MAHARAJA'S COLLEGE

ERNAKULAM

(A Government Autonomous College affiliated to Mahatma Gandhi University)

CURRICULUM AND SYLLABUS - 2016 ADMISSION ONWARDS

for

Bachelor of Science (BSc)Programme in Physics

under

Choice Based Credit System (CBCS)

Acknowledgement

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Sri. Robin Francis, Assistant Professor
Smt. Sheeja V, Assistant Professor
Dr. Jijo P U, Assistant Professor
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AIMS AND OBJECTIVES

The Board of Studies in Physics (UG) recognizes that curriculum and syllabus play vital roles in shapingeducation. The committee is of the view that assessment should support andencourage the broad instructional goals such as basic knowledge of the discipline ofPhysics including phenomenology, theories and techniques, concepts and generalprinciples. This should also support the ability to ask physical questions and to obtainsolutions to physical questions by use of qualitative and quantitative reasoning andby experimental investigation. The important student attributes includingappreciation of the physical world and the discipline of Physics, curiosity, creativityand reasoned skepticism and understanding links of Physics to other disciplines andto societal issues should gave encouragement. With this in mind, we aim to provide afirm foundation in every aspect of Physics and to explain a broad spectrum ofmodern trends in physics and to develop experimental, computational andmathematics skills of students.

The syllabi are framed in such a way that it bridges the gap between the plus twoand post graduate levels of Physics by providing a more complete and logicalframework in almost all areas of basic Physics.

Course structure:

The UG programme in Physics must include (a) Common courses, (b) Core courses,(c) Complementary Courses and (d) Project. No course shall carrymore than 4 credits. The student shall select any Choice based course offered by thedepartment which offers the core courses, depending on the availability of teachersand infrastructure facilities, in the institution.

Courses:

The number of Courses for the restructured programme should contain 12compulsory core courses, two choice based courses from the frontier area of thecore courses and a project; 8 complementary courses, or otherwise specified, fromthe relevant subjects for complementing the core of study. There should be 10common courses, or otherwise specified, which includes the first and secondlanguage of study.

Scheme and Syllabus for BScprogrammes in Physics

Courses

There are two different types of courses in Physics programme. They are Physics-regular and Physics - Instrumentation programmes. The Physics-regular consists of common courses with 38 credits,core& complementary courses with 82 credits(including elective core courses). The programme Physics-Instrumentation consists of common courses with 8 credits,core & complementary courses with 112 credits.

Scheme of Courses

The different courses and their numbers are as the following

Physics-Regular		**Physics-Instrumentation**	
Courses	**No.**	**Courses**	**No.**
Common Courses	10	Common courses	2
Core courses	12	Core courses	10
Project	1	Project	1
Choice basedcore courses	2	Choice based core courses	2
		Second Core courses	10

		OJT(On Job Training)	1
Complementary courses	8	Complementary courses	8
Total	33	Total	34

Course Code:

Every course should be coded according to the following criteria.

The first three letters of the code indicate the name of programme (PHY for physics-regular & INS for physics-instrumentation). One digit to indicate the semester, followed by 3 letters to indicate course category-CMR for common courses, COR for core courses, CMP for complementary courses and CRE for choice based core courses. Last 2 digits to indicate course number. For example PHY1COR01 indicates Physics-regular,first semester, core course and course number is 1. For core practical courses letter P is used for course category and letters CP is used for complementary practical courses. For example, PHY1P01 indicates Physics-regular, first semester, core practical course and course number is 1.

Courses with credits:

	Physics-Regular		**Physics-Instrumentation**	
Courses	Credits	Total	Credits	Total
Core Courses	46		46	
Elective core courses	7		7	
Project	1		1	
2nd Core courses	Nil		30	
Total		54		84

Complementary courses I	14		14	
Complementary courses II	14		14	
Total		28		28
Common courses	38		8	
Total		38		8
Grand Total		120		120

Scheme of distribution of instructional hours for core courses:

Semester	Physics		Physics-Instrumentation	
	Theory	Practical	Theory	Practical
First semester	2	2	8	4
Second semester	2	2	8	4
Third semester	3	2	9	6
Fourth semester	3	2	9	6
Fifth semester	17	8	17	8
Sixth semester	17	8	17	8

Core Courses (Common for both Physics& Physics-Instrumentation)

Semester	**Title of the course with code**	**Number of hours per week**	**Number of credits**	**Total credits**	**Total hours/semester**
1	PHY1COR01- Methods of Physics Practical	2 2	2 1	3	72
2	PHY2COR02- Properties of Matter Practical	2 2	2 1	3	72
3	PHY3COR03- Basic Electronics Practical	3 2	3 1	4	90
4	PHY4COR04- Electricity, Magnetism& Electrodynamics Practical	3 2	3 1	4	90
5	PHY5COR05- Classical Mechanics Practical	3 2	3 1	4	90

	PHY5COR06- Thermal and Statistical Physics Practical	3 2	3 1	4	90
	PHY5COR07-Quantum Mechanics& Spectroscopy Practical	3 2	3 1	4	90
	PHY5COR08- Advanced Electronics* Practical	3 2	3 1	4	90
	PHY5CBP01- Choice based course I- Optics and Photonics	4	3	3	72
	PHY5D01- Project	1	1	1	18
6	PHY6COR09- Nuclear and Particle physics Practical	3 2	3 1	4	90
	PHY6COR10- Numerical methods and Computational Physics Practical	3 2	3 1	4	90
	PHY6COR11- Condensed Matter Physics Practical	3 2	3 1	4	90
	PHY6COR12- Special Theory of Relativity & Astrophysics* Practical	3 2	3 1	4	90
	PHY6CBP01- Choice based course II- Material Science & Nanotechnology	5	4	4	90

(* Only for Physics-Regular)

2nd Core courses for Physics-Instrumentation

Semester	Title of the course with code	Number of hours per week	Number of credits	Total credits	Total hours/Semester
1	INS1COR01- BasicsofMechanical Engineering	3	3	3	54
	INS1COR02- Basic Instrumentation Instrumentation Practical	3 2	3 1	4	90
2	INS2COR03- Basic Measurements	3	2	2	54

	INS2COR04- Industrial Instrumentation I Instrumentation Practical	3 2	2 1	3	90
3	INS3COR05- Industrial Instrumentation II	5	4	4	90
	INS3COR06- Transducers and Signal Conditioning Instrumentation Practical	3 2	3 1	4	90
4	INS4COR07- Process Control Instrumentation Instrumentation Practical	3 2	3 1	4	90
	INS4COR08- Biomedical Instrumentation	5	4	4	90
5	INS5COR09- Microprocessors and Microcontrollers Instrumentation Practical	3 2	3 1	4	90
	On Job Training	0	2	2	
6	INS6COR10- Industrial Automation Instrumentation Practical	3 2	3 1	4	90
	INS6CBP01- Elective core I (Physics-Instrumentation)	5	4	4	90

Choice based core courses for B Sc Physics:

1. PHY5CBP01- Optics and Photonics
2. PHY5CBP02-Medical Physics
3. PHY5CBP03- Renewable Energy and Energy Harvesting
4. PHY6CBP01 - Material Science and Nanotechnology
5. PHY6CBP02- Embedded systems: Introduction to Microcontrollers
6. PHY6CBP03- Applied Mathematical Physics

Choice based core courses for B Sc Physics-Instrumentation

1 INS6CBP01- Analytical Instrumentation
2 INS6CBP02- Ultrasonic and Optoelectronic Instrumentation
3 INS6CBP03- Power Plant Instrumentation

Complementary Courses

1. Physics for Mathematics

Semester	Title of the course with code	Numbers of hours per week	Number of credits	Total credits	Total hours/Semester
1	PHY1CMM01- Classical Mechanics Practical	2 2	2 1	3	72
2	PHY2CMM02- Electricity, Optics and Lasers Practical	2 2	2 1	3	72
3	PHY3CMM03-Properties of Matter and Thermodynamics Practical	3 2	3 1	4	90
4	PHY4CMM04- Quantum Mechanics & Nuclear Physics Practical	3 2	3 1	4	90

Physics for Chemistry

Semester	Title of the Paper with code	Number of hours per week	Number of credits	Total credits	Total hours/ Semester
1	PHY1CMC01- Condensed Matter Physics Practical	2 2	2 1	3	72
2	PHY2CMC02- Electricity, Optics and Lasers Practical	2 2	2 1	3	72
3	PHY3CMC03-Properties of Matter and Thermodynamics Practical	3 2	3 1	4	90
4	PHY4CMC04- Quantum Mechanics & Nuclear Physics Practical	3 2	3 1	4	90

Electronics for Physics – Instrumentation

Semester	Title of the paper with code	Number of hours per week	Number of credits	Total credits	Total hours/Semester
1	INS1CMP01- Basic Electronics Practical	2 2	2 1	3	72
2	INS2CMP02- Amplifiers & Oscillators Practical	2 2	2 1	3	72
3	INS3CMP03-Communication Electronics Practical	3 2	3 1	4	90
4	INS4CMP04- Operating system and Python Programming Practical	3 2	3 1	4	90

Examinations:

The evaluation of each course contain two parts:

i. **In-Semester Assessment** (ISA)
ii. **End-Semester Assessment** (ESA)

The ratio of ISA and ESA should be 1:4. For all courses grades are given on a ten point scale based on total percentage of marks as follows

Percentage of Marks	Grade	Grade Point(GP)
95 and above	SOutstanding	10
85 to below 95	A^+Excellent	9
75 to below 85	A Very Good	8
65 to below 75	A^- Good	7
55 to below 65	B^+ Above average	6
50 to below 55	B Average	5
40 to below 50	C Pass	4
Below 40	F Fail	0
	Ab Absent	0

Credit Point and Semester Grade Point Average

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

CP = C × GP, where C = Credit and GP = Grade Point

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

SGPA= $\frac{T}{T}$, where TCP = Total Credit Point and TC = Total Credit

Cumulative Grade Point Average (CGPA) of a programme is calculated using the formula

CGPA = $\frac{\Sigma(T \quad \times T \ )}{\Sigma(T \ )}$ shall be rounded off to two decimal places

Grades for different semesters and overall programme are given based on the corresponding CPA as follows

GPA	Grade
Equal to 9.5 and above	SOutstanding
Equal to 8.5 and below 9.5	A^+Excellent
Equal to 7.5 and below 8.5	A Very Good
Equal to 6.5 and below 7.5	A^-Good
Equal to 5.5 and below 6.5	B^+ Above average
Equal to 5.0 and below 5.5	B Average
Equal to 4.0 and below 5.0	C Pass
Below 4.0	F Failure

A separate minimum of 30% marks each for ISA and ESA (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, a separate minimum of Grade E is required for all the individual courses. Candidate who secures E Grade and above will be eligible for higher studies.

Marks Distribution

Marks for theory – End Semester Examination: 80

Marks for theory –In Semester Evaluation: 20

Components of Theory- In Semester Evaluation	Marks
Attendance	5
Assignment/Seminar/Viva	5
2 test papers (Average should be taken)	10
Total	20

Marks for Practical – End Semester Examination: 80 (Only in even semesters)

Marks for Practical – In Semester Evaluation: 20

(odd and even semesters combined annually)

Components of Practical – In Semester Evaluation	Marks
Attendance	4
Record (Marks awarded should be related to number of experiments recorded)	10
Viva/Working Model Projects	6
Total	20

Project Evaluation: (Maximum Marks 100)

Components of Project Evaluation	Marks
In- Semester Evaluation	20
Dissertation (End Semester)	50
Viva – Voce (End- Semester)	30
Total	100

Components of Internal Evaluation	Marks
Relevance and Contents	5
Analysis and Presentation	5
Pre- Submission Presentation and Viva	10
Total	20

Attendance Evaluation

(Minimum Attendance required is 75%)

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

% of Attendance	Marks for Practical
90 and above	4
85 – 89	3
80 – 84	2
75- 79	1

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

Pattern of Questions

Questions shall be set to assess knowledge acquired, standard application ofknowledge, application of knowledge in new situations, critical evaluation ofknowledge and the ability to synthesize knowledge. The question setter shall ensurethat questions covering all skills are set. He/She shall also submit a detailed schemeof evaluation along with the question paper.A question paper shall be a judicious mix of objective type, short answer type, short essay type problem solving type and long essay type questions. Differenttypes of questions shall be given different weights to quantify their range.

Pattern of Questions for End Semester examination

For theory

Type	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
Very short answer	10	8	1	8
Short answer	8	6	2	12
Short essays and problems	8	6	5	30
Essays	4*	2	15	30
Total	30	22		80

(* Questions in bunches of two)

Course Structure:

BSc Physics

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	2 2	2 1	3	72	3	1	4
	Complementary I(Chemistry/Statistics) Practical (If no practical 4hrs with 3 credits)	2 2	2 1	3	72	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	2 2	2 1	3	72	3	1	4
	Complementary I(Chemistr/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	3 2	3 1	4	90	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	3 2	3 1	4	90	3	1	4
	Complementary I(Chemistry/Statistics) Practical (If no practical 5 hrs with 4 credits)	3 2	3 1	4	90	3	1	4
	Complementary II(Mathematics)	5	4	4	90	3	1	4
5	PHY5COR05- Classical Mechanics Practical	3 2	3 1	4	90	3	1	4
	PHY5COR06- Thermal & Statistical Physics Practical	3 2	3 1	4	90	3	1	4
	PHY5COR07- Quantum Mechanics Practical	3 2	3 1	4	90	3	1	4

	PHY5COR08-Advanced Electronics Practical	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			
6	PHY6COR09-Nuclear & Particle Physics Practical	3 2	3 1	4	90	3	1	4
	PHY6COR10-Numerical methods & Computational Physics Practical	3 2	3 1	4	90	3	1	4
	PHY6COR11-Condensed Matter Physics Practical	3 2	3 1	4	90	3	1	4
	PHY6COR12-Special Theory of Relativity & Astrophysics Practical	3 2	3 1	4	90	3	1	4
	PHY6CBP01-Choice based courseII- Material Science & Nanotechnology	5	4	4	90	3	1	4

BSc Physics- Instrumentation

Se	Title of the Course	No. of	No. of Credit	Total Credit	Total hours/Semest	Exam Duratio	Weightage ratio

		hours per week	s	s	er	n	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	3 2	3 1	4	90	3	1	4
	PHY1COR01- Methods of Physics Physics Practical	2 2	2 1	3	72	3	1	4
	Complementary- Mathematics I	4	3	3	72	3	1	4
	Complementary- Electronics I Electronics Practical	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	2 2	2 1	3	72	3	1	4
	PHY2COR02- Properties of Matter Physics Practical	2 2	2 1	3	72	3	1	4
	Complementary- Mathematics II	4	3	3	72	3	1	4
	Complementary- Electronics II Electronics Practical	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	3 2	3 1	4	90	3	1	4
	PHY3COR03- Basic Electronics Physics Practical	3 2	3 1	4	90	3	1	4
	Complementary-	5	4	4	90	3	1	4

	Mathematics III							
	Complementary-Electronics III Electronics Practical	3 2	3 1	4	90	3	1	4
4	INS4COR07- Process Control Instrumentation Instrumentation Practical	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	3 2	3 1	4	90	3	1	4
	Complementary-Mathematics IV	5	4	4	90	3	1	4
	Complementary-Electronics IV Electronics Practical	3 2	3 1	4	90	3	1	4
5	INS5COR09-Microprocessors& Microcontrollers Instrumentation Practical	3 2	3 1	4	90	3	1	4
	PHY5COR05-Classical Mechanics Physics Practical	3 2	3 1	4	90	3	1	4
	PHY5COR06-Thermal& StatisticalPhysics Physics Practical	3 2	3 1	4	90	3	1	4
	PHY5COR07-Quantum Mechanics Physics Practical	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	PHY6COR09- Nuclear & Particle Physics Physics Practical	3 2	3 1	4	90	3	1	4

	PHY6COR10-Numerical methods and Computational Physics Physics Practical	3 2	3 1	4	90	3	1	4
	PHY6COR11-Condensed Matter Physics Physics Practical	3 2	3 1	4	90	3	1	4
	INS6COR10-Industrial Automation Instrumentation Practical	3 2	3 1	4	90	3	1	4
	INS6CBP01-Choice based course II-Analytical Instrumentation	5	4	4	90	3	1	4

SYLLABI OF COURSES

CORE COURSES

(Common for Physicsand Physics - Instrumentation)

Semester I

PHY1COR01- Methods of Physics

Credits- 3 (Theory 2+ Practical 1)

Contact hours-36

Module I: **Mathematical basis of physics**

Basic functions–linear, quadratic, trigonometric, hyperbolic, exponential, Gaussian, their derivatives and their visualization;Vector calculus – importance of calculus in physics, vector differentiation, gradient, divergence and curl, solenoidal and irrotational vectors, point functions;Vector integration – line, surface and volume integrations, Green's theorem, Gauss theorem and Stokes theorem (statements and basic idea) and physical interpretations, Eigen values and vectors, complex analysis – Euler's formula, de Moivre's theorem (no proof), n^{th}roots of a complex number.

Applications: Formulation, solution and visualization of the simple harmonic oscillator problem, damped harmonic oscillations, forced harmonic oscillations, wave equation and its solutions. DC and AC LCR circuit analysis using calculus and complex analysis.

[9 hours] [Books 1 - 6]

Module II: **Origin and evolution of modern physics**

History of the two pillars of modern physics – relativity and quantum mechanics (brief qualitative description) – how a theory develops/should be developed – timeline of development of modern physics.

[9 hours] [Books 7 and 8]

Module III: **Measurement in physics**

Units and dimensions, constants, measuring instruments, uncertainty in measurements, error analysis – systematic error, random error, and combination of errors, measurement standards – the SI system.

[9 hours] [Books 9 and 10]

Module IV: **Communicating physics**

Sources of knowledge in physics – books, journals, magazines, conference proceedings, reviews, etc., scientific reporting, technical presentations, peer review process.

[9 hours]

Text books:

1. Force and Motion – An illustrated guide to Newton's Laws, J. Zimba, John Hopkins University Press (2009).
2. New Century Senior Physics – Concepts in Context, R. Walding, G. Rapkins, and G. Rossiter, Oxford (2004).
3. Basic Training in Mathematics – A Fitness Program for Science Students, R. Shankar, Plenum Press (1995)
4. Essential Mathematical Methods for Physical Sciences, K. F. Riley and M. P. Hobson, Cambridge
5. The Theoretical Minimum – What you need to know to start doing physics, L. Susskind and G. Hrabovsky, Basic Books, New York
6. Waves – Berkeley physics course – volume 3, TMH
7. The character of physical law, Richard P. Feynman, MIT Press.
8. Six Easy Pieces, Richard P. Feynman, Basic Books, New York
9. Methods of Experimental Physics, I. Estermann (Ed), Academic Press (1959)
10. Probability and Statistics in Experimental Physics, Byron P Roc

Reference:

1. A student's guide to vectors and tensors – Daniel Fleisch, Cambridge.
2. The Demon Haunted World – Science as a candle in the dark, Carl Sagan
3. For the love of Physics – Walter Lewin
4. Mathematical methods: For Students of Physics and Related Fields, Sadri Hassani

for Scientists and Engineers, Serway and Jewette
5. Quantum Mechanics – Berkeley physics course – volume 4, TMH
6. Fundamentals of Physics, Resnick, Halliday and Walker
7. University Physics, Harris Benson
8. Encyclopaedia of Scientific Units, Weights and Measures – Their SI Equivalences and Origins, F. Cardarelli, Springer

Semester II
PHY2COR02-PROPERTIES OF MATTER

Credits- 3 (theory 2 + Practical 1)

Contact hours-36

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, non uniform bending of beam, depression of beam under its own weight, I-section girders

[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 and measurement of rate of flow of fluid, filter pump. Viscosity, Newton's law of viscosity, Stoke's formula, Derivation of Poiseuille's formula and measurement of viscosity of liquid, viscosity of gases, Meyer's modification of Poiseulli's formula, viscosity of gases and kinetic theory

[10 hours] [Chapter 7, Book 1]

Phenomenon of diffusion, Fick's law, Graham's law of diffusion of gases

[Chapter 13, Book 2]

[10 hours]

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 and Graham's law of diffusion(ch.15- gases- kinetic theory, 'Elements of properties of matter', D. S. Mathur, 11thedn.)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

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 – Frequency domain signals, harmonics – Signal sources, Independent sources - Thevenin's theorem, Norton's theorem, (Problems are to be worked out), Load lines – Troubleshooting analog signals.

[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 – Transition and diffusion capacitance – Reverse recovery time – 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 – Miscellaneous bias configurations – Design operations – Transistor switching networks – Troubleshooting techniques

[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, complementary DC amplifier, 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), Gray code, 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

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 of a 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 conductor -Capacitors.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 acapacitor through a resistance - measurement of high resistance by capacitor leakmethod- 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, 2nd 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 Hill
2. Electromagnetics, 4th Edition, Matthew N Sadiku, Oxford
3. Electromagnetics:Schaum's series, 2nd Edition,J A Edminister, TMH
4. A Text book of Magnetism and Electricity, N. S. Khare,Atma Ram & Sons, Delhi
5. Sears and Zemansky's University Physics:Electricity and Magnetism, Vol. II, 12th Edition, Hugh D. Young, Roger A. Freedman,Pearson,India

Semester V

PHY5COR05-CLASSICAL MECHANICS

Credits-4 (Theory 3+ Practical 1)

Contact hours - 54

Module I: **Fundamentals of Newtonian mechanics**

Frames of reference- Cartesian, plane polar and spherical polar co-ordinates, Newton's laws of motion, inertial frames and non-inertial frames.

mechanics of a particle- 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.

system of particles- centre of mass, conservation of linear momentum and angular momentum, energy conservation of a system of particles, time varying mass systems-rockets

[14 hours] [Book 1]

Module II: **Lagrangian 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, generalized momentum, first integrals of motion and cyclic co-ordinates, conservation laws and symmetry properties- homogeneity and isotropy of space, homogeneity of time, simple applications of Lagrange's equations- free particle, linear harmonic oscillator, simple pendulum

[14 hours] [Book 1]

Module III: **Central force problem**

Reduction of two body problem to the equivalent one body problem- reduced mass of a system, general properties of central force motion- angular momentum, law of equal areas, effective potential, classification of orbits, motion in central force field- general solution, inverse square law force, Kepler's laws, law of gravitation from Kepler's laws, satellite parameters, communication satellites, scattering in a central force field

[13 hours] [Book 1]

Module IV: **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, derivation of moment of inertia of thin rod, ring, disc, cylinder and sphere, angular acceleration of rigid body, conservation of angular momentum, kinetic energy of a rotating body, parallel axis theorem and perpendicular axes theorem-applications, radius of gyration of rigid body, flywheel- determination of moment of inertia

[12 hours] [Book 2]

Text Books:

1. Classical Mechanics, 1st Edition, G. Aruldhas, PHI
2. Mechanics, D. S. Mathur, S Chand

References:

1. Classical Mechanics, 3rd Edition, Goldstein, Poole &Safko, Pearson
2. University Physics, Harris Benson, Wiley
3. Physics for scientists and engineers with modern physics, 9th Edition, J.W. Jewett, R.A. Serway, Cengage

PHY5COR06-Thermal and Statistical Physics

Credits-4 (Theory 3+ Practical 1)

Contact hours - 54

Module I

Temperature

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

[3 hours]

Heat and First Law of thermodynamics

Thermodynamic equilibrium-Equation of state- Work-Quasi-Static process-PV diagram.

Work and Heat- Adiabatic work- Internal Energy Function- Mathematical Formulation of the First Law of thermodynamics- Concept of Heat- Differential form of the first law of Thermodynamics- Heat capacity and its measurement- Heat Capacity of water – 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 1,2, 3 & 4, Book 1; Chapter 4, Book 2]

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

[11 hours] [Chapter 4, Book 1; Chapter 10, Book 3]

Module II

Ideal Gases

Equation of state of a gas- Internal energy of a gas- Ideal gas-Experimental determination of heat capacities- Quasi-static adiabatic process- The microscopic point of view- Kinetic theory of ideal gas

[4 hours][Chapter 5, Book 1]

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

Reversible part of the second law- Entropy- Entropy of an ideal gas- TS diagram- Carnot cycle-Entropy and reversibility- Entropy and Irreversibility - Irreversible part of the second law-Heat and entropy in irreversible processes-Entropy and Non equilibrium states- Principle of Increase of entropy- Application of the entropy principle- Entropy and disorder- Exact differentials

[5 hours] [Chapter 8, Book 1]

Pure Substances

Characteristics functions-Enthalpy- The Helmoltz and Gibbs Functions- Two mathematical theorems- Maxwell´s relations- The TdS equations- Internal Energy Equations- Heat-Capacity Equations- First order phase transitions:Clausius –clapeyron equation

[Chapter 9, Book 1]

Clausius – Clapeyron equation and phase diagram- Clausius – Clapeyron equation and the Carnot Engine- Chemical potential- Open hydrostatic systems in thermodynamic equilibrium

[9hours] [Chapter 10 &12, Book 1]

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)- Application of BE distribution

law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-Fermi energy-Expression for Fermi energy of electron system-electron energy distribution- average electron energy at absolute zero-Degeneracy pressure and its astrophysical significance.

[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

Reference:

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 group, LLC

PHY5COR07- Quantum Mechanics and Spectroscopy

Credits- 4 (Theory 3 + Practical 1)

Contact hours - 54

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, finite square well, potential barrier and barrier penetration-tunnel effect, 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, symmetric and anti symmetric wave functions, periodic table, 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, H_2+ molecular ion, hydrogen molecule, 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 test book of Quantum mechanics, P. M. Mathews &Venketesan, Mcgraw-Hill
2. Modern physics, G. Aruldhas and P.Rajagopal, PHI

PHY5COR08- Advanced Electronics

Credits – 4(Theory 3+ Practical 1)

Contact Hours- 54

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, Digital switch.

[Chapter 4, Book 1]

Varactor diodes – Tunnel diodes – Photodiodes – Photoconductive cells – IR emitters – Liquid crystal displays – Solar cells – Thermistors

[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

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

[7 hours] [Chapter 3, Book 3; Chapter 4, Book 4]

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.

[hours] [Chapter 7, Book 4]

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

[12 hours] [Book 5]

Module IV: **Storage Devices, IC Technology**

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

[12 hours] [Book 5]

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 Logic and Computer Design, M. Morris Mano

Semester V: Choice based core course I
PHY5CBP01- Optics and Photonics

Credits- 3(Theory 3)
Contact hours- 72

Module I

Interference

Superposition of light waves, Coherence, Interference by division of wavefront –Youngs double slit, Fresnel bi-prism, Llyod single mirror. Interference by division of amplitude – interference from parallel thin films due to reflected and refracted light. Air wedge, Newtons rings – arrangement – theory, wavelength, refractive index of transparent liquids. Michelson interferometer – wavelength, wavelength separation between closed spectral lines refractive

index of film. Fabry-Perot interferometer (qualitative ideas only – set up, condition for fringe formation, visibility).
[8 hours][Book 1]

Diffraction

Fresnel diffraction – Theory of zone plate, comparison with convex lens, Fresnel diffraction due to straight edge. Fraunhofer diffraction – single slit, double slit, transmission grating, wavelength determination, dispersive power of grating. Rayleigh criterion for the limit of resolution - Resolving power of grating and prism.
[8 hours][Book 1]

Module II
Polarization

Polarized light, production of linearly polarized light, double refraction, quarter and half wave plates, types of polarized light, production and detection, optical activity, specific rotation.

[7 hours] [Book 1]

Optical instruments

Camera, size of an object- magnifier - Microscopes-simple, compound microscopes – Telescopes – refracting, reflecting, astronomical telescopes - Eyepieces - Huygens, Ramsden, Gauss eyepieces- Spectrometer.
[10 hours] [Books 1 and 2]

Module III
Radiometry

Radiant power- radiant energy – Units related transmitter and receiver- Lamberts Law.

[2 hours] [Book 3]

Matrix Method in optics

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

[6 hours] [Book 4]

Lasers

principle of laser action, properties, optical resonators, three and four energy levels laser systems, laser systems – ruby laser, He-Ne laser, Nd-YAG laser, CO_2 laser, dye laser, semiconductor laser, laser applications.

[8 hours] [Book 3]

Module IV
Photonics

Holography – method, principle, characteristics and applications.
Fiber Optics – total internal reflection, step index and graded index fibres, numerical aperture, multimode and single mode fibers, optical fibre cables, glass fibre, plastic fibre, attenuation in optical fibre, fibre optic sensors, optical fibre communication system (qualitative study).
Photodetectors – photo-conductive detectors, junction photodiode and solar cell, pin photodiode, avalanche photodiode, photo transistor, photomultiplier tube.
Luminescences, Light emitting diode, characteristics, Liquid crystal display, Integrated optics (qualitative study only).

[13 hours] [Book 3]

Advances in optical phenomena
(qualitative study only)

Dispersion, Rayleigh scattering, Raman scattering, photo refractive effect, optogalvanic effect, photo-thermal effect, photo-refraction in diffusing media, optical bistability, second harmonic generation, self focusing and defocusing, optical parametric interaction, multi-photon absorption, electro-optic effects – Pockel, Kerr, Stark and Franz-Keldysh effects, Faraday effect, acousto-optic effect.

[6 hours] [Book 3]

Text Books:

1. A Text book of Optics, N Subrahmanyam and Brijlal, S Chand & Co.Ltd. New Delhi
2. Fundamental of Optics, Devaraj Singh, PHI Learning Ltd, New Delhi.
3. Photonics an Introduction, P R Sasi Kumar, PHI Learning Ltd, New Delhi.
4. Optics, Ajoy Ghatak, TMH Publishing Co. Ltd, New Delhi.

Reference:

1. Optoelectronics, S O Kasap, Pearson
2. Optics, Eugene Hecht, Pearson
3. Fundamentals of Photonics, Textbook by Bahaa E. A. Saleh, Wiley

Semester VI

PHY6COR09-Nuclear and Particle Physics

Module I: **Nuclear structure**

Nuclear composition - isotopes, atomic mass unit. Nuclear Properties - radii, spin and magnetic moment. NMR (qualitative ideas). 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, Qualitative treatment of shell model.

[14 hours] [Chapter 11, Book 1; Chapter 8, Book 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 (qualitative treatment).

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

Cross section of interactions. Nuclear reactions- centre of mass co-ordinate system, Q value. Nuclear fission. Nuclear reactors - Power and breeder reactors. Nuclear fusion in stars - formation of heavier elements. Fusion reactors – confinement methods.

[15 hours] [Chapter 12, Book 1; Chapter 3, Book 2]

Module III: **Detectors of Nuclear Radiations and Particle Accelerators**

Interaction of energetic particles with matter.

Detectors of Nuclear radiations - ionization chamber, solid state detector, proportional counter, GM counter, Wilson cloud chamber, scintillation counter and Cerenkov counter.

Particle Accelerators - Van de Graaff generator, linear Accelerator, cyclotron and betatron. Large Hadron Collider - purpose and design (basic ideas).

[15 hours] [Chaptes 29 & 30, Book 3]

Module IV: **Elementary Particles**

Classification of elementary particles, Particles and anti particles, Four fundamental interactions. Elementary particle quantum numbers – identification of interactions. Conservation laws and symmetry.

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

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

[10 hours] [Chaptes 37 & 38, Book 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.

Reference:

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).

PHY6COR10- Numerical Methods and Computational Physics

Credits – 4(Theory 3 + Practical 1)

Contact hours- 54

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. Errors of computation –round off error, error propagation.

[6 hours]

Examples

Cartesian to Spherical Polar Coordinates, 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 (1) Lissajous figures and (2) 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 evaluate sum of finite series and the area under a curve.
2. To find the product of two matrices
3. To find a set of prime numbers and Fibonacci series.
4. Print out the wavelengths of hydrogen lines
5. Convert from polar to Cartesian coordinates
6. To find the roots of a quadratic equation.
7. To print out all natural even/odd numbers between given limits.
8. To find maximum, minimum and range of a given set of numbers
9. Calculating Euler number with high precision.
10. To compile a frequency distribution and evaluate mean, standard deviation etc.
11. Calculate and display the interference pattern generated by two circular sets of waves
12. Bisection method– finding the root on an equation
13. Solving equation using Newton – Raphson method
14. Evaluate an integral using the trapezoidal rule
15. Simpson’s rule – program to evaluate a definite integral with n subdivisions.
16. Taylor’s series for cos(x) and sin(x).
17. Numerical Integration with Euler method
18. 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, 5th Edn, 2012, PHI Learning Pvt. Ltd.

Reference:

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, 3rd Edn, 2007, Wiley India Edition.

PHY6COR11- Condensed Matter Physics

Credits – 4(Theory 3+ Practical 1)

Contact hours- 54

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, diamond cubic,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- The Von Laue equations, Bragg's law from Laue equations, comparison of Bragg's law and Laue approaches, Bragg's law in reciprocal lattice: Ewald construction-Vector form of Bragg's law, 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, 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, energy bands in diamond, Bloch theorem-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, some definiions, 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, Frequency dependence of polarization- dielectric loss, Dilectric breakdown, 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, Quantum 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, Thermodynamic and Optical properties-Entropy-Specific heat-Energy gap, Isotope effect, Flux quantisation, The Josephson effects and tunneling, Additional Characteristics, BCS theory (qualitative ideas only), High temperature ceramic superconductors, Applications.

[Chapter 10, Book 2]

[17 hours]

Text Books:

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

Reference:

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

PHY6COR12 - Special relativity & Astrophysics

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

Module I: **Special Relativity**

Inertial frame, Galilean transformation, invariance of Newton's laws of motion, principle of Relativity, postulates of Special Relativity, Lorentz transformation, consequences of Lorentz transformation- relativity of simultaneity, Lorentz-Fitzgerald contraction, time dilation, dilation of life of muon, Lorentz transformation for the components of velocity, relativity of mass, mass-energy equivalence, applications, energy-momentum relation, space- time diagram

[14 hours] [Chapter10, Book 1]

Module II: **Introduction to Observational Astronomy**

Types of telescopes-reflecting, refracting, Newtonian, Ideas of celestial sphere, Parsec and light years. Distances of stars from parallax, magnitude systems- Apparent and Absolute magnitudes, Distance modulus, Standard Candles-Variable stars and Type I supernovae, Astronomy in different bands of electromagnetic radiation- Optical, radio, X-ray astronomies

[14 hours]

Module III: **Astrophysics I**

Hydrostatic equilibrium of stars- Eddington's equation, energy production in stars by fusion process- pp chain and CNO chain, Virial theorem, Star formation- condition for gravitational collapse, Free fall time, Jeans mass and density, Protostars, contraction of protostars and condition for stardom, H R diagram - Luminosity and surface temperature. Main sequence stars.

[12 hours]

Module IV: **Astrophysics II**

Evolution of Main sequence stars- Triple alpha process, advanced burning, Red Giants and planetary nebulae, electron degeneracy and White dwarfs, Chandrasekhar limit (qualitativeideas), Super Red giants and Type II Supernova, neutron degeneracy and Neutron stars, Tolman-Volkof limit, Pulsars and their features, Schwarzchild radius and Blackholes (qualitative ideas)

[14 hours]

Text Book:

1. Classical Mechanics, G. Aruldhas, PHI
2. Introductory Astronomy and Astrophysics, 4th Edition, Zeilik & Gregory, Cengage
3. Introduction to Modern Astrophysics, 2nd Edition, Bradley W.Caroll, Pearson

Reference:

1. Concepts of Modern Physics, 6th Edition, Arthur Beiser, Tata McGraw-Hill
2. Astronomy: The structure of the universe, Kaufmann, PHI
3. Concepts of contemporary astronomy, 2nd Edition, Paul W. Hodge, McGraw-Hill
4. Astrophysics for Physicists, ArnabRaiChoudhari, Cambridge

Semester VI: Choice based core course II
PHY6CBP01- Materials Science and Nanotechnology

Credits – 4(Theory 4)

Contact hours-90

Module I: **Classes of materials - Metals, Ceramics, Polymers and Composites**

Metals: The structure of pure metals, metallic radii, Alloy solid solutions, metallic glasses, the principal properties of metals

Ceramics: Bonding and structure of silicate ceramics, bonding and structure of nonsilicate ceramics-the preparation and processing of ceramics, the principal properties of ceramics

Glass: Bonding and structure of silicate glasses, glass deformation, strengthened glass-glass

ceramics

Polymers: The chemical structure of some polymers, microstructure of polymers, production of polymers, elastomers, the principal properties of polymers

Composite materials: Fibre, reinforced plastics, metal matrix composites, ceramic matrix composites, cement and concrete

[20 hours] [Chapter 6, Book 1]

Module II: **Macrostructure, microstructure, defects and thin films**

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

Defects: Point defects in crystal of elements, solid solutions, Schottkey 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.

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

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

Module IV: **Introductory Quantum Mechanics for Nanoscience**

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

[16 hours] [Chapter 5, Book 2]

Module V: **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. Chemical Vapour Deposition (CVD). 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- General concepts of AFM- Compositional Analysis- electron scanning for Chemical analysis- Optical Analysis- Spectro photometer- electrical analysis- Hall set up- Four Probe set up (Elementary ideas only)

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

Text books:

1. Understanding Solids- The Science of Materials, Richard J.D. Tilly, John Wiley & Sons Ltd
2. Thin film device applications, K.L.Chopra, Inderjeet Kaur, Plenum Press
3. Introduction to Nanoscience& Nanotechnology (2014), K. K. Chattopadhyay and A. N. Banerjee, Publisher: PHI Learning and Private Limited
4. Nanotechnology (2012), RakeshRathi, S Chand & Company, New Delhi
5. Manotechnology a crash course (2010), Raul J. Martin-Palma, AkhleshLakhtakia, SPIE Press
6. Nano structures and nano materials: Synthesis, properties and Application (2004), Guozhong Cao, Imperial College Press

Choice based core courses

PHY5CBP02-MedicalPhysics

Credits – 3(Theory-3)

Contacthours-72

ModuleI

X-rays:

Electromagneticspectrum,productionofx-rays,x-rayspectra,Brehmsstrahlung,Characteristicx-ray.X-raytubes&types:Coolidgetube,x-raytubedesign,tubecoolingstationarymode,Rotatinganodex-raytube,Tuberating,qualityandintensityofx-ray.X-raygeneratorcircuits,halfwaveandfullwaverectification,filamentcircuit,kilovoltagecircuit.Singleandthreephaseelectricsupply.Powerratings.TypesofX-RayGenerator,highfrequencygenerator,exposuretimersandswitches,HTcables.

[16hours]

ModuleII

RadiationPhysics:

Radiationunitsexposure,absorbeddose,units:radgray,relativebiologicaleffectiveness,effectivedose-RemandSievert,inversesquarelaw.Interactionofradiationwithmatter-Compton&photoelectriceffect,linearattenuationcoefficient.RadiationDetectors:ionizationchamber(Thimblechamber,condenserchamber),GeigerMullercounter,ScintillationcountersandSolidStatedetectors,TFT.

[18hours]

ModuleIII

RadiationTherapyandProtection:

Radiotherapy-kilovoltagmachines-deeptherapymachines-tele-cobaltmachines-Medicallinearaccelerator.BasicsofTeletherapyunits-deepx-ray,telecobaltunits,medicallinearaccelerator-Radiationprotection-externalbeamcharacteristics-phantom-dosemaximumandbuildup-bolus-percentagedepthdose-tissuemaximumratioandtissuephantomratio,backscatterfactor.

Principlesofradiationprotection,protectivematerials-radiationeffects,somtic,geneticstochasticanddeterministiceffect.Personalmonitoringdevices:TLDfilmbadge,pocketdosimeter,OSLdosimeter,Radiationdosimeter.Naturalradioactivity,Biologicaleffectsofradiation,radiationmonitors.StepstoreduceradiationtpPatient,StaffandPublic.Doslimitsforoccupationalworkersandpublic.AERB:ExistenceandPurpose.

[22hours]

ModuleIV

MedicalImagingPhysics:

Evolutionofmedicalimaging,Radiography:Filters,grids,cassette,X-rayfilm,filmprocessing,fluoroscopy.Computedtomographyscanner-principleandfunction,display,generations,mammography.Ultrasoundimaging,MRIimaging,NMRimaging,PhysicsofDopplerwithapplicationsandmodes,VascularDoppler.ThyroiduptakesystemandGammacamera(OnlyPrinciple,functionanddisplay).

[16hours]

References:

1. BasicRadiologicalPhysicsDr.K.Thayalan,JayapeeBrothersMedicalPublishingPvt.Ltd.NewDelhi(2

003)
2. TheessentialphysicsofMedicalImaging:Bushberg,Seibert,LeidholdtandBooneLippincotWilliamsandWilkins,SecondEdition(2002)
3. MedicalPhysics,J.R.CameronandJ.G.Skofronick,Wiley(1978)
4. PhysicsofRadiationTherapy:FMKhan-WilliamsandWilkins,3rdedition(2003)
5. HandbookofPhysicsinDiagnosticImaging:R.S.Livingstone:B.I.PublicationPvt.Ltd.
6. ThePhysicsofRadiology-HEJohnsandCunningham.
7. AdvancedMedicalRadiationDosimetry:GovindarajanKNPrenticeHallofIndiaPvt.Ltd.NewDelh,(1992).

PHY5CBP03-RenewableEnergyandEnergyHarvesting

Credits –3 (Theory-3)

Contacthours-72

ModuleI

Conventionalandnon-conventionalenergysources:

Energysourcesandtheir availability:-
Conventionalenergysources,Limitationsofconventionalenergysources,Nonconventionalsources,-Advantagesofrenewableenergysources,Obstaclestotheimplementation,Prospectsofrenewableenergysources.

[14hours]

ModuleII

SolarEnergy:

Typesofsolarradiation-BeamandDiffusesolarradiation,Radiationattenuation,solarradiationmeasurements-pyrheliometers,Pyranometers,sunshinerecorder,Solarenergycollectors-flatplateandliquidcollectors,solarairheters,concentratingcollector,comparisonwithflatplatecollector,

Solarenergystorage – thermal,electrical,chemicalandmechanical,solarpond,ApplicationsofSolarenergy – waterheating,spaceheating,Solarelectricpowergeneration,solardistillation,solarcooking,solargreenhouses,absorptionairconditioning,Solarcellprinciples,solarcellmodules,suntrackingsystems.

[20hours]

ModuleIII

WindandBio-energy:

Basicprinciplesofwindenergyconversion,Siteselection-Basiccomponentsofwindenergyconversion-Windenergycollectors-

Windenergygenerationandstorage,Advantagesanddisadvantagesofwindenergysystems,Applicationsofwind energy.

Biomass,Biofulesanditsclassification,Biomassconversiontechniques,Biogasgeneration-factorsaffectingbiogasgeneration-Biogasplantsanditsclassification,Energyplantation-advantages.

[18hours]

ModuleIV

Otherrenewableenergysources:

Geothermalenergy,geothermalsources,GeothermalTechnologies,EnergyfromOcean – Oceanthermalelectricconversion – Oceanthermalelectricpowergenerationmethods.Energyfromtides,componentsoftidalpowerplant,Advantagesanddisadvantagesoftidalpowergeneration-waveenergy – conversiondevices,advantagesanddisadvantages.Fuelcells-classification,Designandprincipleofoperation,Advantagesanddisadvantages.PiezoelectricEnergyharvesting:Physicsandcharacteristicsofpiezoelectriceffect,materialsandmathematicaldescriptionofpiezoelectricity,Piezoelectricparametersandmodelingpiezoelectricgenerators,Piezoelectricenergyharvestingapplications,Humanpower

[20hours]

Reference:

1. Non-conventionalEnergysources-G.D.Rai-Khannapublishers
1. Fundamentalsofrenewableenergysystems.D.MukherjeeandS.Chakrabarti.NewAgeInternationalpublishers
2. Solarenergy-MPAgarwal-SChandandCo.Ltd.
3. Solarenergy-SuhasPSukhativeTataMcGraw-HillPublishingCompanyLtd.

PHY6CBP02-Embeddedsystem:IntroductiontoMicrocontrollers

Credits – 4(Theory-4)

Contacthours-90

ModuleI

Embeddedsystem:

Introductiontoembeddedsystemsandgeneralpurposecomputersystems,architectureofembeddedsystem,classifications,applicationsandpurposeofembeddedsystems,challengesanddesignissuesinembeddedsystems,operationalandnon-operationalqualityattributesofembeddedsystems,elementaldescriptionofembeddedprocessorsandmicrocontrollers.

Reviewofmicroprocessors:OrganizationofMicroprocessorbasedsystem,8085µppindiagramandarchitecture,conceptofdatabusandaddressbus,8085programmingmodel,instructionclassification,subroutines,stacksanditsimplementation,delaysubroutines,hardwareandsoftwareinterrupts.

MicroprocessorsandMicrocontrollers – Comparison –TheZ80andThe8051 – AMicrocontrollersurvey – 4bit,8bit,Sixteenbit,32bitmicrocontrollers – Developmentsystemformicrocontrollers
[24hours]

ModuleII

Intel8051microcontroller:
8051microcontrollers:Introductionandblockdiagramof8051microcontroller,architectureof8051,overviewof8051family,8051assemblylanguageprogramming,ProgramCounterandROMmemorymap,DatatypesanddirectivesFlagbitsandProgramStatusWord(PSW)register,Jump,loopandcallinstructions.
8051I/Oportprogramming:IntroductionofI/Oportprogramming,pinoutdiagramof8051microcontrollers,I/Oportpinsdescriptionandtheirfunctions,I/Oportprogrammingin8051,(UsingAssemblyLanguage),I/Oprogramming:Bitmanipulation
[24hours]

ModuleIII

Programmingof8051:
Programmingof8051:8051addressingmodesandaccessingmemoryusingvariousaddressingmodes,assemblylanguageinstructionsusingeachaddressingmode,arithmetic&logicinstructions,8051programminginC: -
fortimedelayandI/Ooperationsandmanipulation,forarithmetic&logicoperations,forASCIIandBCDconversions.Timerandcounterprogramming:Programming8051timers,counterprogramming.

Serialportprogrammingwithandwithoutinterrupt:Introductionto8051interrupts,programmingtimerinterrupts,programmingexternalhardwareinterruptsandserialcommunicationinterrupt,interruptpriorityinthe8051.

Interfacing8051microcontrollertoperipherals:ParallelandserialADC,DACinterfacing,LCDinterfacing.
[22hours]

ModuleIV

ProgrammingEmbeddedsystems:
ProgrammingEmbeddedSystems:Structureofembeddedprogram,infiniteloop,compiling,linkinganddlocating,downloadinganddebugging.Embeddedsystemdesignanddevelopment:Embeddedsystemdevelopmentenvironment,filetypesgeneratedaftercrosscompilation,disassembler/decompile,simulator,emulatoranddebugging,embeddedproductdevelopmentlife-cycle,trendsinembeddedindustry.
[20hours]

Reference:

4. The8051Microcontroller,Architecture,Programming&Applications-KennethJAyala – SecondEdition
5. FundamentalsofMicroprocessorsandMicrocomputers – BRamPub:DhanpatRaiPublications(P)Ltd. (6thEdn.)
6. MicroProcessorArchitecturesProgrammingandApplications – R. S.Gaonkar,Pub:PenramInternational
7. EmbeddedSystems:Architecture,Programming&Design,R.Kamal,2008,TataMcGrawHill
8. The8051MicrocontrollerandEmbeddedSystemsUsingAssemblyandC,M. A. Mazidi,J. G. Mazidi,andR. D.McKinlay,2ndEd.,2007,PearsonEducationIndia.
9. Microcontrollersinpractice,I. SusneaandM. Mitescu,2005,Springer.
10. EmbeddedSystems:Design&applications,1/eS.F.Barrett,2008,PearsonEducationIndia
11. EmbeddedMicrocomputersystems:Realtimeinterfacing,J. W. Valvano2011, CengageLearning

PHY6CBP03-AppliedMathematicalPhysics

Credits – 4(Theory-4)

Contacthours-90

ModuleI

NumericalMethodsinphysics:
Generalintroductiontonumericalmethods,Comparisonbetweenanalyticalandnumerical techniques-CurveFitting:Principleofleastsquares,fittingastraightline-Interpolation: Finitedifferenceoperator,Newton'sforwarddifferenceinterpolationformula,Solutionof algebraicequations:Newton-Raphsonmethod-Numericaldifferentiationandintegration: Differencetable,TrapezoidalandSimpson's(1/3)method-Solutionofdifferential equations:RungeKuttamethod(Secondorder)-Taylor'sSeries:Sin(x)andCos(x).
[24hours]

ModuleII

ComplexAnalysis:
BriefRevisionofComplexNumbersandtheirGraphicalRepresentation.Euler'sformula,DeMoivre'sth eorem,RootsofComplexNumbers.FunctionsofComplexVariables.AnalyticityandCauchy-RiemannConditions.Examplesofanalyticfunctions.Singularfunctions:polesandbranchpoints,order ofsingularity,branchcuts.Integrationofafunctionofacomplexvariable.Cauchy'sInequality.Cauchy'sI ntegralformula.
[20hours]

ModuleIII

CalculusoffunctionsandFourierseries:
Partialderivatives,exactandinexactdifferentials.Integratingfactor,withsimpleillustration.Constrain edMaximizationusingLagrangeMultipliers.FourierSeries:Periodicfunctions.Orthogonalityofsinea

ndcosinefunctions,DirichletConditions(Statementonly).ExpansionofperiodicfunctionsinaseriesofsineandcosinefunctionsanddeterminationofFouriercoefficients.ComplexrepresentationofFourierseries.Expansionoffunctionswitharbitraryperiod.Expansionofnon-periodicfunctionsoveraninterval.EvenandoddfunctionsandtheirFourierexpansions.Application.SummingofInfiniteSeries.

[24hours]

ModuleIV

SpecialIntegralsandFunctions:

SomeSpecialIntegrals:BetaandGammaFunctionsandRelationbetweenthem.ExpressionofIntegralsintermsofGammaFunctions.ErrorFunction(ProbabilityIntegral).
SingularPointsofSecondOrderLinearDifferentialEquationsandtheirimportance.Frobeniusmethodanditsapplicationstodifferentialequations.Legendre,Bessel,HermiteandLaguerreDifferentialEquations.PropertiesofLegendrePolynomials:RodriguesFormula,Orthogonality.Simplerecurrencerelations.

[22hours]

Reference:

1. IntroductiontoNumericalAnalysis,S.S.Sastry,5th Edn,2012,PHILearningPvt.Ltd.
2. MathematicalMethodsforPhysicists:Arfken,Weber,2005,Harris,Elsevier.
3. AnIntroductiontoOrdinaryDifferentialEquations,EarlACoddington,1961,PHILearning.
4. DifferentialEquations,GeorgeF.Simmons,2006,TataMcGraw-Hill.
5. PartialDifferentialEquationsforScientistsandEngineers,S.J.Farlow,1993,DoverPublications
6. MathematicalmethodsforScientistsandEngineers,D.A.McQuarrie,2003,VivaBooks.
7. ElementaryNumericalAnalysis,K.E.Atkinson,3rd Edn,2007,WileyIndiaEdition.
8. NumericalMethodsinEngineeringandScience,Dr.BSGrewal,KhannaPublishers,Newdelhi
9. FourierAnalysisbyM.R.Spiegel,2004,TataMcGraw-Hill.
10. MathematicsforPhysicists,SusanM.Lea,2004,ThomsonBrooks/Cole.21"
11. Numericalmethodsforscientistsandengineers,K.SankaraRao,PHI
12. Introductorymethodsofnumericalanalysis,S.S.Shastry,(PrenticeHallofIndia,1983)

PHYSICS-INSTRUMENTATION

(2nd CORE COURSES)

SEMESTER	TITLE OF THE COURSE	NUMBER OF HOURS PER WEEK	NUMBER OF CREDITS	TOTAL CREDITS	TOTAL HOURS / SEMESTER
1	**INS1COR01-Basics of Mechanical Engineering**	3	3	3	54
	INS1COR02-Basic Instrumentation Instrumentation Practical (Basic Instrumentation Lab)	3 2	3 1	4	90
2	**INS2COR03-Basic Measurements**	3	2	2	54
	INS2COR04-Industrial Instrumentation 1 Instrumentation Practical (Industrial Instrumentation Lab)	3 2	2 1	3	90
3	**INS3COR06-Transducers and Signal Conditioners** Instrumentation Practical (Signal Conditioners Lab)	3 2	3 1	4	90
	INS3COR05-Industrial Instrumentation 2	5	4	4	90
4	**INS4COR07-Process Control Instrumentation** Instrumentation Practical (Process Control Instrumentation Lab)	3 2	3 1	4	90
	INS4COR08-Biomedical Instrumentation	5	4	4	90
	INS5COR09-Microprocessors and	3	3	4	90

5	**Microcontrollers** Instrumentation Practical (Microprocessor Lab)	2	1		
	On Job Training		2	2	0
	Project	1	1	1	18
6	**INS6COR10-Industrial Automation** Instrumentation Practical (Industrial Automation Lab)	3 2	3 1	4	90
	INS6CBP01-choice based course	5	4	4	90

Choice based courses:

1. INS6CBP01-Analytical Instrumentation
2. INS6CBP02-Ultrasonic and Optoelectronic Instrumentation
3. INS6CBP03-Power Plant Instrumentation

Semester I

INS1COR01-Basics of Mechanical Engineering

Credits – 3(Theory 3)

Contact hours-54

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

Machiningprocesses

Joining, 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, sintering, 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 measurements- 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. Work shop 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

INS1COR02 - Basic Instrumentation

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

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)

[15 hours]

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, Dhanpat Rai & Co
2. Measurement Systems: 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.

SemesterII

INS2COR03 - Basic Measurements

Credits – 3(Theory 3)

Contact hours-54

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]

ModuleII

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]

ModuleIII

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]

ModuleIV

Acceleration

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

Specific gravity

Introduction, hydrometer (principle, construction and working, advantagesand 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, 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 and Instrumentation & Control – A.K. Sawhney, Puneet Sawhney, Dhanpat Rai & Co.
4. Industrial Instrumentation and control – S.K.Singh, Mc Graw Hill

INS2COR04 - Industrial Instrumentation 1

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

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]

ModuleII: **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]

ModuleIII: **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]

ModuleIV: **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, 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 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

SemesterIII

INS3COR05 - Industrial Instrumentation 2

Credits-4 (Theory 4)

Contact hours - 90

ModuleI: 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]

ModuleII: 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]

ModuleIII

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]

ModuleIV

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 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

INS3COR06 - Transducers and Signal Conditioners

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

ModuleI: Transducers

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

[16 hours]

ModuleII: 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]

ModuleIII: Display devices

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

[8 hours]

ModuleIV: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, Dhanpat Rai & 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 – Ramakant A. Gayakwad , PHI

Semester IV

INS4COR07 - Process Control Instrumentation

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

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, controlelements, mechanical, electrical and fluid valves, control valves. (basic idea and principle only).

[12 hours]

ModuleII: 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]

ModuleIII

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]

ModuleIV

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. Process Systems Analysis and Control - D R Coughanowr, McGraw Hill.
6. Instrumentation handbook-process control - B.G. Liptak, Chilton

INS4COR08 - Bio Medical Instrumentation

Credits-4 (Theory 4)

Contact hours - 90

Module I

Introduction

General perspective including objectives– an overview of safety requirements, biometrics, biomedical instruments, parameters, man-machine interface and components.
Introduction to biology basics, objectives, Generalized system, Electrical activity of excitable cells, SD curve, introduction to transducers and its applications, safety in bio-instrumentation.

Electrodes

Recording electrodes, surface electrodes, needle electrodes, micro electrodes, metal plate electrode, floating electrode, disposable electrode, polarisable and non-polarisable electrodes.

[30 hours]

ModuleII

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, clinical applications.Electromyogram, Electro-neurogram, measurement techniques.

[23 hours]

ModuleIII: Blood pressure measurement

Direct measurements - harmonic analysis of blood pressure waveform, system for measuring venous pressure, heart sounds, phonocardiography, cardiac catheterization.

Indirect blood pressure measurement- electromagnetic blood flow meters, ultrasonic blood flow meters, plethysmography, sphygmomanometer.

[20hours]

ModuleIV

Hemodialysis, lithotripsy, ventilators, infant incubators, cardiac pacemakers, defibrillators, lasers in bio-medicine.

Electrical safety

Physiological effects of electricity, micro and macro shock hazards, electrical safety codes and standards, patient safety considerations in power distribution and equipment design.

[17 hours]

Reference Books:

1. Handbook of Biomedical Instrumentation - R.S Khandpur, Tata Mc-Graw Hill
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 V

INS5COR09 - Microprocessors and Microcontrollers

Credits-4 (Theory 3 + Practical 1)

Contact hours - 54

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]

ModuleII: Microprocessor 8086

Register organization of 8086, architecture.

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

[14 hours]

ModuleIII

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]

ModuleIV**:** 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 publications

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

ModuleI

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 - Ppovik Bhatkar, 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

ModuleI

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)

[22 hours]

ModuleII

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).

[24 hours]

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)
[26 hours]

ModuleIV

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 books-cole 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

Semester VI

Choice based course

INS6CBP02 - Ultrasonic and Optoelectronic Instrumentation

Credits – 3 (Theory 3)
Contact Hours - 90

ModuleI

Introduction

Ultrasonic waves, principle and propagation of various waves, Characterization Ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sound beam, power level.
Generation of ultrasonic waves, Magnetostrictive and Piezoelectric effect, search unit , types, construction, characteristics.

[20 hours]

ModuleII

Ultrasonic Test methods: Echo, Transit time, Resonance, Direct contact and immersion types.
Ultrasonic methods of measuring thickness, depth, flow, level etc.
Various parameters affecting ultrasonic testing and measurements, their remedy.
Ultrasonic in medical diagnosis and therapy, Acoustical holography.

[27 hours]

Module III

Opto-electronic components

Laser fundamental, Laser configuration - Q-Switching - Mode locking - Different types of Lasers - Ruby, Nd-Yag, He-Ne, CO2, Orgon ion.
LED, LD, PIN & APD, Electro-optic, Magneto optic and Acousto-optic Modulators.

Fiber optic sensors

IR sources and detectors - Interferometer method of measurement of length, Moire fringes, Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain, fiber optic Gyroscope,Polarization maintaining fibbers, Applications.

[27 hours]

ModuleIV

Industrial applications of lasers, Bio-medical application, Laser Doppler velocity meter,-Laser heating.
Holography**,** Principle, Methods, Holographic Interferometers and applications.
Medical application,Lasers and tissue interaction, Laser instruments for surgery, removal tumors of vocal cords, plastic surgery, dermatology.

[16 hours]

Reference Books:

1. Ultrasonic Testing of materials - Krantkramer,Springer 2005
2. Handbook of Nondestructive Testing - Mc Graw Hill, 1998
3. Biomedical Ultrasonic - Wells N T, Academic Press, London.
4. Optics - A.K. Ghatak, Second edition, Tata McGraw Hill, New Delhi.
5. Optoelectronics-an introduction, Wilson and Hawkes, 3rd edition, PHI.
6. Lasers: Theory and Applications, K. Thyagarajan and A.K. Ghatak, Plenum Press, New York.
7. Lasers and Optical Engineering, P. Das, Springers International Students Edition, 1991.
8. Laser and Applications, W.O.N. Guimarass andA. Mooradian, Springer Verlag, 1981

Semester VI

Choice based course

INS6CBP03 - Power Plant Instrumentation

Credits – 3 (Theory 3)
Contact Hours – 90

ModuleI

Introduction to power plant process, types of fuel, rankine and brayton cycles, boilers, water tube and fire tube boilers, once through, types of condensers.
Combined cycle power plant, power generating and distribution system, introduction to nuclear reactor, PWR, BWR, FBR, GCR, pollution from power plants.

[25 hours]

ModuleII

Measurement and analysis in power plant- electrical measurement, current, voltage, power and frequency.
Flow measurements-feed water, fuel flow, and air flow correction temperature and pressure measurements.
Level measurements, smoke density measurements.

[25 hours]

Module III

Reading and drawing of Instrumentation diagrams- flow sheet symbols-ANSCI symbols for 1. Lines, 2. Valves, 3. Heat transfer, 4. Material handling equipment, 5.dryer, 6. Storage vessel, 7. Turbine compressor, 8. Flow sheet codes and lines, 9. Graphical symbols for pipe fittings, valves and piping – instrumentation symbols.

One-line diagram of typical measurements and control schemes – for flow, temperature, pressure and other process variables – one-line diagram of typical pneumatic hydraulic and electrical instrumentation system.

[20 hours]

ModuleIV

Combustion control main pressure air/fuel ratio, furnace draft and excess air control, drum level control, two elements and three elements control, main and reheat stem temperature control, burner tilting and bypass damper, super heater- spray and gas recirculation control, hot well and de-aerator level control.

Interlocks,MFT turbine trip control, turbine monitoring and control, automatic turbine runs off systems, condenser vacuum control, gland steam exhaust pressure control speed vibration, shell temperature monitoring, lubricant oil temperature control, H2 generator cooling system, h2 purity monitoring, nuclear reactor control loops description and functions.

[20 hours]

Reference Books:

1. Modern Power Station Practice – volume 6 Pergamon, CEGB Engineers
2. Power plant instrumentation – Kallen
3. Applied instrumentation in process industries – Andrews and Williams
4. Safety aspects of nuclear reactors – Mc Culough C.R, Van
5. Power plant engineering –G.R. Nagpal

SYLLABUS FOR PRACTICAL – CORE COURSES

(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 PHY1P01

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 concavesurface
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

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

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

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

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

Course PHY5P06

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

Course PHY5P07

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

Course PHY5P08

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

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

Course PHY6P10

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

9. Solution of equations by Newton - Raphson method.
10. Generation of the Fibonacci sequence and Catalan sequence
11. 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.
12. Two photon interference

Course PHY6P11

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

Course PHY6P12

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

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

Reference:

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, 4th Edition, reprinted 1985, Heinemann Educational Publishers

SYLLABUS FOR PRACTICAL – 2nd CORE COURSES(Instrumentation)

(A minimum of 50% experiments in the syllabus should be done and recorded in each practical course component to appear for the examination)

Semester I

INS1P01-Basic Instrumentation

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

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

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

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 V

INS5P05-Microprocessor

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

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

Complementary Physics for BSc Mathematics

Semester I

PHY1CMM01- Classical Mechanics

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

Module I: **Newtonian mechanics and Lagrangian formulation (12 Hours)**

Reference frame. Newton's laws of motion. Inertial frames. Galilean transformations and Newtonian relativity. Newton's universal law of gravitation. Planetary motions and Kepler's laws. Limitations of Newtonian mechanics.

[Chapters 2 & 11, 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**

Search for ether frame. Interpretation of negative result of Michelson-Morley experiment(Qualitative idea only)- Postulates of special theory of relativity- Lorentz transformation equations-Time dilation and Length contraction-Relativity of simultaneity-Relativistic velocity addition-Relativistic mass-momentum and energy-Mass energy equivalence- $E = mc^2$ relation- Massless particle.

[9 hours] [Chapter 3, Book 1]

Module III: **Conservation laws**

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

[9 hours] [Chapters 5 & 6, Book 1]

Module IV: **Rotational motion**

Moment of inertia of a particle - Rigid body- Moment of inertia of a rigid body- Radius of gyration- Parallel and perpendicular axes theorem-Applications-Moment of inertia of a thin

uniform rod, ring,disc and sphere- Angular momentum of a rotating body- Torque on a rotating body- Rotational kinetic energy- Fly wheel

[9 hours] [Chapter 10, Book 1]

Text book:

1. Mechanics, Eleventh edition, D S Mathur,S Chand & Company.
2. Classical Mechanics, 1st Edition, K Sankara Rao, Prentice-hall of India Pvt. Ltd.

Reference:

1. Classical mechanics,First edition,2009, G Aruldas, PHI Private Ltd.
2. Concepts of modern physics, Second Edition, 2010,Arthur Beiser,Shobhit Mahajan, S Rai Choudhury,Tata McGraw Hill Education Pvt. Ltd, New Delhi.
3. Mechanics, Second Edition,2003, H S Hans& S P Puri,Tata McGraw Hill Education Pvt. Ltd.

Semester II

PHY2CMM02- Electricity, Optics and Lasers

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

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- ac generator & dc generators- Principle-working. AC measuring instruments- AC Wattmeter.
[12 hours] [Book]

Module II: **Optics**

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]

Module III: **Polarization**

Polarized and unpolarized 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]

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]

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

PHY2CMM03 - Properties of Matter and Thermodynamics

Credits 4(Theory 3+ Practical 1)

Contact hours-54

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]

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]

Module III: **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- absolute scale of temperature.

Thermodynamic potentials- internal energy- enthalpy- Helmholtz free energy - Gibbs free energy - derivation of Maxwell's thermodynamic relations- Clasius-Clapeyron equation- Latent heat-phase transitions- first order and second order transitions.

[14 hours] [Book]

Module IV: **Statistical mechanics**

Microstates and macro states 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 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 and Nuclear Physics

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

Module I: **Particle properties of waves (15 hours)**

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.

[Chapter 2, Book 1]

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.

[Chapter 3, Book 1]

[13 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] [Chapter 4, Book 1]

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 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.

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

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] [Chapter 13, Book 1]

Text Book:

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

.

Reference:

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

Complementary Physics for BSc Chemistry

Semester I

PHY1CMC01- Condensed matter physics

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

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**

Magnetic permeability-Magnetisation- Bohr magneton- Magnetic moment due to electron spin and nuclear spin- Diamagnetism, Paramagnetism (Langevin theory not needed)-Curie law(equation only). Ferromagnetism-Spontaneous magnetization-Domains. Antiferromagnetism and Ferrimagnetism. Electric polarization in solids-Ferroelectricity- Piezoelectricity(Qualitative ideas only).

[10 hours] [Chapters 9 & 10, Book 1]

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, 6thedition,S.O.Pillai, New Age international publishers.

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

Semester II

PHY2CMC02- Electricity, Optics and Lasers

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

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- ac generator & dc generators- Principle-working. AC measuring instruments- AC Wattmeter.

[12 hours] [Book]

Module II: **Optics**

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]

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]

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]

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,RatanPrakashanMandir,Agra.

Semester III

PHY3CMC03 - Properties of Matter and Thermodynamics

Credits 4 (Theory 3+ Practical 1)

Contact hours-54

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- absolute scale of temperature.

Thermodynamic potentials- internal energy- enthalpy- Helmholtz free energy - Gibbs free energy - derivation of Maxwell's thermodynamic relations – Clausius-Clapeyron equation- Latent heat- phase transitions- first order and second order transitions.

[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

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, 5th Edition,AjoyGhatak.
2. Quantum Mechanics, Second Edition,G. Aruldhas, PHI.

SYLLABUS FOR PRACTICAL

Complementary Physics for BSc Mathematics and BSc Chemistry

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

SEMESTER I

Course PHY1CP01

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

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 PHY3CP03

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

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

Reference:

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

Complementary Electronics for Physics – Instrumentation

Semester I

INS1CMP01- Basic Electronics

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

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

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

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

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 PetterLangtangen

SYLLABUS FOR PRACTICAL

Complementary Electronics for Physics- Instrumentation

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

Semester I

Course INS1CP01

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

Semester II

Course INS2CP02

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

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

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.