of transistor in the construction of different types of feedback amplifiers and oscillators .Distinguish between amplitude modulation,angle modulation .	PS05	U,An,Ap,C	F,P
CO3	Understand the working of combinational logic circuits like half adder,fulladder,decoder,encoder,multiplexerandde multiplexer.Understand the working of sequential logic circuits like different flipflops,different asynchronous counters,synchronous counterand shift register etc.	PSO5	U,An,Ap,C	F,P
CO4	Understand and compares the memory and storage devices,magnetic and optical storage devices and integrated circuit technologies TTL and CMOS.	PSO5	U,An,Ap,C	F,P

Module I

Semiconductor devices:

Structure of FET – FET family – JFET characteristics - JFET operation, symbols – Drain characteristic curve – Pinch off voltage, cut off voltage, comparison – Transconductance curve – JFET input resistance and capacitance – MOSFET characteristics – D-MOSFET, E-MOSFET, FET switching circuits, Analog switch.

[Chapter 4, Book 1]

Varactor diodes – Tunnel diodes – Photodiodes – Photoconductive cells

[Chapter 20, Book 2]

Silicon Controlled Rectifier – Operation, characteristics, applications – Light activated SCR

[Chapter 22, Book 2]

[15 hours]

Module II

Amplifiers and Oscillators:

Feedback amplifiers-Principle of feedback amplifiers-Positive and negative feedback and its effects - Different types of feedback (Block diagrams only)-Emitter follower.

Sinusoidal oscillators-Principle of oscillators-Barkhausen criterion-Tuned collector oscillator-Hartley and Colpitt's Oscillators – RC Phase shift oscillators – Crystal oscillator.

[8 hours]

Communication Electronics:

Amplitude modulation concepts – Modulation index and Percentage of Modulation – Sidebands in the frequency domain – AM power – Single Side Band modulation.

[Chapter 3, Book 3]

Angle modulation – Mathematical Analysis – Deviation sensitivity – FM and PM wave forms - Phase deviation and modulation index – Frequency deviation and percent modulation –Bandwidth requirement – Average power of angle modulated wave.

[Chapter 7, Book 4]

[7 hours]

Module III

Logic circuits:

Combinational logic circuits – Half adder, Full adder, 4 bit parallel adder, Decoders, Encoders, Multiplexer and Demultiplexer

Sequential logic – Flip flops – SR, D, J-K – Applications – Asynchronous counters – Binary and Decade counters – Synchronous counters – 4 bit binary counter, 4 bit synchronous decade counter, Shift register – Serial in serial out, Serial in Parallel out, Parallel in parallel out

[Chapter 6,7,8,9,Book 5] [12 hours]

Module IV

Storage Devices, IC Technology:

Memory and storage devices – RAM – Static RAM and DRAM, ROM, PROM, EPROM, Flash memory, FIFO memory, LIFO memory and CCD memories

Magnetic and optical storage – Magnetic storage, Magneto-optical storage and optical storage

Integrated circuit technologies – TTL and CMOS – Operational characteristics and parameters – TTL inverter, TTL NAND gate, CMOS inverter, CMOS NAND gate and CMOS NOR gate

[Chapter 11, 15 ,Book 5] [12 hours]

Text Books:

1. Electronics: Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, Prentice Hall.
2. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, Prentice Hall.
3. Principles of Electronic Communication Systems, Third Edition, Louis E. Frenzel.
4. Electronic Communication Systems: Fundamentals Through Advanced, Fifth Edition, Wayne Tomasi, Pearson.
5. Digital Fundamentals,EleventhEdition,Thomas L.Floyd,Pearson
6. Digital Logic and Computer Design, M. Morris Mano

Semester VI: Choice based core course

PHY6CBP01-Materials Science and Nanotechnology

Credits–4 (Theory 5)

Contact hours-90

	COURSE OUTCOME	PSO	CL	KC
CO1	Understand and distinguish between crystalline, non- crystalline and micro crystalline solids and various types crystals	PSO5	U, An	C,F
CO2	Understand and distinguish between various types of crystal defects and imperfections	PSO5	U, An, Ap	C,F
CO3	To get knowledge about formation of thin films	PSO5	U, An	C,F
CO4	Understand the various mechanisms of electrical conduction in solids and nanomaterials.	PSO2 & PSO5	U, An, Ap	C,F
CO5	To analyse the reasons for the properties of nanomaterials using quantum mechanics and get knowledge about quantum confinement	PSO2 & PSO5	U, An, Ap	C,F
CO6	To understand , differentiate and analyze various methods for the preparation and characterization of thin films and nanomaterials	PSO2 & PSO5	U, An, Ap	C,F

Module I

Macrostructure, microstructure, defects and thin films:

Structure and microstructure: crystalline solids, non-crystalline solids, partly crystalline solids, the development of microstructure: Solidification, processing

Defects: Point defects in crystal of elements, solid solutions, Schottky defects, Frenkel defects, Nonstoichiometric compound, Edge dislocations, screw dislocations, partial and mixed dislocations, planar defects, volume defects, precipitation

Thin films: Thin film growth processes, Structural consequence of growth process, microstructure, surface roughness, density, adhesion, metastable structure, solubility relaxation.

[25 hours] [Chapter 3, Book 1; Chapter 1, Book 1]

Module II

Introductory Quantum Mechanics for Nanoscience:

Size effects in small systems, Quantum behaviour of nanometric world: Applications of Schrödinger equation – infinite potential well, potential step, potential box; trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials.

[20 hours] [Chapter 5, Book 2]

Module III

Band Structure, Density of states and Electrical transport in nanostructure:

Band Structure, Density of states: Introduction- Energy bands, Density of states in low dimensional structures

Electrical transport in nanostructure: Electrical conduction in metals- The Drude model, Free electron model, Conduction in insulators/ Ionic Crystals-Electron transport in semiconductors

Various conduction mechanisms in 3D (Bulk), 2D (thin film) and low dimensional systems: Thermionic emission, Field enhanced thermionic emission (Schottky effect), Field assisted thermionic emission from traps (Poole- Frenkel effect), Arrhenius type thermally activated conduction-variable range Hopping conduction, Polaron conduction

[20 hours] [Chapters 3 &4, Book 2]

Module IV

Growth and Characterization techniques of nanomaterials (Elementary ideas only):

Top down vs bottom up techniques, Lithographic process, Non -Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam evaporation. Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol Gel Technique, Electro-deposition, Ball-milling. (Elementary ideas only)

Structural Analysis- XRD methods- Scanning Electron Microscope-Tunneling Electron Microscope-Compositional Analysis- electron scanning for Chemical analysis- Optical Analysis-Spectrophotometer- electrical analysis- Hall set up- Four Probe set up (Elementary ideas only)

[25 hours] [Chapter 6 & 7, Book 2]

Text books:

1. Thin film device applications, K.L.Chopra, Inderjeet Kaur, Plenum Press

2. Introduction to Nanoscience& Nanotechnology (2014), K. K. Chattopadhyay and A. N. Banerjee, Publisher: PHI Learning and Private Limited

3. Nanotechnology (2012), RakeshRathi, S Chand & Company, New Delhi

4. Nanotechnology a crash course (2010), Raul J. Martin-Palma, Akhlesh Lakhtakia, SPIE Press

5. Nanostructures and nano materials: Synthesis, properties and Application (2004), Guozhong Cao, Imperial College Press.

5.C. Programme Specific Outcomes for BSc Physics-Instrumentation (Model III)

- PSO1: Understand what scientific method is, how science is developed, what the importance of mathematical logic in science is and why/how science is experimentally limited.
- PSO2: Learn and understand the concepts and facts about the mechanical, electric, magnetic and thermodynamic properties of matter, the principles of electronics and the theoretical basis of classical and quantum mechanics, electrodynamics, optics and statistical mechanics and to apply the knowledge for analysing and solving problems.
- PSO3: Understand the physics of condensed matter.
- PSO4: Understand the basics of mechanical engineering, instrumentation and measurements.
- PSO5: Acquire the knowledge of industrial Instrumentation, process control instrumentation, biomedical instrumentation and analytical instrumentation.
- PSO6: Understand the physics and applications of transducers and signal conditioners.
- PSO7: Get introduced to the architecture of microprocessors and microcontrollers.
- PSO8: Understand the concept of industrial automation and how it is realized.
- PSO9: Apply the concepts of Electronics in designing analogue and digital circuits.
- PSO10: Understand the fundamentals of Programming to apply it to solve numerically the theoretical problems.
- PSO11: Apply the knowledge of microprocessor programming for mathematical operations.
- PSO12: Apply and verify the theoretical concepts and facts in physics and physics instrumentation by laboratory experiments.
- PSO13: Understand the facts about the environmental issues from a scientific point of view.
- PSO14: Understand human rights for being a better social animal.

5.D. Course Outcomes and Syllabi

[Second Core Courses for BSc Physics-Instrumentation (Model III)]

Semester	Title of the Course	No of Hours per week	No of credits	Total Credits	Total Hours
1	INS1COR01-Basics of Mechanical Engineering	3	3	3	54
	INS1COR02-Basic Instrumentation	3	3	4	90
	Instrumentation Practical (Basic Instrumentation Lab)	2	1		
2	INS2COR03-Basic Measurements	3	2	2	54
	INS2COR04-Industrial Instrumentation 1	3	2	3	90
	Instrumentation Practical (Industrial Instrumentation Lab)	2	1		
3	INS3COR06-Transducers and Signal Conditioners	3	3	4	90
	Instrumentation Practical (Signal Conditioners Lab)	2	1		
	INS3COR05-Industrial Instrumentation 2	5	4	4	90
4	INS4COR07-Process Control Instrumentation	3	3	4	90
	Instrumentation Practical (Process Control Instrumentation Lab)	2	1		
	INS4COR08-Biomedical Instrumentation	5	4	4	90
5	On Job Training		2	2	0
	Project	1	1	1	18
6	INS5COR09-Microprocessors and Microcontrollers	3	3	4	90
	Instrumentation Practical (Microprocessor Lab)	2	1		
	INS6COR10-Industrial Automation	3	3	4	90
	Instrumentation Practical (Industrial Automation Lab)	2	1		
	INS6CBP01-choice based course	5	4	4	90

Semester I

INS1COR01-Basics of Mechanical Engineering

Credits – 3(Theory 3)

Contact hours-54

PSO4, CL-U, KC-F, P

CO 1

- To study the various tools used, hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To gain theoretical knowledge in material casting processes and develops an understanding of the parts used in that.
- To impart concepts of different primary shaping processes.

CO 2

- To understand the basic concepts of manufacturing process like machining, joining, surface finishing.

CO 3

- Understand the different types of power transmission methods and its application.
- Analyze different types of bearings and its application ,design procedure of Ball Bearings and Sliding contact bearing.
- Comprehend different types of clutches and its applications and to analyze single and multiplate clutches.

CO 4

- Familiarity with different types of measurement systems/devices for engineering measurements

Module I

Familiarization with tools

Handheld tools- measuring tape, hammer, screw driver, pliers, chisels, hack saw, vice, centre punch, mallet, try square, wrenches, scribers, spanners. Automatic Power tools- power drill, power screw drivers. (brief explanation of each Tool with figures and application.)

Primary shaping processes

Casting, forging, Rolling, bending, drawing, squeezing simple definition of, extruding, shearing, forming, piercing, spinning, crushing (casting only in detail, only brief explanation of each and their objectives)

[10 hours]

Module II

Machining processes

Shaping, slotting, planning, Drilling, Milling, Lathe operations (Brief explanation of each . Lathe–its parts operations only in detail)

Surface finishing processes

Polishing, electro- plating, metal spraying, anodizing, galvanizing, painting (simple definition and use and advantages)

Joining processes

Welding, soldering, brazing, riveting, adhesive joining, screwing, pressing (simple description, uses and advantages)

[14 hours]

Module III

Power transmission

Introduction, belt drive, flat belt, V-belt, round belts, open belt drive, cross belt drive, velocity ratio, slip, belt materials, length of belt, ratio of tensions, power transmitted by a belt, (basic description, use and advantage)

Rope drive

Application, fiber rope and wire ropes, materials (basic description, use and advantages)

Chain drive

Application, driving or power transmission chain, crane chains, pulling chains, roller chains, silent chain (basic description, use and advantages)

Gear drive

Introduction, gear terminology, spur gear, helical gear, bevel gear, worm gear, rack and pinion, gear train, velocity ratio (basic description, use and advantages)

Shaft coupling

Introduction, rigid couplings, flexible couplings, disengaging couplings, non aligned coupling (simple description and uses)

Bearings

Introduction, sliding contact bearing, rolling contact bearings , ball bearings , roller bearings ,contact bearings (simple description and uses)

Clutches

Introduction, mechanical clutch, electromagnetic fluid and power clutch ,fluid Clutch (simple description and uses)

[20 hours]

Module IV

Standard of measurements

Standard of length, end standards, vernier calipers, inside, depth, and height gauges, fixed gauges-gauge block, end bars, slip gauges, surface plates, micrometers.

Angular measurement- sine bar, angle gauges, levels, clinometers, taper gauges.

[10 hours]

Reference:

1. Basic mechanical engineering –R.K. Rajput, Laxmi Publications
2. Basic mechanical engineering –J.Benjamin
3. Workshop technology-R.S.Khurmi,J.K.Gupta, S.Chand publishers
4. Machine design-P.C. Sharma,D.K.Aggarwal, Katson books
5. Elements of precision engineering ---R.Raman,Oxford & IBH Pubishing, New Delhi
6. Engineering Metrology-R.K.Jain, Khanna Publishers

Semester I
INS1COR02 - Basic Instrumentation
Credits-4 (Theory 3 + Practical 1)

Contact hours – 54

PSO5, PSO12, CL-U,Ap,KC-F,P

CO 1

- To introduce the basic concept instrumentation and the possible errors and its calculation.
- To gain theoretical and practical knowledge in types and elements in instrument

CO 2

- To introduce the concept of circuit elements, analog circuits and fundamentals .

CO 3

- To provide a foundation in basic meters and its application.
- Get introduced to the concept of bridges and learn its application in practical.

CO 4

- The students should be able to learn the fundamentals of Networks and its applications.
- Study basic concepts of Magnetism.

Module I

Basics of Instrumentation, static and dynamic characteristics, errors, measurement and units, applications of measurement instrumentation. (basic idea and definition of terms and principle). Functional elements of Instrument, Transducers (active and passive),Null and deflection methods (basic idea and definition of terms and principle).

Classification of instruments (absolute, secondary) (basic idea and definition of terms and principle).

[15 hours]

Module II

A.C. fundamentals- sinusoidal and non-sinusoidal waves, terminology, different parameters (amplitude, rise time fall time etc..) (basic Idea and definition of terms and principle)

D.C. fundamentals (basic idea and definition of terms and principle) A. C. circuits, A.C. through R, L, C , RL, RC, RLC , resonance , tuned Amplifiers (basic idea and definition of terms and principle)

[15hours]

Module III

Electromechanical indicating instruments- Galvanometers (D'Arsonaval), analog Ammeters & voltmeters, moving iron instruments, watt meters, energy meter(principle, working and construction)

Bridge circuits- D.C. bridges – Wheatstone's bridge, Kelvin bridge, A.C. bridges- Wein bridge, Maxwell bridge (principle, working and construction)

[12 hours]

Module IV

Network fundamentals, Kirchhoff's voltage and current laws, thevenin's voltage and current laws (Basic concepts and simple problems). Magnetism (Basic concepts and terms).

[12 hours]

Reference Books:

1. A Course in Electrical and electronics Measurements and Instrumentation – A. K. Sawhney, Puneet Sawhney DhanpatRai & Co
2. MeasurementSystems: Application and Designs –Ernest O Doebelin, Mc Graw Hill
3. Circuits and networks: Analysis and synthesis – A Sudhakar, Shyammohan S Palli, Mc Graw Hill
4. Basic Electrical Engineering – For first year BTech Degree Course, MA College of Engineering, Kothamangalam.

Semester II

INS2COR03 - Basic Measurements

Credits – 3(Theory 3)

Contact hours-54

PSO5, CL-U, Ap, C, KC-F, P

CO 1

- To introduce a knowledge about displacement, force and torque.
- To impart different measurement techniques of the above variables.

CO 2

- To introduce a knowledge about speed, dimension and weight.
- To impart different measurement techniques of the above variables.

CO 3

- To introduce a knowledge about density, viscosity and humidity.
- To impart different measurement techniques of the above variables

CO 4

- To introduce a knowledge about acceleration, specific gravity, conductivity.
- To impart different measurement techniques of the above variables.

Module I

Displacement

Definition, measurements method- resistance strain gauge, LVDT, capacitive (principle, construction and working, advantages and disadvantages)

Force

Definition, measurements method- hydraulic force meter, pneumatic force meter, proving ring, strain gauge load cell (principle, construction and working, advantages and disadvantages)

Torque

Definition, measurement methods- In-line rotating torque sensor, In-line stationary torque sensor, proximity torque sensors (principle, construction and working, advantages and disadvantages)

[16 hours]

Module II

Speed

Definition, measurement methods- revolution counter, stroboscope ,resonance tachometer, tachometer generators, photoelectric tachometer (principle, construction and working, advantages and disadvantages)

Dimension

Thickness- Introduction, contact type thickness measurement- contact type thickness gauge, ultrasonic vibration method, non-contact type- capacitance thickness gauge, radiation thickness gauge(principle, construction and working, advantages and disadvantages)

Industrial weighing

Introduction, pneumatic load cell, strain gage cell(principle, construction and working, advantages and disadvantages

[13 hours]

Module III

Density

Introduction, definition, solid density measurement, liquid density measurement, gas density measurement, hydrostatic weighing densitometer, vibrating tube densitometer (principle, construction and working, advantages and disadvantages)

Viscosity

Introduction, capillary viscometers, industrial viscometers (principle, construction and working, advantages and disadvantages)

Humidity

Introduction, principle, hygrometer (principle, construction and working, advantages and disadvantages)

[13 hours]

Module IV

Acceleration

Introduction, accelerometers(principle, construction and working, advantages and disadvantages)

Specific gravity

Introduction, hydrometer (principle, construction and working, advantages and disadvantages)

Conductivity

Introduction, definition, measuring instruments(principle, construction and working, advantages and disadvantages)

[12 hours]

Reference Books:

1. Process/Industrial Instruments and Controls Handbook –Gregory K. McMillan, DouglasM. Considine, Mc Graw Hill
2. A Course in Electrical and electronics Measurements and Instrumentation– A.K.Sawhney, Puneet Sawhney,Dhanpat Rai & Co.
3. A Course in Mechanical Measurements and Instrumentation & Control –A.K. Sawhney, Puneet Sawhney, DhanpatRai & Co.
4. Industrial Instrumentation and control –S.K.Singh, Mc Graw Hill

Semester II

INS2COR04 - Industrial Instrumentation 1

Credits-4 (Theory 3 + Practical 1)

Contact hours – 54

PSO5, CL-U, Ap, C, KC-F, P

CO 1

- To make students aware of various types of pressure sensors and its applications in industries.

CO 2

- Introduce vacuum and its fundamentals.

CO 3

- Gain knowledge about vacuum measurement instruments and introduce application

.

CO 4

- Get knowledge about temperature measurement and understand the applications.

Module I

Pressure

Definition, units, unit conversions, different types of pressure (basic idea only) Pressure measurement-barometer, dead weight pressure gauge, bourden tube, manometers, bellows, diaphragm, pressure switches (principle, construction and working, advantages and disadvantages)

[11 hours]

Module II

Vacuum

Definition, different ranges of vacuum (basic idea) Fundamentals, gas flow mechanisms, gas laws, conductance calculation, concept of throughput and pumping speed (basic principle and definitions)

[11 hours]

Module III

Vacuum measurement and applications

Vacuum measuring instruments- thermal conductivity gauges, ionization gauges, pirani gauge, Mc Leo gauge(principle, construction and working, advantages and disadvantages)

Pumps- rotary pumps, root blowers (principle, construction and working, advantages and disadvantages) Application of vacuum –freeze drying, sputtering process, thin film deposition technique.

[19 hours]

Module IV

Temperature

Definition, units, unit conversions (basic idea only) Temperature measurement-thermometer, filled system thermometers, bimetallic, RTD, thermistor, thermocouple, pyrometer, temperature switches (principle, construction and working, advantages and disadvantages)

[13 hours]

Reference Books:

1. Process/Industrial Instruments and Controls Handbook –Gregory K. McMillan, DouglasM. Considine, Mc Graw Hill
2. A Course in Electrical and electronics Measurements and Instrumentation –A.K. Sawhney, Puneet Sawhney,DhanpatRai & Co.
3. A Course in Mechanical Measurements and Instrumentation & Control –A.K. Sawhney, Puneet Sawhney, Dhanpat Rai & Co.
4. Industrial Instrumentation and control –S.K.Singh, Mc Graw Hill
5. Measurement Systems: Application and Designs –Ernest O Doebelin, Mc Graw Hill

Semester III

INS3COR05 - Industrial Instrumentation 2

Credits-4 (Theory 4)

Contact hours – 90

PSO5, CL-U, Ap, C, KC-F, P

CO 1

- To make students aware of various types of level sensors and its applications in industries.

CO 2

- To make students aware of various types of flow sensors and its applications in industries.

CO 3

- Familiarize pH and make knowledge about electrodes used in pH measurement.
- Study the smart sensors used in real time applications.

CO 4

- To understand about vibration and how it is measured in industries.
- Introduce various types of detectors.

Module I

Level

Definition, units, Sight glass method, pressure gauge, purge system, buoyancy method- float and displacer capacitive method, ultrasonic method (principle, construction and working, advantages, disadvantages)

[18 hours]

Module II

Flow

Definition, units, Flow characteristics, flow measuring technique, flow measurement methods, venturi, flow nozzle, orifice, pitot tube, rotameters, electromagnetic flow meter (principle, construction and working, advantages, disadvantages)

[21 hours]

Module III

pH

Definition, types of electrodes, glass electrode pH measurement, application in Chemical industries (principle, construction and working, advantages, disadvantages)

Smart sensors

Block diagram- Smart transmitter., Recent trends in sensor technology, Semiconductor sensors, Film sensors, MEMS, Nanosensors (principle, construction and working, advantages, disadvantages)

[26 hours]

Module IV

Vibration

Nature of vibration, quantities involved in vibration measurements, seismic transducers (principle, construction and working, advantages, disadvantages)

Detectors

Smoke detectors, LPG detectors, Chlorine detectors, SPM, Dissolved oxygen meters, CO analyzers(principle, construction and working)

[25 hours]

Reference Books:

1. Process/Industrial Instruments and Controls Handbook –Gregory K. McMillan, Douglas M. Considine, Mc Graw Hill
2. A Course in Electrical and electronics Measurements and Instrumentation–A. K. Sawhney, Puneet Sawhney,Dhanpat Rai & Co.
3. A Course in Mechanical Measurements andInstrumentation & Control –A.K. Sawhney, Puneet Sawhney, Dhanpat Rai & Co.
4. Industrial Instrumentation and control –S.K.Singh, Mc Graw Hill
5. Measurement Systems: Application and Designs –Ernest O Doebelin, Mc Graw Hill

Semester III

INS3COR06 - Transducers and Signal Conditioners

Credits-4 (Theory 3 + Practical 1)

Contact hours – 54

PSO6, CL-An,C,KC-C,P

CO 1

- Familiarize different types of transducer and different input system.
- Study the dynamic response of system.

CO 2

- To study various types of signal conditioners like modulator, filter etc.

CO 3

- Familiarize different types of display devices and its applications.

CO 4

- Understand various types of recorders and printers.

Module I

Transducers

Transducers and classification (only basic idea)

Transfer function, dynamic response- zero, first, second order, standard input signals (only basic idea)

[16hours]

Module II

Signal conditioners

Rectifiers, bridge circuits (A.C. and D.C. bridges),active and passive filters, instrumentation amplifiers, ADC, DAC.

Inverting and non-inverting amplifiers, voltage follower, adder, subtractor, differentiator, integrator, comparator, sample and hold circuits, voltage to current, current to voltage. Modulation, need of modulation, types. (only basic idea)

[18 hours]

Module III

Display devices

Seven segment, dot matrix, CRT, LED, LCD (principle, construction and working, advantages and disadvantages)

[8 hours]

Module IV

Recording devices

Strip chart recorders, LVDT recorders, circular chart recorders, XY recorders, Magnetic recorders, recorder selection for particular application, objectives and requirements of recording data.

Printers-dot matrix, inkjet printers, laser printers

[12 hours]

Reference Books:

1. Process/Industrial Instruments and Controls Handbook –Gregory K. McMillan, Douglas M. Considine, Mc Graw Hill
2. A Course in Electrical and electronics Measurements and Instrumentation–A. K. Sawhney, Puneet Sawhney,DhanpatRai & Co.
3. A Course in Mechanical Measurements And Instrumentation & Control –A. K. Sawhney, Puneet Sawhney, Dhanpat Rai & Co.
4. Industrial Instrumentation and control –S.K.Singh, Mc Graw Hill
5. Measurement Systems: Application and Designs –Ernest O Doebelin, Mc Graw Hill
6. Op-Amps and Linear Integrated Circuits –RamakantA. Gayakwad , PHI

Semester IV

INS4COR07-Process Control Instrumentation

Credits-4 (Theory 3 + Practical 1)

Contact hours-54

PSO5, PSO9,CL-U,Ap,KC-F,P

CO 1

- Introduce a process and gain the knowledge of a controller in process.
- This course develops the students approach to identify different Control system components like Hydraulic, Pneumatic, Electrical and Electronic

- To make the students understand all the processes involved in the industries, the various unit operations and be able to apply control schemes to these processes to get the output with desired specifications.

CO 2

- To study the process characteristics and parameter.
- Introduction to different controller modes.

CO 3

- To study different analog and digital controller modes in process controller.

CO 4

- Understand different process controllers for process variables.
- To introduce different types of tuning methods.
-

Module I

Introduction

Process control principle, block diagram, identification of elements, control system evaluation, Units, standards and definitions, p& I diagram (basic idea and description).

Final control

Final control operation, signal conversions, analog and digital electrical signals, pneumatic signals, actuators, electrical, pneumatic and hydraulic actuators, control elements, mechanical, electrical and fluid valves, control valves. (basic idea and principle only).

[12 hours]

Module II

Controller principles

Process characteristics, control system parameters, controller modes, discontinuous controller modes-two position mode.

Continuous controller modes-proportional control mode, integral control mode, derivative control mode.

Composite control modes- PI,PD and PID control modes. Design guidelines (basic idea and principle only).

[17 hours]

Module III

Analog controllers

General features, electronic and pneumatic controllers, mode implementation, design consideration (explanation only about electronic controllers)

Digital controllers

Digital electronic methods, simple alarms, multivariable alarms, computer in process control, programmable controllers, data logging, supervisory control (basic idea and principle)

[11 hours]

Module IV

Discrete state process control, relay controllers, introduction to PLC (basic idea and principle).

Process Control types-open loop, closed loop, feed forward, cascade, ratio control (basic principle). Control loop tuning (only basic idea).

[14 hours]

Reference Books:

1. Process Control Instrumentation –Curtis D. Johnson
2. Chemical Process Control -George Stephenopoulos
3. Automatic Process Control -Donald P. Eckman
4. Process Control-Peter Harriot, TMH
5. ProcessSystems Analysis and Control - D R Coughanowr, McGraw Hill.
6. Instrumentation handbook-process control -B.G.Liptak, Chilton

Semester IV

INS4COR08 - Bio Medical Instrumentation

Credits-4 (Theory 4)

Contact hours – 90

PSO5,CL-U,Ap,KC-F

CO 1

- To make the students acquainted with safety requirements in biomedical field.
- Introduction to biology basics.
- Understand the various types of electrodes used in biomedical

CO 2

- Identify various Biopotential and their specifications in terms of amplitude and frequency using different diagnostic tool like ECG, EEG and EMG.

CO 3

- To know about direct and indirect blood pressure measurement

CO 4

- Gain the knowledge of biomedical instruments used for to protect the life of patients
- To analyze the hazards and its safety precautions

Module I

Introduction

General perspective including objectives– an overview of safety requirements. biomedical instruments, components introduction to transducers and its applications, safety in bio-instrumentation.

Electrodes

surface electrodes, needle electrodes, micro electrodes, metal plate electrode, floating electrode, disposable electrode.

[30 hours]

Module II

Electrical activity of heart, ECG, typical ECG and characteristics, ECG as a diagnostic tool, monitoring scheme, lead system. EEG-typical EEG and characteristics-significance-lead system. Electromyogram.

[23 hours]

Module III

Blood pressure measurement.
Direct measurements - harmonic analysis of blood pressure waveform, , heart sounds, phonocardiography.
Indirect blood pressure measurement-electromagnetic blood flow meters, ultrasonic blood flow meters, sphygmomanometer.
[**20hours]**

Module IV

Hemodialysis, ventilators, infant incubators, cardiac pacemakers, defibrillators, lasers in bio-medicine.
Electrical safety
Physiological effects of electricity, micro and macro shock hazards, patient safety considerations in power
distribution and equipment design.
[17hours]
Reference Books:

1. Handbook of Biomedical Instrumentation-R.S Khandpur, Tata Mc-GrawHill
2. Medical instrumentation-application and design -Webster J.G, John Wiley
3. Biomedical Instrumentation and Measurements -Leslie Cromwell, Fred J. Weibell and Erich A Pferffer ,Prentice Hall of India, 1990

Semester VI

INS6COR09 - Microprocessors and Microcontrollers

Credits-4 (Theory 3 + Practical 1)

Contact hours – 54

PSO7, PSO11, CL-U, Ap , C, KC-P

CO 1

- To make the students understand the fundamentals of 8085.
- Students should understand the working of these systems and should be able to determine hardware and software

CO 2

- Understand the concept of 8086 processor.
- To make the students should understand the working of these systems and should be able to determine hardware.

CO 3

- Students should hardware and software interfacing with real time systems.
- They should further understand how to design any application based on these systems.

CO 4

- To make the students understand the fundamentals of 8051 microcontroller.
- Students should understand the working of these systems and should be able to determine hardware and software.

Module I

Introduction to 8085 Architecture

Block diagram, Address Bus, Control Bus, Data Bus, Need to multiplex address and data bus. Memory organization, Control and timing unit. ALU details. Registers, Flags, memory mapped I/O and I/O mapped I/O.

Instruction set of 8085-addressing modes, Intel 8085 instructions.

[17 hours]

Module II

Microprocessor 8086

Register organization of 8086, architecture.

Signal description of 8086, physical memory organization, machine language instruction formats.

[14 hours]

Module III

Addressing modes of 8086, instruction set of 8086, assembler directives and operators.

Basic programs (addition, subtraction, multiplication, division, perfect square root), introduction top stack, interrupts and interrupt service routines, macros, timing and delays.

[12 hours]

Module IV

Microcontrollers Microprocessors and microcontrollers, Basic functional blocks of a microcontroller, Intel 8051 microcontroller, pins and signals of 8051, architecture of 8051.

Programming mode of 8051, instruction set of 8051 – machine cycles and timing diagram, addressing modes, classification of 8051 instructions, data transfer instructions, arithmetic instructions, logical instructions, program branching instructions, Boolean variable instructions

[11 hours]

Reference Books:

1. Microprocessors & Microcontrollers –A.Nagoor Kani, RBA publication
2. Microprocessor Architecture, Programming and Applications –Gaonkar
3. Microprocessors's and Applications –Mathur
4. Advanced Microprocessors and Peripherals –A.K. Ray, K.M. Bhurchandi, Mc Graw Hill

Semester VI

INS6COR10 - Industrial Automation

Credits-4 (Theory 3 + Practical 1)

Contact hours – 54

PSO8,CL-U,Ap,C,KC-P

CO 1

- To make the students understand the fundamentals of automation and various automation

CO 2

- Students should understand the working of these systems and should be able to determine hardware and software requirements of PLC.

- They should further understand how to design any application based on these systems.

CO 3

- To understand the working of SCADA systems and should study the hardware requirements of it.

CO 4

- To familiarize the working of DCS systems and should be able to determine hardware and its application

Module I

Introduction to computer control of process- need for computers in control system –block diagram of a computer control system.

Introduction to Industrial Automation, Role of automation in industries, Introduction to the types of manufacturing industries, Introduction to type of automation system, Benefits of automation. Introduction to Automation pyramid, Introduction to automation tools like PAC, PLC, SCADA, DCS.

[15 hours]

Module II

Programmable logic controller basics

Overview of PLC systems, parts of PLC, Input/Output modules, power supplies and isolators, Fundamental PLC wiring diagram, relays, switches, transducers , sensors.

Fundamentals of logic – Program scan – Relay logic – PLC programming languages – timers – counters – math instructions – data manipulation instructions – requirement of communication networks for PLC –connecting PLC to computer.

[11 hours]

Module III

SCADA

Definition – elements of SCADA system – history of SCADA, architecture, basic explanations.

Remote terminal unit (RTU), discrete control, analog control , master terminal unit , (MTU) , operator interface.

[14 hours]

Module IV

Distributed Control System

Basics DCS introduction, Various function Blocks, DCS components/block diagram, DCS Architecture of different makes, comparison of these architectures with automation pyramid.

DCS specification, latest trend and developments, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS and other automation tools.

[14 hours]

Reference Books:

1. The management of control system: Justification and Technical Auditing -N.E. Bhttiha, ISA
2. Computer aided process control -S.K.Singh, PHI.
3. Understanding Distributed Process Systems for Control-Samuel Herb, ISA.
4. Programmable Logic Controllers: Principles and Applications -Webb &Reis, PHI.
5. Introduction to Programmable Logic Controllers -Garry Dunning, Thomson Learning.
6. Distributed computer control for industrial automation -PpovikBhatkar, Dekkar Pub.
7. Computer Based Process control -Krishna Kant, PHI

8. Supervisory Control and Data Acquisition –Stuart Boyer A, Second Edition, ISA

Semester VI

Choice Based Course

INS6CBP01 - Analytical Instrumentation

Credits – 3 (Theory 3)

Contact Hours – 90

PSO4, PSO5,CL-U,An,KC-F

CO 1

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.

CO 2

- To study various spectroscopic techniques and its instrumentation.
- To study the concept of separation science and its applications.

CO 3

- Comprehend different types of Chromatography and its application.

Module I

Elements of an analytical instrument, electromagnetic radiation, electromagnetic spectrum, interaction of radiation with matter.

Laws relating to absorption of radiation, absorption instruments- source, filter, optical system, detecting system, display. Slit width, Sample holders (basic explanation)

[22hours]

Module II

UV and Visible spectroscopy, Single beam filter Photometers, double beam filter Photometers (principle, construction and working of basic parts)

IR Spectroscopy- radiation source, monochromators, detectors (principle, construction and working of basic parts).

Atomic absorption spectrophotometers- radiation sources, monochromators, detectors (principle, construction and working of basic parts).

[24hours]

Module III

Raman spectrometer –source, sample holder, spectrometer, detector, display (principle, construction and working of basic parts).

Mass spectrometer, NMR spectrometer, ESR Spectrometers (principle, construction and working of basic parts).

Radiochemical instruments, X-ray spectrometers (principle, construction and working of basic parts)

[26hours]

Module IV

Chromatography- basic definitions, gas chromatography (principle, construction and working of basic parts).

Liquid chromatography (principle, construction and working of basic parts).

[18 hours]

Reference Books:

1. Hand book of analytical instruments -Khanpur R.S., TMH
2. Instrumental method of analysis -Williard, Merrit, Dean & Settle, CBS
3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Thomson bookscole publications, 5th edition.
4. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition.
5. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company

6.Syllabi of Complementary Courses (Theory)

6.A. Complementary Physics for BSc Mathematics (Model 1)

Semester I
PHY1CMM01 – CLASSICAL MECHANICS
Credits - 3 (theory 2 + Practical 1)
Contact hours – 36

COURSE OUTCOMES				
C01	Understand the reference frames, and newton's laws	PS05	CL - U	KC – F
C02	Learn the theory of lagrangian formulation, and solve for fundamental examples	PS05	CL – U, Ap	KC – F, C
C03	Realize the concept of relativity	PS05	CL – U, An	KC – F, C
C04	Comprehend the conservation laws	PS05	CL – U	KC – F
C05	Examine the rigid body motion, and compute M.I. for various situations	PS05	CL – An, Ap	KC – C

Module I

Newtonian mechanics and Lagrangian formulation:

Reference frames – Cartesian, Plane polar, Cylindrical and Spherical polar co-ordinates. Newton's laws of motion. Inertial and non-inertial frames. Newton's universal law of gravitation. Kepler's laws. Limitations of Newtonian mechanics.

[Chapters 1 & 5, Book 1]

Lagrangian formulation- Constraints. Degrees of freedom and generalized coordinates. Lagrange's equations of motion (Derivation not required). Applications – Harmonic oscillator and simple pendulum.

[Chapter 6, Book 2]

[12 hours]

Module II

Relativity:

Galilean transformation. Electromagnetism and Galilean transformations. Postulates of special theory of relativity. Lorentz transformation equations - Time dilation and Length contraction, Relativity of simultaneity, Relativistic velocity addition, Relativistic mass-momentum. $E = mc^2$ relation - Massless particle.

[Chapter 10, Book 1][9 hours]

Module III

Conservation laws:

Conservation of linear momentum. angular momentum and torque. Conservation of angular momentum. Conservative forces - Conservative force as negative gradient of potential energy. Law of conservation of mechanical energy. Centre of mass and motion of centre of mass. System of variable mass - the rocket.

[Chapters 1 & 2, Book 1] [9 hours]

Module IV

Rotational motion:

Moment of inertia of a particle. Angular momentum of a rotating body. Torque on a rotating body. Rotational kinetic energy. Rigid body- Moment of inertia of a rigid body, Radius of gyration. Parallel and perpendicular axes theorem (for plane laminar body). Moment of inertia of a thin uniform rod, thin circular ring, disc and sphere. Fly wheel

[Chapter 10, Book 3] [9 hours]

Text books:

1. Classical mechanics, First edition,2009, G Aruldas, PHI Private Ltd.
2. Classical Mechanics, 1st Edition, K Sankara Rao, Prentice-hall of India Pvt. Ltd.
3. Mechanics, Eleventh edition, D S Mathur, S Chand & Company.

References:

3. Concepts of modern physics, Second Edition, 2010, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, Tata McGraw Hill Education Pvt. Ltd, New Delhi.
4. Mechanics, Second Edition, 2003, H S Hans& S P Puri, Tata McGraw Hill Education Pvt. Ltd.

Semester II
PHY2CMM02- Electricity and Optics
Credits 3 (Theory 2+ Practical 1)
Contact hours-36

Course Outcome	PSO	CL	KC
CO1: Understand the basics of current electricity and the role of resistors, inductors and capacitors in AC circuits.	PSO2	U, Ap	C, P
CO2: Understand the phenomenon of interference of light, interference in double slit, thin films, air wedge and Newton's rings and applications.	PSO2	U, Ap	C,P
CO3: Understand the phenomenon of Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at single sit, double slit, circular aperture and grating.	PSO2	U,Ap	C, P
CO4: Understand the phenomenon of polarization of light by reflection, refraction, double refraction, selective absorption and scattering.	PSO2	U	F,C

Module I

Electricity:

AC circuits-Peak value- Root mean square value –Effective value- Mean value-AC circuit containing pure resistance only- AC circuit containing pure inductance only- AC circuit containing capacitor only-AC circuit containing inductance - capacitance and resistance in series , parallel- acceptor circuit-rejector circuit-Resonance- Sharpness of resonance-Quality factor
[10 hours] [Book 1]

Module II

Interference:
Interference of light- Principle of superposition- conditions for maximum and minimum intensities-coherent sources- Interference by division of wave front and division of amplitude- Young's double slit experiment-Interference in thin films due to reflected light, Interference in thin films due to transmitted light, Air wedge, Newton's rings by reflected light - measurement of wavelength of sodium light by Newton's rings. Dielectric mirrors, Interference filters.

[10 hours] [Book 2]

Module III

Diffraction
Introduction- Fresnel diffraction- Fraunhofer diffraction- Fraunhofer Diffraction at a single slit-Fraunhofer Diffraction at double slit-Distinction between single slit and double slit diffraction patterns-Fraunhofer diffraction due to circular aperture, Theory of plane transmission grating- Determination of wavelength (normal incidence) – resolving power of a grating. Difference between interference and diffraction pattern.

[8 hours] [Book 2]

Module IV

Polarization:
Polarized and unpolarized light- plane of vibration –plane of polarization – Types of polarization, polarization by reflection- Brewster's law- Polarization by refraction-pile of plates, polarization by

double refraction- Calcite crystal and Nicol Prism -polarization by selective absorption- polaroids- law of Malus- polarization by scattering.

[8 hours] [Book 2]

Text Books:

1. Electricity and Magnetism,7th Edition, R Murugeshan,S Chand and Co.
2. A Text book of Optics- 25th revised edition,N. Subrahmanyam, Brijlal andM.N. Avadhanulu,S. Chand & Co.

Reference:

1. Optics- First Edition, Satya Prakash, Pragati Prakashan.
2. Optics- Third edition, Ajoy Ghatak , Tata McGraw-Hill Publishing company Ltd .
3. Electricity and Magnetism- Second Edition- Brijlal & N Subrahmanyam (Ratan Prakashan Mandir,Agra).

Semester III

PHY3CMM03 - Properties of Matter, Thermodynamics and Statistical Physics

Credits 4 (Theory 3+ Practical 1)

Contact hours-54

Course Outcome	Programme Specific Outcome	Cognitive Level	Knowledge Category
CO1: Understand the elastic properties of matter and learn how Young's modulus and bulk modulus can be measured	PSO2	U, Ap	C, P
CO2: Understand the concept of viscosity of a liquid, learn how to measure it and study it's variation with temperature and pressure.	PSO2	U, Ap	C
CO3: Understand the concept of surface tension of a liquid, learn how to measure it.	PSO2	U, Ap	C,P
CO4: Understand the basics of thermodynamics, laws of thermodynamics, thermodynamic potentials and Maxwell's thermodynamic relations.	PSO2	U	C
CO5: Understand the basics principles of classical statistics and derive Maxwell-Boltzmann distribution law.	PSO2	U	C
CO6: Understand the basics principles of quantum statistics and derive Bose –Einstein distribution law for bosons and Fermi-Dirac Distribution law for fermions.	PSO2	U	C

Module I

Properties of matter

Elasticity-Stress- Strain-Hooke's Law-Young's modulus-Bulk Modulus – Torsion Modulus- Twisting couple of a cylinder-Determination of rigidity modulus-Torsional pendulum-Static torsion-Bending of beams-Bending moment-cantilever-uniform and non-uniform bending

Viscosity-Coefficient of viscosity-Poiseuille's equation for flow of a liquid through a horizontal capillary tube - Stoke's equation- Determination of viscosity by Stoke's method-Effect of temperature and pressure on viscosity of fluids.

Surface tension- Molecular theory of surface tension-surface energy-Excess pressure inside a liquid drop and soap bubble-Shape of liquid meniscus in a capillary tube - Angle of contact - Rise of liquid in a capillary tube.

[16 hours] [Book 1]

Module II

Thermodynamics 1:

Thermodynamic system, closed and open systems, thermodynamic variables, Zeroth law of thermodynamics and concept of temperature, isothermal process and adiabatic process, internal energy and heat of a system, first law of thermodynamics, work during isothermal and adiabatic process.

[8 hours] [Book2]

Module III

Thermodynamics 2:

Reversible and irreversible process- entropy and disorder- entropy change in reversible and irreversible process- Second law of thermodynamics-Third law of thermodynamics- unattainability of absolute zero of temperature- absolute scale of temperature.

Thermodynamic potentials- internal energy- enthalpy- Helmholtz free energy - Gibbs free energy - derivation of Maxwell's thermodynamic relations- Clasius-Clapeyron equation.

[10 hours] [Book2]

Module IV

Statistical mechanics:

Microstates and macro states of a system - Principle of equal a priori probability, concept of ensemble-classification of ensembles- thermodynamic probability and Boltzmann-Planck relation for entropy-Classical statistics and Maxwell-Boltzmann distribution law- thermodynamics of an ideal monoatomic gas

[12 hours] [Book 2]

Quantum Statistics:

Indistinguishability of identical particles and the need of Quantum statistics- Bosons and Fermions – Bose Einstein Distribution law, Fermi Dirac – Distribution law, Comparison of MB, BE and FD statistics, classical limit of Quantum statistics.

[8 hours] [Book 2]

Text books:

1. Elements of Properties of Matter – 11th edition,D S Mathur, S Chand and Company Ltd.
2. Heat Thermodynamics and Statistical physics, First Edition 2010,BrijLal, N. Subrahmanyam, P. S. Hemne- S.Chand & Company Ltd.

Semester IV

PHY4CMM04 -Quantum Mechanics, Nuclear Physics and Particle Physics

Credits 4(Theory 3+ Practical 1)

Contact hours-54

Course Outcome	PSO	CL	KC
CO1: Understand the development of old quantum theory and explanation of blackbody radiation , photoelectric effect and Compton effect based on it.	PSO2	U	F, C
CO2: Understand the concept of matter waves and uncertainty principle.	PSO2	U, Ap	C, P
CO3: Understand the basic concepts of quantum mechanics including Schrodinger equation, stationary states and its application to particle in a box.	PSO2	U,Ap	C,P
CO4: Understand the concept of spin of electron , spin orbit coupling .	PSO2	U	C
CO5 : Understand the origin of rotational and vibrational spectra of a linear diatomic molecule.	PSO2	U	C
CO6: Understand the structure and properties of nucleus, radio activity and fission and fusion of nuclei.	PSO2	U	C
CO7: Understand the classification of elementary particles and their interactions.	PSO2	C	F,C

Module I

Dual nature of matter:

Electromagnetic waves-The principle of superposition- Black body radiation- The ultraviolet catastrophe- Rayleigh-Jeans formula- Planck radiation formula- The photoelectric effect- Quantum theory of light- Photoelectric equation- X rays- X ray diffraction- Compton effect.

De Broglie waves- De Broglie wavelength- Waves of probability- Probability density- General wave formula- Phase and group velocities- Particle diffraction- Davisson-Germer experiment- Uncertainty principle.

[16 hours] [Chapter 2 & 3, Book 1]

Module II

Quantum Mechanics:

Wave function- State of a system- Time dependent Schrodinger equation- Linearity and superposition- Expectation values- Time independent Schrodinger equation- Stationary states- Eigen functions and eigen states- Eigen values and eigen functions for particle in a box- Electron spin- Pauli's exclusion principle- Spin-Orbit coupling and fine structure of Hydrogen atom- Rotational and vibrational energy levels of a linear diatomic molecule- Rotational and vibrational spectra.

[18 hours] [Chapters 5, 6 & 8, Book 1]

Module III

Nuclear physics:

Structure of nucleus-Binding energy and nuclear stability-radioactivity-alpha decay-beta decay-gamma decay-Radioactive decay law- Half life –radioactive series- Fission-Fusion-nuclear fusion in stars.
[10 hours] [Chapter 13, Book 1]

Module IV

Particle physics:

Elementary particles- - Interactions and particles- classification- Leptons- hadrons, Neutrinos and anti neutrinos, elementary particle quantum numbers- Symmetries and conservation laws, quarks-color, flavor, Field bosons, Higgs boson, History of the universe

[10 hours] [Chapter 13, Book 1]

Text Books:

1. Concepts of modern physics, Sixth Edition, A Beiser ,Shobhit Mahajan, S Rai Choudhury,Tata McGraw Hill Eduation Private Limited, New Delhi.

.

References:

1. Introduction to Quantum Mechanics,1st Edition,AjoyGhatak, Mac Millian Publishers.
2. Quantum Mechanics,Second Edition, G. Aruldhas,PHI.

6.B. Complementary Physics for BSc Chemistry (Model 1) & BSc Environmental Chemistry and Water Management (Model III)

Semester I

PHY1CMC01- Condensed matter physics

Credits 3 (Theory 2+ Practical 1) Contact hours- 36

Course Outcome	PSO	CL	KC
CO1: Understand different types of bonding in solids and the structure of crystalline solids.	PSO3	U	F, C
CO2: Understand the properties of intrinsic and extrinsic semiconductors and p-n junctions.	PSO2, PSO3	U	C
CO3: Understand dielectric polarization of matter in electric fields, piezo-electricity, pyro-electricity and ferro-electricity.	PSO2	U	F,C
CO4: Understand the origin of magnetism in materials and different types of magnetic materials.	PSO2	U	F,C
CO5: Understand the phenomenon of superconductivity and the applications of superconductors.	PSO2	U	F,C

Module I

Crystal physics:

Bonding in solids. Ionic bonding and properties of ionic solids. (Madelung constant not needed). Covalent bond and properties of covalent solids- Metallic bonds.Crystals and amorphous solids- Lattice points and space lattice-Unit cell and lattice parameters- Primitive cell-Crystal systems- The Bravaisspace lattices- Miller indices-X-ray diffraction- Bragg's law. (Qualitative ideas only)

[10 hours] [Chapters 3 & 4, Book 1]

Module II

Semiconductors:

The band structure of semiconductors- Intrinsic and extrinsic semiconductors- Electrical conductivity- Fermi level in an extrinsic semiconductor (General equation)- Conductivity of extrinsic semiconductors- Current flows in n-type and p-type semiconductors- Drift and Diffusion-Drift current - Diffusion current- The p-n junction- The potential barrier (Qualitative ideas only) - Biasing in p-n junctions.

[10 hours] [Chapter 10, Book 1]

Module III

Electric and magnetic properties of solids:

Electric dipole moment, Polarization, Concepts of electronic, ionic and dipolar polarizability, Piezo and Pyro electricity, Ferroelectricity and ferro electric domains(derivation not needed) , Atomic Theory of Magnetism, Origin of permanent magnetic dipole moment, Diamagnetism, Langevin's classical theory of Diamagnetism, Paramagnetism and Curie's law (Derivation not needed), Ferromagnetism(

No derivations needed), Ferromagnetic domains, Antiferromagnetism and ferrimagnetism(No derivations needed).

[10 hours]| Chapters 14 and 16, Book 3]

Module IV

Superconductivity:

Introduction-Meissner effect- Thermal properties- energy gap- Isotope effect- penetration depth- Type I and type II superconductors- BCS theory(Qualitative ideas only)- High temperature superconductors. Applications of superconductivity.

[6 hours] [Chapter 8, Book 1]

Text books:

1. Solid State physics, 6 thedition,S.O.Pillai, New Age international publishers.

2. Solid state physics, Third Edition, R.K Puri&V.K.Babber,S Chand& Co.

3. Solid State Physics, Structure and properties of materials,Third Edition, M.A.Wahab, Narosa Publications.

Semester II

PHY2CMC02- Electricity, Optics and Lasers

Credits 3 (Theory 2+ Practical 1) Contact hours- 36

Course Outcome	Programme Specific Outcome	Cognitive Level	Knowledge Category
CO1: Understand the basics of current electricity and the role of resistors, inductors and capacitors in AC circuits.	PSO2	U, Ap	C, P
CO2: Understand the basics of interference of light and apply it to measure the wavelength of light.	PSO2	U,Ap	C,P
CO3: Understand the phenomenon of diffraction and apply it to a grating for wavelength determination.	PSO2	U,Ap	C, P
CO4: Understand the phenomenon of polarization of light by reflection, double refraction, selective absorption and scattering.	PSO2	U	F,C
CO5: Understand the principle of LASER and learn different types of LASER s' and their applications.	PSO2	U	F,C

Module I

Electricity:

AC circuits-Peak value- Root mean square value –Effective value- Mean value-AC circuit containing pure resistance only- AC circuit containing pure inductance only- AC circuit containing capacitor only- AC circuit containing inductance - capacitance and resistance in series, parallel- acceptor circuit- rejecter circuit-Resonance- Sharpness of resonance-Quality factor.

[12 hours] [Book 1]

Module II

Interference:

Interference of light- Principle of superposition- conditions for maximum and minimum intensities- coherent sources- Interference by division of wave front and division of amplitude- Young's double slit experiment-Newton's rings by reflected light - measurement of wavelength of sodium light by Newton's rings.

Diffraction:

Introduction- Fresnel diffraction- Fraunhofer diffraction- Diffraction at a single slit-Diffraction at double slit-Distinction between single slit and double slit diffraction patterns-Theory of plane transmission grating- Determination of wavelength (normal incidence) – resolving power of a grating.

[13 hours] [Book 2]

Module III

Polarization:

Polarized and un-polarized light- plane of vibration –plane of polarization - polarization by reflection- Brewster's law- double refraction- polarization by double refraction -polarization by selective absorption- polarization by selective absorption- law of Malus- polarization by scattering.

[6 hours] [Book 2]

Module IV

Laser Physics:

Interaction of electromagnetic radiation with matter- stimulated absorption -spontaneous emission- stimulated emission-Einstein's coefficients- principle of laser-population inversion- Metastable states- Components of Laser- Types of lasers- Ruby laser-Neodymium YAG laser- He-Ne laser- Properties of laser beams- Application of laser beams.

[5 hours] [Book 2]

Text Books:

1. Electricity and Magnetism- R Murugeshan ,S Chand and Co.

2. A Text book of Optics- 25th Revised Edition, N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)

Reference:

1. Optics- Satyaprakash,Ratan Prakash Mandir.

2. Optics, Third edition, Ajoy Ghatak,Tata McGraw-Hill Publishing company Ltd.

3. Electricity and Magnetism—Brijlal& N Subrahmanyam, Ratan Prakashan Mandir,Agra.

Semester III

PHY3CMC03 - Properties of Matter and Thermodynamics

Credits 4 (Theory 3+ Practical 1)

Contact hours-54

	COURSE OUTCOME	PSO	CL	KC
CO1	To understand the concept of heat , zeroth and first law of thermodynamics to get knowledge of various thermodynamic processes and thermal conductivity.	PSO5	U, An, Ap	C, F
CO2	To understand, analyse and apply the concepts and facts about the basic ideas behind different heat engines	PSO5	U, An, Ap	C,F
CO3	To understand, analyse and apply the concepts and facts of entropy, thermodynamic potentials, maxwell's thermodynamic relations and phase transitions.	PSO5	U, An, Ap	C,F
CO4	To understand and analyse some of the basic concepts of statistical physics.	PSO5	U, An,Ap	C, F

Module I

Properties of matter:

Elasticity-Stress- Strain-Hooke's Law-Young's modulus-Bulk Modulus – Torsion Modulus- Twisting couple of a cylinder-Determination of rigidity modulus-Torsional pendulum-Static torsion-Bending of beams-Bending moment-cantilever-uniform and nonuniform bending

Viscosity-Coefficient of viscosity-Poiseuille's equation for flow of a liquid through a horizontal capillary tube - Stoke's equation- Determination of viscosity by stoke's method-Effect of temperature and pressure on viscosity of fluids.

Surface tension- Molecular theory of surface tension-surface energy-Excess pressure inside a liquid drop and soap bubble-Shape of liquid meniscus in a capillary tube - Angle of contact - Rise of liquid in a capillary tube.

[16 hours] [Book]

Module II

Thermodynamics 1:

Thermodynamic system, closed and open systems, thermodynamic variables, Zeroth law of thermodynamics and concept of temperature, isothermal process and adiabatic process, internal energy and heat of a system, first law of thermodynamics, work during isothermal and adiabatic process, applications of first law of thermodynamics- Mayer's equation for ideal gas.

[10 hours] [Book]

ModuleIII

Thermodynamics 2:

Reversible and irreversible process- entropy and disorder- entropy change in reversible and irreversible process- Second law of thermodynamics- heat engine- Carnot engine- Carnot cycle- expression for efficiency of Carnot engine- Carnot refrigerator-Third law of thermodynamics- unattainability of absolute zero of temperature.

Thermodynamic potentials- internal energy- enthalpy- Helmholtz free energy - Gibbs free energy - derivation of Maxwell's thermodynamic relations – Clausius-Clapeyron equation- Latent heat.

[14 hours] [Book]

Module IV

Statistical mechanics:

Microstates and macrostates of a system- concept of ensemble- classification of ensembles- thermodynamic probability and Boltzmann-Planck relation for entropy- Classical statistics and Maxwell-Boltzmann distribution law for ideal gas- thermodynamics of an ideal monoatomic gas- indistinguishability of identical particles and the need of Quantum statistics- classical limit of Quantum statistics.

[14 hours] [Book]

Text book:

1. Elements of Properties of Matter – 11th edition, D S Mathur, S Chand and Company Ltd.
2. Thermodynamics and Statistical physics- Revised edition 2010,BrijLal, N. Subrahmanyam, P. S. Hemne- S.Chand& Company Ltd.

Semester IV

PHY4CMC04- Quantum Mechanics and Nuclear Physics

Credits- 4 (Theory 3+ Practical 1) Contact hours- 54

Course Outcome	PSO	CL	KC
CO1: Understand the development of old quantum theory and explanation of blackbody radiation , photoelectric effect and Compton effect based on it.	PSO2	U	F, C
CO2: Understand the concept of matter waves and uncertainty principle.	PSO2	U, Ap	C, P
CO3: Understand atomic structure based on Bohr model and the origin of spectrum.	PSO2	U, Ap	C, P
CO4: Understand the basic concepts of quantum mechanics including Schrodinger equation, stationary states and its application to particle in a box.	PSO2	U,Ap	C,P
CO5: Understand the concept of spin of electron , spin orbit coupling .	PSO2	U	C
CO6 : Understand the origin of rotational and vibrational spectra of a linear diatomic molecule.	PSO2	U	C
CO7: Understand the structure and properties of nucleus, radio activity and fission and fusion of nuclei.	PSO2	U	C

CO8: Understand the classification of elementary particles and their interactions.	PSO2	C	F,C

Module I

Particle properties of waves:

Electromagnetic waves-The principle of superposition- Black body radiation- The ultraviolet catastrophe- Rayleigh-Jeans formula- Planck radiation formula- The photoelectric effect- Quantum theory of light- Photoelectric equation- X rays- X ray diffraction- Compton effect.

[Book 1, Chapter 2]

Wave properties of particles De Broglie waves- De Broglie wavelength- Waves of probability- Probability density- General wave formula- Phase and group velocities- Particle diffraction- Davisson-Germer experiment- Uncertainty principle.

[Book 1, Chapter 3] [15 hours]

Module II

Atomic structure

The Nuclear atom- Electron orbits- Energy of hydrogen atom- Failure of classical physics- Atomic spectra- The Bohr atom- Bohr radius- Energy levels and spectra- Origin of line spectra in Hydrogen atom- Correspondence principle- Nuclear motion- Atomic excitation-Franck-Hertz experiment.

[12 hours] [Book 1, Chapter 4]

Module III

Quantum Mechanics:

Wave function- State of a system- Time dependent Schrodinger equation- Linearity and superposition- Expectation values- Time independent Schrodinger equation- Stationary states- Eigen functions and eigen states- Eigen values and eigenfunctions for particle in a box- Electron spin- Pauli's exclusion principle- Spin-Orbit coupling and fine structure of Hydrogen atom- Rotational and vibrational energy levels of a linear diatomic molecule- Rotational and vibrational spectra.

[15 hours] [Book 1, Chapters 5, 6 & 8]

Module IV

Nuclear and particle physics:

Structure of nucleus-Binding energy and nuclear stability-radioactivity-alpha decay-beta decay-gamma decay- Radioactive decay law- Half life –radioactive series- Fission-Fusion-nuclear fusion in stars. Elementary particles- - Interactions and particles- classification-Leptons and hadrons-elementary particle quantum numbers – quarks-color.

[12 hours] [Book 1, Chapter 13]

Text Book:

1. Concepts of modern physics, Sixth Edition, A Beiser ,Shobhit Mahajan, S RaiChoudhury,Tata McGraw Hill Eduation Private Limited, New Delhi.

Reference

1. Introduction to Quantum Mechanics, 5 th Edition,AjoyGhatak.

2. Quantum Mechanics, Second Edition,G. Aruldhas, PHI.

6.C. Complementary Electronics for BSc Physics-Instrumentation (Model III)

Semester I

INS1CMP01- Basic Electronics

Credits –3(Theory 2+ Practical 1)

Contact hours- 36

PSO 2; CL-U, Ap,; KC- C

CO 1

- To introduce resistors, capacitors and inductors as examples of passive components

CO 2

- To learn techniques of solving circuits involving different active and passive elements.
- Understand the behavior of different circuits and their response using various circuit analysis tools and theorems

CO 3

- To introduce the students about the semiconductor devices.
- To introduce diodes as simple semiconductor components.
- To study the characteristics and operation of rectifiers and filter circuits

CO 4

- To introduce transistors as simple semiconductor components.
- To understand the operation of the various bias circuits of BJT.

Module I: **Introduction to circuit components**

Resistor - General information such as symbols, colour codes, types, variable resistors, potentiometers, thermistors, LDRs, VDRs, technical specifications like voltage rating; Capacitors - General information

such as symbols, colour codes, types, fixed and variable Capacitors, Specifications, Voltage Rating; Inductors - symbols, types, such as air core, iron core, chocking core, frequency response; Relays – symbols, types, Application area; Microphone & Speaker; Transducers

[6 hours] [Book 1]

Module II: **Network analysis**

Circuit elements - Power Sources, Nodes, Mesh; Equivalent resistance, Delta Wye conversions; Network Theorems - Kirchoff's laws, Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem.

[14 hours] [Book]

Module III: **Semiconductor Diode Devices and their applications**

Semiconductors- Energy bands in semiconductors, Intrinsic and Extrinsic semiconductors- P type and N type semiconductors, Majority and minority carriers- PN junction, Properties of PN Junction, Biasing- V-I Characteristics of PN Junction-Semiconductor Diode-Zener Diode, Zener diode as voltage regulator. Half Wave Rectifier- Full Wave Rectifier, Bridge Rectifier (Efficiency and Ripple Factor with derivation) -Filter Circuits- Advantages and use of filters-Shunt capacitor filter, LC filter, RC filter Clipper, Clamper. LEDs- Multi color LED, Applications of LED, Schottky diode, Tunnel diode-Photo Diode, Solar cell, Varactor Diode, Principle of operation and Characteristics.

[14 hours] [Book 2]

Module IV: **Transistors**

Transistor - PNP and NPN transistors; Transistor characteristics in the three configurations CE, CB, CC; Current gain α, β and their relation; Amplifying action; Faithful amplification criteria; BJT factors contributing to Thermal Stability, Stability factor, Operating Point; Biasing and its need; Biasing types - Voltage Divider Bias, Base resistor feedback, Potential divider Bias.

[8 hours] [Book 3]

Text Book:

1. Basic Electronics, Theraja
2. Electronic Principles, Malvino
3. Principles of Electronics. V. K Mehta & Rohit Mehtha.

Reference:

1. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky

Semester II

INS2CMP02-Amplifiers and Oscillators

Credits – 3 (Theory 2 + Practical 1)

Contact hours – 36

PSO 2; CL-U, Ap,; KC- C

CO1:

- To study of transistor as an amplifier.

CO 2:

- To familiarize the students about the feedback amplifiers.
- To understand the effects of negative feedback on amplifier circuits.
- Observe the effect of negative feedback on different parameters of an amplifier and different types of negative feedback topologies.

CO 3:

- To familiarize the students about oscillators.

CO 4:

- Develop the ability to understand the design and working of FET amplifiers.
- To understand the operation of the various bias circuits of MOSFET and analyze and design MOSFET bias circuits.

Module I: **Transistor Amplifier**

Amplifier classification based on operating point, frequency of operation, coupling element;
Single stage CE amplifier with voltage divider bias, ac and dc analysis; voltage gain, current gain, power gain, input impedance, output impedance.

[6 hours] [Book]

Module II: **Feedback Amplifiers**

Principles of feedback circuit; Advantages of negative feedback - Stabilization of gain, Reduction of non linear distortion- Effect of feedback on input and output resistances; Four feedback topologies - voltage amplifier, current amplifier, transconductance amplifier, transresistance amplifier, with examples.

[8 hours] [Book]

Module III: **Oscillators**

Feedback requirements of Oscillators, Barkhausen criteria for Oscillations and basic oscillator analysis, Phase Shift Oscillator, Hartley Oscillator, Collpitt's Oscillator, Piezoelectric Crystal Oscillator.
[10 hours] [Book]

Module IV: **Field effect transistor**

FET – Principle, types; JFET – Construction, working principle, Characteristics; FET vs BJT; JFET as Amplifier - operating point; JFET biasing - fixed bias, Self-bias, voltage divider bias; MOSFET – Construction and working principle, MOSFET types – D and E, Characteristics.

[8 hours] [Book]

Reference:

1. Principles of Electronics, V. K. Mehta, Rohith Mehta
2. A Textbook of Applied Electronics, R. S. Sedha
3. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky

Semester III

INS3CMP03- Communication Electronics

Credits –4 (Theory 3+ Practical 1)

Contact Hours- 54

PSO 2; CL-U, Ap ; KC- C

CO 1

- To introduce students the concept and theory of signals and systems needed in telecommunication engineering fields.
- The fundamentals of basic communication system, types of noise affecting communication system and noise parameters.

CO 2

- To introduce students to various modulation and demodulation techniques of analog communication.
- To analyze different parameters of analog communication techniques.

CO 3

- Aim is to identify the number system and conversion.
- To familiarize the students about different modulation techniques.

CO 4

- To learn the basic elements of communication networks and its terminology.

- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.

Module I: **Introduction to Communication**

Basic communication system – information source, coding, channel (bound and unbound), noise, decoding, information destination; EM spectrum – bands, properties and typical uses in each band.

[12 hours] [Book]

Module II: **Analog Modulation**

Modulation and its needs; Types of sinusoidal modulations – Amplitude modulation and Angle modulation; AM – Principle, mathematical expression, sidebands, bandwidth, modulation index, AM modulator, AM demodulator; FM – Principle, mathematical expression, sidebands, bandwidth, modulation index, FM modulator, FM demodulator.

[15 hours] [Book]

Module III: **Digital Modulation**

Number system and conversion– binary, octal, decimal, hexadecimal; Advantages of digital systems; AD conversion – sampling, quantization and encoding; Digital modulation– ASK, FSK, PSK, QAM; Pulse modulation – PAM, PTM, PCM

[12 hours] [Book]

Module IV: **Modern communication standards**

Communication Networks – Nodes, Endpoints, Topology; OSI model; Channel sharing – FDM, TDM, WDM, CDM; Familiarization of wired (FireWire, USB, I2C, CAN, HDMI, 1-Wire) and wireless standards (WiFi, Bluetooth, UWB, ZigBee, TransferJet, DVB-S); Mobile generations – 0G, 1G, 2G, 3G, 4G, 5G.

[15 hours] [Book]

Reference:

1. Electronic Communication Systems, George Kennedy, Bernard Davis
2. Electronic Communications Systems, Wayne Tomasi
3. Telecommunication Transmission Systems, Robert G. Winch
4. Digital Communications, John G. Proakis
5. Mobile Communications, Jochan Schiller
6. Mobile Cellular Communications, William C. Y. Lee

Semester IV

INS4CMP04-Operating System and Python Programming

Credits –4 (Theory 3+ Practical 1)

Contact Hours- 54

PSO 2; CL-U, Ap; KC- C

CO 1

- To introduce operating system as a resource manager, its evolutions and fundamentals.
- To help student understand concept of process and different management.
- To help student familiar with memory, file and I/O management policies.

CO 2

- To help student understand history and concept of Linux.
- To introduce bash programming and how it is used in different areas.

CO 3

- To familiarize the students about python.
- To introduce python syntax in detail.

CO 4

- Learn and understand the concepts of python in physics.

Module I: **Operating system concepts**

Computer organization – Input devices, output devices, CPU, Bus; Storage – registers, cache, primary memory, secondary memory; Operating systems – Objectives and Functions; Generations of Operating systems; Types of Operating Systems – Mainframe, Desktop, Multiprocessor, Distributed, Clustered, Batch processing, Multiprogramming, Multiuser, Real time, Embedded and Time sharing; OS components – Process management, Memory management, I/O management, File management, Protection system, Network management,Command interpreter; OS services – Process Execution, I/O operations, File manipulations, Communications, Error detection and recovery, Resource allocation, Accounting, System Protection, System Calls, System call Execution.
[12 hours] [Book]

Module II: **Linux and bash programming**

History of Linux; Features of Linux; Differences between UNIX and Linux; Linux Architecture; Popular Flavors of Linux; Linux runlevels; Linux filesystem; Mounting and unmounting; Processes –

parent, child, zombie, orphan; Bash scripting – common bash commands used in filesystem handling, text file handling, process handling, job handling, piping and redirecting output, bash startup files.
[15 hours] [Book]

Module III: **Python preliminary**

Python and its advantages; Python interpreter – IDLE; Basic python syntax – comments, string operations, variable types, type casting, operators; Simple IO – print, input, loadtxt; Program control flow – conditional statements, loops.

[12 hours] [Book]

Module IV: **Python for physics (15 hours)**

Functions; Packages and modules – math, numpy, scipy; Lists – append, pop, map, sort; Arrays – Slicing, range function, linspace function; Tuples; Dictionary; Generating graphs – matplotlib, figure, plot, title, xlabel, ylabel, xlim, ylim, legend; Visual python – coordinates, objects, controls and parameters.
[15 hours] [Book]

Reference:

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, and Peter BaerGalvin
2. UNIX Systems for Modern Architectures, Curt Schimmel
3. Mastering UNIX shell scripting: Bash, Bourne, and Korn shell scripting for
4. programmers, system administrators and linux gurus, Randal K. Michael
5. UNIX shell programming, Stephan G.Kochan, Patrick Wood
6. Beginning Linux Programming, Neil Matthew, Richard Stones
7. Python in a nutshell, Alex Martelli
8. Computational Physics with Python, Dr. Eric Ayars
9. A Primer on Scientific Programming with Python, Hans Petter Langtangen

7.COs and Syllabi of Core Courses (Practical)

(A minimum of 60% experiments in the syllabus should be done and recorded in each practical course component to appear for the examination)

7.A.Course Outcomes and Syllabi for BSc-Physics (Model I)

[Common to BSc Physics-Instrumentation (Model III)]

Semester I

Course PHY1P01

	Course Outcome	PSO	CL	KC	Hours allotted
CO1	Familiarization of measuring instruments as follows and to measure physical constants of materials. Vernier Calipers - volume of a cylinder, sphere and a beaker Screw gauge - volume of a sphere and a glass plate Spherometer - thickness of a glass plate, radius of curvature of a convex surface and a concave surface Travelling microscope - radius of a capillary tube Multimeter – familiarization of measurements (resistance, potential difference, current) and checking of electronic components. Viscosity of a liquid -variable pressure head Spectrometer – familiarization of the instrument and measurement of angle of prism To determine g and velocity for a freely falling body using Digital Timing Technique To study the motion of a spring and calculate (a) spring Constant (b) g Symmetric compound pendulum - determination of radius of gyration (K) and acceleration due to gravity (g) Beam balance - mass of a solid (sensibility method) Surface tension - capillary rise method	PSO6	U, Ap	P	36

1. Vernier Calipers - volume of a cylinder, sphere and a beaker
2. Screw gauge - volume of a sphere and a glass plate
3. Spherometer - thickness of a glass plate, radius of curvature of a convex surface and a concave surface
4. Travelling microscope - radius of a capillary tube
5. Multimeter – familiarization of measurements (resistance, potential difference, current) and checking of electronic components.
6. Viscosity of a liquid -variable pressure head
7. Spectrometer – familiarization of the instrument and measurement of angle of prism
8. To determine g and velocity for a freely falling body using Digital Timing Technique
9. To study the motion of a spring and calculate (a) spring Constant (b) g
10. Symmetric compound pendulum - determination of radius of gyration (K) and acceleration due to gravity (g)
11. Beam balance - mass of a solid (sensibility method)
12. Surface tension - capillary rise method

Semester II

Course PHY2P02

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Cantilever- pin & microscope – determination of Young's modulus Carey Foster's Bridge - measurement of resistivity voltage variation with load. Conversion of galvanometer into voltmeter Viscosity - constant pressure head - coefficient of viscosity (η) of the liquid Spectrometer - refractive Index of prism material Hare's apparatus - comparison of liquid densities Bifilar pendulum - intensity of gravitational field	PSO6	U,Ap,An	P	24
CO2	To understand electronic components and design electronic experiments like Half wave rectifier with C filter - ripple factor variation with capacitance. Half wave rectifier with and without C filter – Study of V-I characteristics of photo diode Familiarization of CRO – measurement of amplitude and frequency of different wave forms Study of UJT characteristics	PSO4	U,Ap,An	P	12

1. Cantilever- pin & microscope – determination of Young's modulus
2. Carey Foster's Bridge - measurement of resistivity
3. Half wave rectifier with C filter - ripple factor variation with capacitance.
4. Half wave rectifier with and without C filter - voltage variation with load.
5. Conversion of galvanometer into voltmeter
6. Viscosity - constant pressure head - coefficient of viscosity (η) of the liquid
7. Spectrometer - refractive Index of prism material
8. Study of V-I characteristics of photo diode
9. Familiarization of CRO – measurement of amplitude and frequency of different wave forms
10. Hare's apparatus - comparison of liquid densities

11. Study of UJT characteristics
12. Bifilar pendulum - intensity of gravitational field

Semester III

Course PHY3P03

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Cantilever – Scale and Telescope - determination of Young's modulus Asymmetric Compound Pendulum - determination of K and g Spectrometer - refractive index of liquids – hollow prism Potentiometer - measurement of resistivity of a metallic wire Torsion pendulum - rigidity modulus Lee's disc method – thermal conductivity of a bad conductor	PSO6	U,Ap,An	P	18
CO2	To understand electronic components and design electronic experiments like I - V characteristics of PN diode and Zener diode I - V characteristics of LED Full wave rectifier with and without C filter - variation of ripple factor with capacitance value Full wave rectifier with and without C filter - voltage variation with load Gates - AND, OR, NOT, XOR (using transistor and diodes) - verification of truth table Study of LDR characteristics	PSO4	U,Ap,An	P	18

1. Cantilever – Scale and Telescope - determination of Young's modulus
2. Asymmetric Compound Pendulum - determination of K and g
3. Spectrometer - refractive index of liquids – hollow prism
4. I - V characteristics of PN diode and Zener diode

5. I - V characteristics of LED
6. Potentiometer - measurement of resistivity of a metallic wire
7. Full wave rectifier with and without C filter - variation of ripple factor with
1. capacitance value
8. Full wave rectifier with and without C filter - voltage variation with load
9. Gates - AND, OR, NOT, XOR (using transistor and diodes) - verification of truth table
10. Torsion pendulum - rigidity modulus
11. Study of LDR characteristics
12. Lee's disc method – thermal conductivity of a bad conductor

Semester IV

Course PHY4P04

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Non-uniform bending - pin and microscope method Bridge rectifier using diodes and C filter - ripple factor variation with capacitance and voltage variation with load, Spectrometer – prism - i-d curve, Potentiometer - calibration of ammeter, Searle's vibration magnetometer - magnetic moment Sonometer – verification of laws, measurement of density of solid	PSO6	U,Ap,An	P	18
CO2	To understand electronic components and design electronic experiments like Diode clamper - positive and negative, Verification of superposition and maximum power transfer theorems, Transistor characteristics - CE configuration.Characteristics of linear variable differential transformer (LVDT). Study of diac characteristics Sweep generator - using transistor	PSO4	U,Ap,An	P	18

1. Non-uniform bending - pin and microscope method
2. Bridge rectifier using diodes and C filter - ripple factor variation with capacitance and voltage variation with load
3. Spectrometer – prism - i-d curve
4. Potentiometer - calibration of ammeter
5. Searle's vibration magnetometer - magnetic moment
6. Diode clamper - positive and negative
7. Sonometer – verification of laws, measurement of density of solid
8. Verification of superposition and maximum power transfer theorems
9. Transistor characteristics - CE configuration.
10. Characteristics of linear variable differential transformer (LVDT).
11. Study of diac characteristics
12. Sweep generator - using transistor

Semester V

Course PHY5P05

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Fly Wheel – moment of inertia Uniform bending – Young's modulus - optic lever method Static torsion - rigidity modulus, Viscosity - Stoke's method, Melde's experiment - frequency of an electrically maintained tuning fork and verification of $\lambda 2$ – T law, A C sonometer - frequency of a.c, Liquid lens- refractive index of liquid, Spectrometer - resolving power of plane diffraction grating Conversion of Galvanometer into ammeter Ballistic galvanometer – measurement of small steady current. To record and analyze the temperature variation of a hot object as a function of time - thermocouple and suitable data acquisition system	PSO6	U,Ap,An	P	32
CO2	To understand electronic components and design electronic experiments like Study of triac characteristics	PSO4	U,Ap,An	P	4

1. Fly Wheel – moment of inertia
2. Uniform bending – Young's modulus - optic lever method
3. Static torsion - rigidity modulus
4. Viscosity - Stoke's method
5. Melde's experiment - frequency of an electrically maintained tuning fork and verification of λ^2 – T law
6. A C sonometer - frequency of a.c
7. Liquid lens- refractive index of liquid
8. Spectrometer - resolving power of plane diffraction grating
9. Study of triac characteristics
10. Conversion of Galvanometer into ammeter
11. Ballistic galvanometer – measurement of small steady current.
12. To record and analyze the temperature variation of a hot object as a function of time - thermocouple and suitable data acquisition system

Semester V

Course PHY5P06

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Spectrometer – grating - wave length of mercury spectrum, Spectrometer- prism -dispersive power, Liquid lens - optical constants of a convex lens, Air wedge - diameter of wire, Potentiometer - calibration of low range ammeter	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like Study of solar cell characteristics, Series LCR circuit analysis – resonant frequency and Q-factor, Temperature co-efficient of resistance by Platinum resistance thermometer, Study of SCR characteristics, To investigate the motion of coupled oscillators, Study of V-I characteristics of photo transistor, Circular coil - Variation of magnetic field along the axis	PSO4	U,Ap,An	P	20

1. Spectrometer – grating - wave length of mercury spectrum
2. Spectrometer- prism -dispersive power
3. Liquid lens - optical constants of a convex lens
4. Air wedge - diameter of wire
5. Potentiometer - calibration of low range ammeter
6. Study of solar cell characteristics
7. Series LCR circuit analysis – resonant frequency and Q-factor
8. Temperature co-efficient of resistance by Platinum resistance thermometer
9. Study of SCR characteristics
10. To investigate the motion of coupled oscillators.
11. Study of V-I characteristics of photo transistor.
12. Circular coil - Variation of magnetic field along the axis

Semester V

Course PHY5P07

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Optical fibre characteristics - numerical aperture., Seebeck effect – thermo emf with temperature, Spectrometer – prism - resolving power	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like Study of FET characteristics, Voltage regulation using Zener diode, Voltage multiplier - doubler and tripler., Regulated power supply using IC 741, Wave shaping R C circuits - integrator and differentiator, Diode clipper - positive, negative and biased, Half adder and full adder – using IC, Colpitt's oscillator – frequency measurement De Morgans theorem – verification using IC gates	PSO4	U,Ap,An	P	20

1. Study of FET characteristics
2. Voltage regulation using Zener diode
3. Voltage multiplier - doubler and tripler.
4. Regulated power supply using IC 741

5. Wave shaping R C circuits - integrator and differentiator
6. Diode clipper - positive, negative and biased
7. Half adder and full adder – using IC
8. Colpitt's oscillator – frequency measurement
9. De Morgans theorem – verification using IC gates.
10. Optical fibre characteristics - numerical aperture.
11. Seebeck effect – thermo emf with temperature
12. Spectrometer – prism - resolving power

Semester V

Course PHY5P08

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Spectrometer – grating - dispersive power, Spectrometer – prism – Cauchy's constants, Newton's rings - determination of wave length, Laser - determination of wave length using calibrated ruler, Single slit – diffraction using Laser Study of Peltier effect, Study of Lissajous figures using oscilloscope – frequency and phase measurements, Kundt's tube method – velocity of sound waves, Ballistic galvanometer – determination of high resistance by the method of leakage, Parallel LCR circuit analysis – resonant frequency and Q-factor	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like Thevenin's and Norton's theorem – verification, Phase shift oscillator- frequency	PSO4	U,Ap,An	P	20

1. Spectrometer – grating - dispersive power
2. Spectrometer – prism – Cauchy's constants
3. Newton's rings - determination of wave length.
4. Laser - determination of wave length using calibrated ruler.
5. Single slit – diffraction using Laser

6. Thevenin's and Norton's theorem - verification
7. Phase shift oscillator- frequency
8. Study of Peltier effect
9. Study of Lissajous figures using oscilloscope – frequency and phase measurements
10. Kundt's tube method – velocity of sound waves
11. Ballistic galvanometer – determination of high resistance by the method of leakage.
12. Parallel LCR circuit analysis – resonant frequency and Q-factor

Semester VI

Course PHY6P09

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Young's Modulus – Koenig's method, Torsion pendulum - n and I - using two identical masses, Spectrometer - small angled prism - refractive index of prism material (supplementary angle method), Field along the axis of circular coil - Moment of magnet (null method), Kater's pendulum – g, Determination of Planck's constant using LEDs of different colours, Laurent's half shade polarimeter - optical rotation of solutions	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like Determination of Boltzmann constant using V-I characteristic of PN diode	PSO4	U,Ap,An	P	4
CO3	To understand and perform programming using different languages to do numerical problems like Python Programming Conversion of variables from polar coordinates to Cartesian – 2D, Finding the roots of quadratic equation Simulation of freely falling body - tabulation of position, velocity andacceleration as a function of time. Calculation of the Madelung constant for NaCl	PSO5	U,Ap,An	C, P	16

1. Young's Modulus – Koenig's method
2. Torsion pendulum - n and I - using two identical masses
3. Spectrometer - small angled prism - refractive index of prism material (supplementary angle method)
4. Field along the axis of circular coil - Moment of magnet (null method).
5. Kater's pendulum - g
6. Determination of Boltzmann constant using V-I characteristic of PN diode
7. Determination of Planck's constant using LEDs of different colours.
8. Laurent's half shade polarimeter - optical rotation of solutions

Python Programming

9. Conversion of variables from polar coordinates to Cartesian – 2D
10. Finding the roots of quadratic equation
11. Simulation of freely falling body - tabulation of position, velocity andacceleration as a function of time.
12. Calculation of the Madelung constant for NaCl

Semester VI

Course PHY6P10

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Thermistor – Temperature coefficient of resistance, Fresnel's biprism method – wavelength of sodium light.	PSO6	U,Ap,An	P	4
CO2	To understand electronic components and design electronic experiments like Realization of basic gates from universal gates – using IC gates, BCD to 7 segment decoder (IC), Astable multivibrator – using transistor, Monostable multivibrator- using transistor, Monostable multivibrator – IC 555 and Op-Amp	PSO4	U,Ap,An	P	14
CO3	To understand and perform programming using different languages to do numerical problems like Python Programming Solution of equations by Newton - Raphson method. Generation of the Fibonacci sequence and Catalan sequence, Calculation of the nuclear binding energy B of an atomic nucleus with atomic number Z and mass number A using the semi-empirical mass formula is a formula. Two photon interference	PSO5	U,Ap,An	C, P	18

1. Realization of basic gates from universal gates – using IC gates
2. BCD to 7 segment decoder (IC)
3. Astable multivibrator – using transistor
4. Monostable multivibrator- using transistor
5. Monostable multivibrator – IC 555
6. Thermistor – Temperature coefficient of resistance
7. Fresnel's biprism method – wavelength of sodium light.
8. Op amp – logarithmic amplifier

Python Programming

1. Solution of equations by Newton - Raphson method.
2. Generation of the Fibonacci sequence and Catalan sequence
3. Calculation of the nuclear binding energy B of an atomic nucleus with atomic number Z and mass number A using the semi-empirical mass formula is a formula.
4. Two photon interference

Semester VI

Course PHY6P11

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Brewster's law: verification	PSO6	U,Ap,An	P	2
CO2	To understand electronic components and design electronic experiments like Regulated power supply – transistor and Zener diode, Regulated power supply – Using IC's - LM7805,7905,7809,7909,7812,7912, Op-amp - adder and subtractor, Design a CE amplifier of a given gain (mid-gain) using voltage divider bias, Amplitude modulation – IC 555 and high frequency transistor, Pulse width modulation - IC 555, Astable multivibrator – IC 555, Precision rectifier - half wave rectifier using op-amp, Light dimming/Motor speed control circuit using triac	PSO4	U,Ap,An	P	30
CO3	To understand and perform programming using different languages to do numerical problems like Python Programming To find the product of two matrices, Evaluate an integral using the trapezoidal rule	PSO5	U,Ap,An	C, P	4

1. Brewster's law: verification
2. Regulated power supply – transistor and Zener diode
3. Regulated power supply – Using IC's - LM7805,7905,7809,7909,7812,7912

4. Op-amp - adder and subtractor
5. Design a CE amplifier of a given gain (mid-gain) using voltage divider bias
6. Amplitude modulation – IC 555 and high frequency transistor
7. Pulse width modulation - IC 555
8. Astable multivibrator – IC 555
9. Precision rectifier - half wave rectifier using op-amp
10. Light dimming/Motor speed control circuit using triac

Python Programming

11. To find the product of two matrices
12. Evaluate an integral using the trapezoidal rule

Semester VI

Course PHY6P12

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand electronic components and design electronic experiments like D/A Converter using IC 4 - bit shift register, RS flip – flop (IC), JK flip - flop (IC), Schmitt trigger – IC 7414, Op - amp – inverter, non inverter and buffer, 8085 Microprocessor - BCD addition and subtraction, 8085 Microprocessor – multiplication of two eight bit numbers with result 16 bit., Hartley Oscillator –frequency	PSO4	U,Ap,An	P	18
CO2	To understand and perform programming using different languages to do numerical problems like Python Programming Solution of equations by bisection method, Calculation of the wavelengths of emission lines in the spectrum of the hydrogen atom, based on the Rydberg formula, Simulation of projectile –tabulation of position, velocity and acceleration as a function of time –plot trajectory in graph paper from tabulated values	PSO5	U,Ap,An	C, P	18

1. D/A Converter using IC
2. 4 - bit shift register
3. RS flip – flop (IC)
4. JK flip - flop (IC)
5. Schmitt trigger – IC 7414
6. Op - amp – inverter, non inverter and buffer
7. 8085 Microprocessor - BCD addition and subtraction
8. 8085 Microprocessor – multiplication of two eight bit numbers with result 16 bit.
9. Hartley Oscillator –frequency

Python Programming

1. Solution of equations by bisection method.
2. Calculation of the wavelengths of emission lines in the spectrum of the hydrogen atom, based on the Rydberg formula
3. Simulation of projectile –tabulationofposition,velocityandaccelerationasa function of time –plottrajectoryingraphpaperfromtabulatedvalues

References:

1. Properties of Matter - D.S. Mathur
2. Optics – Subramanyan & Brijlal
3. Electricity &Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, AsiaPublishing House.
8. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

7.B. Course Outcomes and Syllabi

(2nd Core Courses for BSc Physics-Instrumentation (Model III)]

(A minimum of 60% experiments in the syllabus should be done and recorded in each practical course component to appear for the examination)

Semester I

INS1P01-Basic Instrumentation

PSO 4,9,12; CL-U, Ap ; KC-C, F, P

CO1: To understand application of mechanical tools.

CO2: Ability to analyze the basic waveforms and different parameters.

CO3: Ability to study and analyze various theorems.

1. Familiarization with tools- measuring tape, hammer, screw driver, pliers, etc.
2. Calibration of given Vernier calipers
3. Calibration of given Screw gauge
4. A.C fundamentals-sinusoidal and non sinusoidal waves – finding amplitude, time period, etc.
5. AC through RLC (series)
6. AC through RLC (parallel)
7. DC circuit analysis – finding values of voltage across resistance
8. Thevenin's theorem
9. Kirchoff's Laws
10. Wheatstone's bridge

Semester II

INS2P02-Industrial Instrumentation

PSO 4, 5; CL-U, Ap ; KC- P

CO1: To train the students in the calibration and use of different measuring instruments.

CO2: To train the students in measuring different process variables like temperature, pressure.

1. Familiarization of pressure and temperature gauges
2. Pressure gauge calibration (dead weight tester)
3. Pressure switches
4. Temperature gauge calibration
5. Temperature switches
6. Measurement of strain using strain gauge
7. Determination of kinematic viscosity
8. Temperature measurement using thermistor
9. Temperature measurement using thermocouple

10. U tube manometer

Semester III
INS3P03- Signal Conditioners

PSO 6, 9; CL-U, Ap, An ; KC- P

CO1: To impart knowledge of design considerations of analog signal conditioning of components.

CO2: Design an analog signal conditioning circuit to provide a range of desired output voltages in respond to a certain range of input voltages.

1. Rectifiers
2. Filters
3. OP-AMP Inverting amplifier
4. OP-AMP Non- inverting amplifier
5. Adder using OP-AMP
6. Subtractor using OP-AMP
7. Differentiator using OP-AMP
8. Integrator using OP-AMP
9. OP-AMP Comparator
10. Instrumentation amplifier

Semester IV
INS4P04- Process Control Instrumentation

PSO 5, 6; CL-U, Ap ; KC- C, P

CO1: To make the students familiar with different process dynamics in Process industries and different control schemes.

CO2: To train the students in measuring different process variables like displacement , pH, temperature.

1. Design of proportional controller
2. Design of proportional integral controller
3. Temperature process station
4. Process level control
5. pH measurement
6. Process pressure control
7. Measurement of temperature using RTD
8. Measurement of pressure using strain gauge
9. Measurement of displacement using LDR
10. Measurement of displacement using LVDT

Semester VI

INS6P05-Microprocessor

PSO 11; CL-U, Ap, C ; KC- P

CO1: To expose students to the operation of typical microprocessor trainer kit.

CO2: To prepare the students to be able to solve different problems by developing different programs.

1. Addition of numbers
2. Subtraction of numbers
3. Multiplication of numbers
4. Division of numbers
5. Equal nibbles in series
6. Square root of a number
7. Factorial of a number
8. Even and odd numbers in a series
9. GCD of two numbers
10. LCM of two numbers

Semester VI

INS6P06- INDUSTRIAL AUTOMATION

PSO 8 ; CL-U, Ap, An, C ; KC- P

CO1: Students will be able to explain and apply the concept of electrical ladder logic and its relationship to programmed PLC instruction.

CO2: Students will be able to use timer, counter, and other intermediate programming functions.

1. Study of PLC
2. Implementation of logic gates PLC
3. Implementation of DOL starter using PLC
4. Switch and lamp problems
5. ON/OFF of motor using two push buttons
6. Two-way traffic control system
7. Operation of different conveyors on timely basis
8. Mixing of reagents in a simple plant
9. Automation a car parking system
10. Fire alarm system

8.COs and Syllabi of Complementary Courses (Practical)

8.A. Course Outcomes and Syllabi:

[Complementary Physics for BSc Model I (Mathematics and Chemistry) & BSc Env. Chemistry and Water Management (Model III)]

(A minimum of 60% experiments in the syllabus should be done and recorded in each practical course component to appear for the examination)

Semester I

Course PHY1CP01

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using basic measuring instruments like Measurements of length and depth using Vernier calipers Measurements of length and diameter using screw gauge Radius of a capillary tube - travelling microscope Density of a liquid - U-Tube and Hare's apparatus Viscosity of a liquid - variable pressure head Liquid lens - refractive index of glass using liquid of known refractive index Symmetric compound pendulum - radius of gyration and g, Spectrometer – familiarization of the instrument and measurement of angle of prism, Surface tension – capillary rise method, Beam balance – mass of a solid (sensibility method)	PSO6	U,Ap,An	P	36

1. Measurements of length and depth using Vernier calipers
2. Measurements of length and diameter using screw gauge
3. Radius of a capillary tube - travelling microscope
4. Density of a liquid - U-Tube and Hare's apparatus
5. Viscosity of a liquid - variable pressure head

6. Liquid lens - refractive index of glass using liquid of known refractive index
7. Symmetric compound pendulum - radius of gyration and g
8. Spectrometer – familiarization of the instrument and measurement of angle of prism
9. Surface tension – capillary rise method
10. Beam balance – mass of a solid (sensibility method)

Semester II

Course PHY2CP02

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using, Asymmetric Compound Pendulum - determination of K and g, Coefficient of viscosity – constant pressure head (Poiseuille's method)., Spectrometer - refractive index of prism material, Torsion pendulum - rigidity modulus, Cantilever - pin & microscope – Young's Modulus, Laser - determination of wave length using calibrated ruler, Sonometer – verification of laws, Potentiometer - calibration of low range voltmeter	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like I-V Characteristics of a semiconductor diode, Construction of half wave rectifier with and without C filter – ripple factor and voltage variation with load	PSO4	U,Ap,An	P	20

1. Asymmetric Compound Pendulum - determination of K and g
2. Coefficient of viscosity – constant pressure head (Poiseuille's method).
3. Spectrometer - refractive index of prism material
4. I-V Characteristics of a semiconductor diode
5. Construction of half wave rectifier with and without C filter – ripple factor and voltage variation with load
6. Torsion pendulum - rigidity modulus

7. Cantilever - pin & microscope – Young's Modulus
8. Laser - determination of wave length using calibrated ruler
9. Sonometer – verification of laws
10. Potentiometer - calibration of low range voltmeter

Semester III

Course PHY3CPP03

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Cantilever – scale and telescope - determination of Young's modulus, Carey Foster's bridge - measurement of resistivity, Liquid lens - refractive index of liquid, Deflection and vibration magnetometer - m & Bh, Spectrometer – Prism – dispersive power, Potentiometer - calibration of low range ammeter, Non-uniform bending – Young's modulus — pin and microscope	PSO6	U,Ap,An	P	24
CO2	To understand electronic components and design electronic experiments like Full wave rectifier with and without C filter - voltage variation with load, Characteristics of Zener diode, Full wave rectifier with and without C filter - variation of ripple factor with capacitance value	PSO4	U,Ap,An	P	12

1. Cantilever – scale and telescope - determination of Young's modulus
2. Carey Foster's bridge - measurement of resistivity
3. Liquid lens - refractive index of liquid
4. Deflection and vibration magnetometer - m & B_h
5. Spectrometer – Prism – dispersive power
6. Potentiometer - calibration of low range ammeter
7. Full wave rectifier with and without C filter - voltage variation with load
8. Characteristics of Zener diode
9. Full wave rectifier with and without C filter - variation of ripple factor with capacitance value

10. Non-uniform bending – Young's modulus — pin and microscope

Semester IV

Course PHY4CP04

	Corse Outcome	PSO	CL	KC	Hours Allotted
CO1	To understand how to measure physical constants using Uniform bending – Young's modulus - optic lever method, Torsion pendulum (Equal mass method) - rigidity modulus and moment of inertia, Fly wheel - moment of inertia, Static Torsion - rigidity modulus, Spectrometer - grating – determination of wavelength, Air wedge - diameter of wire Single slit – diffraction using laser, Circular coil - variation of magnetic field along the axis	PSO6	U,Ap,An	P	16
CO2	To understand electronic components and design electronic experiments like Gates – AND, OR, NOT- verification of truth table using transistor and diodes, Regulated power supply – using IC's - LM7805,7905,7809,7909,7812,7912	PSO4	U,Ap,An	P	20

1. Uniform bending – Young's modulus - optic lever method
2. Torsion pendulum (Equal mass method) - rigidity modulus and moment of inertia
3. Fly wheel - moment of inertia
4. Static Torsion - rigidity modulus
5. Spectrometer - grating – determination of wavelength
6. Air wedge - diameter of wire
7. Gates – AND, OR, NOT- verification of truth table using transistor and diodes
8. Single slit – diffraction using laser
9. Circular coil - variation of magnetic field along the axis
10. Regulated power supply – using IC's - LM7805,7905,7809,7909,7812,7912

References:

1. Properties of Matter - D.S. Mathur

2. Optics – Subramanyan & Brijlal
3. Electricity &Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, AsiaPublishing House.
8. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

8.B. Course Outcomes and Syllabi:

[Complementary Electronics for BSc Physics-Instrumentation (Model III)]

(A minimum of 60% experiments in the syllabus should be done and recorded in each practical course component to appear for the examination)

Semester I

Course INS1CP01

PSO 2; CL-U, Ap ; KC- P

CO1: To understand electronic components and devices.

CO2: To make the students familiar with CRO and other laboratory equipments.

CO3: Prepare the students to make different rectifier circuits.

CO4: Study the V I characteristics of different diodes.

1. CRO familiarization- measurement of ac voltage, dc voltage- measurement offrequency.
2. PN junction diode characteristics.
3. Zener diode characteristics.
4. Half wave rectifier
5. Full wave rectifier with and without filter.
6. Voltage regulator using Zener.
7. Regulated Power Supply using IC.
8. Clippers - positive, negative, biased.
9. Clampers- positive, negative
10. Gates-AND, NOT and OR

Semester II

Course INS2CP02

PSO 2; CL-U, Ap; KC- P

CO1: Study different filter circuits and oscillators.

CO2: To familiarize characteristics of different semiconductor devices.

CO3: To familiarize characteristics of transistors.

1. RC integrator.
2. RC differentiator.
3. Common Base characteristics.
4. Single stage CE amplifier.
5. Hartley oscillator.

6. Colpitts oscillator.
7. JFET characteristics.
8. Emitter follower
9. Photodiode characteristics
10. MOSFET characteristics

Semester III

Course INS3CP03

PSO 9; CL-U, Ap ; KC- P

CO 1: To analyze different signal conditioners like modulators.

CO 2: Study the conversion techniques.

1. Amplitude Modulation
2. Frequency Modulation
3. Amplitude shift keying
4. Pulse amplitude modulation
5. Pulse width modulation
6. Amplitude demodulation
7. F to V converter
8. FSK modulation
9. Binary to decimal converter
10. PWM demodulation

Semester IV

Course INS4CP04

PSO 10; CL-U, Ap; KC- P

CO 1: To expose students to the working of python.

CO 2:To prepare the students to be able to solve different problems by developing different programs.

1. Print a set of numbers in Fibonacci series using bash script.
2. Bash script to check prime numbers.
3. Bash script to check for palindrome numbers.
4. Bash script to accept a number and print it in the reverse order.
5. Bash script to print factorial of a number.
6. Solving a system of linear equations in python.
7. Program to plot standing waves in a cavity using python.
8. Program to plot path of a projectile at different angles using python.
9. Program to convert between temperature scales using python.
10. Stokes' experiment – python program to calculate terminal velocity of freely falling object in a highly viscous medium.

Blue Print and Model of Question Paper

Course Name and Code: Methods of Physics – PHY1COR01

BLUE PRINT				
PROGRAMME: B.Sc. Physics & B.Sc. Physics Instrumentation				
Course Code: PHY1COR01		**Course Title: Methods of Physics**		
Number of Questions				
	A(mark: 1)	**B(marks: 5)**	**C(marks: 10)**	
Module 1	**3**	**2**	**1**	**6**
Module 2	**2**	**2**	**1**	**5**
Module 3	**5**	**3**	**1**	**9**
Module 4	**2**	**2**	**1**	**5**
Module 5	**-**	**-**	**-**	**-**
Total	**12**	**9**	**4**	**25**

MODEL QUESTION PAPER

PHY1COR01 METHODS OF PHYSICS

Time: 3 Hrs Max.marks: 60

Part A (Answer any *ten*, 1mark each)

1. Name any two ideas that revolutionized science.
2. What is pseudo science?
3. What is falsification?
4. What is meant by work function of a metal?
5. On what does de-Broglie wavelength of a particle depend?
6. Calculate modulus of the resultant of **a**= -**i** + 2**j** -3**k** and **b**= 5**i** –**j**
7. What do we mean by a pseudo vector?
8. Define angular momentum of a particle.
9. Scalar product of two non-zero vectors is zero. What does it mean?
10. What is the geometrical meaning of cross product of two vectors?
11. What do we understand from the statement that least count of a screw gauge is 0.01mm?
12. Define standard deviation.

10 x 1= 10 marks

Part B (Answer any *six*, 5 marks each)

13. Power of science is in its ability to predict. Explain.
14. Discuss the limitations of science.
15. Briefly discuss ultraviolet catastrophe. How was it resolved?
16. What is Compton effect? What does it reveal?
17. If **p**=**i** + **j** + **k**, **q**= **i** -**j** +2**k** and **r**= 3**i** -**j** + **k** are the edges of a parallelepiped, what is its volume and surface area?
18. An aeroplane is trying to fly due north at 200m/s and wind is blowing from west to east at 100m/s. Calculate the modulus and direction of the resultant velocity of the aeroplane.
19. Calculate the divergence, curl and Laplacian of the position vector in Cartesian system.
20. Write a note on significant digits?
21. How do we calculate error in sums, differences, products, ratios and exponents?

6 x 5= 30 marks

Part C (Answer any *two*, 10 marks each)

22. Explain what we mean by hypothesis, theory and law. Illustrate with suitable examples.
23. Show that, in a conservative field, the total mechanical energy of a particle is a constant of motion.
24. Describe Davisson-Germer experiment.
25. Discuss the sources of error in a measurement?

2 x 10= 20 marks

Printed and published by the Member Secretary on behalf of the Chairman, Academic Council, Maharaja's College
(Government Autonomous), Ernakulam –11