

ST. ALBERT'S COLLEGE (AUTONOMOUS) ERNAKULAM



A M D G

CURRICULUM FOR UNDER GRADUATE PROGRAMMES IN

PHYSICS

**UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM
(UG CBCSS) 2016**

2016 ADMISSION ONWARDS

Members of the Board of Studies of Physics

Sl.No:	Name	Designation	Qualification
a) Chairman: <i>(Head of the Department concerned)</i>			
1	Dr. Nelson Rodrigues	HoD	MSc, PhD
b) Teachers: <i>(The entire faculty of each specialization)</i>			
1	Dr Nandakumar Kalarikkal	Hon. Director of International and Interuniversity Centre for Nanoscience & Nanotechnology, and Associate Professor, School of pure and Applied Physics Mahatma Gandhi University, Kottayam -686560 , Kerala , India.	MSc, PhD.
2	Dr. Pramod Gopinath	Professor, International School of Photonics, CUSAT, Kalamassery	MSc, Ph.D
3	Dr. James Kurian	Professor, Department of Electronics, CUSAT, Kalamassery	M.Tech , Ph.D
4	Dr. Louie Frobel P.G	Asst. Professor, Department of Physics, St.Albert's College Ernakulam	M.Sc , M.Phil, Ph.D
5	Dr. Sajeesh T H	Asst. Professor, Department of Physics, St. Albert's College Ernakulam	M.Sc, Ph.D
6	Dr. Vimala George	Asst. Professor ,Department of Physics , St. Xavier's College for women Aluva	M.Sc, Ph.D
7.	Dr. Ninan Sajith Philip	Associate Professor, Department of Physics, St. Thomas College,Kozhencherri-689641..	MSc, PhD.
8	Dr. Tripti S.warrier	Assistant Professor, Department of Electronics,CUSAT, Kalamassery.	B Tech, M Tech, PhD.
c) Two Subject Experts: <i>(From outside the Parent University to be nominated by the Academic Council)</i>			
1	Dr. Anand Narayanan	Associate Professor , Department of Earth and Space Science , Indian Institute of Space Science	M.Sc., Ph.D

		and Technology, TVM	
2	Dr. M. K. Jayaraj	Syndicate member, and Professor Department of Physics , CUSAT ,Kalamassery	M.Sc , Ph.D
d) Nominee of Vice Chancellor: <i>(one expert to be nominated by the Vice-Chancellor from a panel of six experts recommended by the Principal)</i>			
1	Dr. Issac Paul	Associate Professor, Department of Physics , S.B.College Changanassery	M.Sc , Ph.D
e) Placement Representative: <i>(One representative from industry/corporate sector/allied area relating to placement)</i>			
1	Mr G. Sivaramakrishnan	Consultant Konark Systems Pvt Ltd Kaloor, Ernakulam, Kerala	
2	Rev.Dr.George Peter Pittappillil	Director, Mithradham	
f) Meritorious alumnus: <i>(One postgraduate meritorious alumnus to be nominated by the Principal)</i>			
1	Dr. Sasikumar	Principal , Govt.College Thalasseri	M.Sc , Ph.D
g) The Chairman, Board of Studies, may with the approval of the Principal of the college, co-opt:			
a) Co-opted Special Experts from outside <i>(Experts from outside the college whenever special courses of studies are to be formulated):</i>			
1	Dr. Joe Jacob	Associate Professor and HoD Department of Physics, SB College Changanerri	M.Sc , Ph.D
2	Dr. L. Godfrey	Emeritus professor, Dept. of Physics, CUSAT	M.Sc , Ph.D
b) Other members of staff of the same faculty:			
1	Sri. Shaji Joseph	Associate Professor	M.Sc
2	Sr. Lawrel Gregory	Associate Professor	M.Sc
3	Sri. S. Charles	Associate Professor	M.Sc
4	Sri. Justin Paiva	Associate Professor	M.Sc, M.Phil
5	Sri. Augustine Sumesh C J	Assistant Professor	M.Sc, B.Ed

SCHEME: CORE COURSES (Common for the Programme)

Se mes ter	Title of the Course	Number of hours per week	Number of credits	Total Credits	Total hours/ semester
1	PHY1CRT01– Methodology in Physics	2	2	3	72
	Practical	2	1		
2	PHY2CRT01 - Mechanics and Properties of Matter	2	2	3	72
	Practical	2	1		
3	PHY3CRT01 – Electronics	3	3	4	90
	Practical	2	1		
4	PHY4CRT01 – Electricity and Electrodynamics	3	3	4	90
	Practical	2	1		
	PHY5CRT01 – Classical and Quantum Mechanics	3	3	4	90
	Practical	2	1		

5	PHY5CRT02 – Physical Optics and Photonics	3	3	4	90
	Practical	2	1		
	PHY5CRT03 – Thermal and Statistical Physics	3	3	4	90
	Practical	2	1		
	PHY5CRT04– Digital Electronics	3	3	4	90
	Practical	2	1		
	PHY5CPR01 - Project	1	1	1	18
	PHY5COT01 – Open course	4	4	4	72
6	PHY6CRT01- Computational Physics	3	3	4	90
	Practical	2	1		
	PHY6CRT02 – Nuclear and Particle Physics	3	3	4	90
	Practical	2	1		
	PHY6CRT03 - Condensed Matter Physics	3	3	4	90
	Practical	2	1		
	PHY6CRT04 - Relativity and Spectroscopy.	3	3	4	90
	Practical	2	1		
	PHY6CRT05–Choice Based Course	5	3	3	90

4	MT4C01U – Physical Optics, Laser Physics and Astrophysics	3	3	4	90
	Practical	2	1		

Scheme: **COMPLEMENTARY COURSES (MODEL-I)**

2. Physics for Chemistry & Geology:

Se mes ter	Title of the paper	Number of hours per week	Number of credits	Total Credits	Total hours/ semester
1	PHY1CMT02 – Properties of Matter, Mechanics and Particle Physics	2	2	3	72
	Practical	2	1		
2	PHY2CMT02 - Electric and Magnetic Phenomena, Thermodynamics and Elementary Solid State Physics	2	2	3	72
	Practical	2	1		
3	PHY3CMT02 –Quantum Mechanics, Spectroscopy, Nuclear Physics and Electronics	3	3	4	90
	Practical				

		2	1		
4	PHY4CMT02 – Physical Optics, Laser	3	3	4	90
	Physics and Superconductivity				
	Practical	2	1		

Projects:

All students shall do a project. The project can be done individually or as a group of maximum 3 students. However, the viva on this project will be conducted individually. The projects are to be identified during the IInd semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department and are to be produced before the external examiners appointed by the University for Valuation.

Zero Credit Courses:

Zero Credit courses shall be included in the programme to encourage advanced learners and shall be indicated in the score sheet. Permission for obtaining Zero credit courses shall be in accordance with the rules and regulations of the university. The Zero Credit courses shall be done only under the supervision of a university approved permanent faculty member of the department which offers the core courses.

Examinations:

The evaluation of each course shall contain two parts such as Internal or In-Semester Assessment (IA) and External or End-Semester Assessment (EA). The ratio between internal and external examinations shall be 1:3. The Internal and External examinations shall be evaluated using Direct Grading system based on 5-point scale.

Internal or In-Semester Assessment (IA):

Internal evaluation is to be done by continuous assessments on the following components. The Components of the internal evaluation for theory and practical and their weights are as below.

Theory

Component	Weights
Attendance*	1
Assignment	1
Seminar /Viva-voce	1
Best two test papers	2

***Attendance**

%age of Attendance	Grade
$\geq 90\%$	A
≥ 85 and < 90	B

≥ 80 and < 85	C
≥ 75 and < 80	D
< 75	E

The student has to take a minimum of 1 assignment, 1 seminar / Viva-voce per course. A minimum of 2 class tests are to be attended. The grades of best 2 tests are to be taken.

Different components are given below:

Seminar

Assignment

Components	Weights
Punctuality	1
Review	1
Content	2
Conclusion	1
Reference	1

Components	Weights
Innovation of Topic	1
Review/ Reference	1
Content	2
Conclusion	1
Presentation	2

Practical: Internal

Component	Weights

Attendance *	1
Laboratory Involvement **	2
Test	2
Record	2
Viva-Voce/Quiz	1

Attendance & Laboratory Involvement *

<u>Attendance *</u>	<u>Laboratory Involvement **</u>
Same as shown in theory	Punctuality +
internal	Handling Equipments +

Skill in Laboratory work +

Group Interaction

The evaluation of all components is to be published and is to be acknowledged by the candidate. All documents of internal assessments are to be kept in the institution for 2 years and shall be made available for verification by the university. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the course.

External or End-Semester Assessment (EA):

The external examination of all semesters shall be conducted by the university on the close of each semester. There will be no supplementary exams. For reappearance/ improvement as per university rules, students can appear along with the next batch.

Examinations (Practical):

The practical examinations for the core courses at the end of semester 1, semester 2, semester 3 and semester 4 should be conducted by the university with a common time-table and questions set by the university. One examiner shall be selected from a panel of examiners published by the university and the other shall be selected internally. The graded score sheet should be sent to the university before the commencement of the end semester university examinations on theory courses. The practical examinations for the core courses at the end of semester 5 and

semester 6 should be conducted externally by arranging two practical examinations in a session.

The practical examinations for the complementary courses at the end of semester 1, semester 2 and semester 3 should be conducted by the university with a common time-table and questions set by the university. One examiner shall be selected from a panel of examiners published by the university and the other shall be selected internally. The graded score sheet should be sent to the university before the commencement of the end semester university examinations on theory courses. The practical examinations for the complementary courses at the end of semester 4 should be conducted externally.

A minimum of 8 experiments should be done in a practical course in all semesters and a candidate submitting a certified record with a minimum of 4 experiments alone is eligible for appearing the University Practical Examination.

Project evaluation:

The internal to external component of the project is on the ratio 1:3. The weightages for assessment of different components is shown below.

Internal:

Component	Weights
Punctuality	1
Experimentation/	2

Data collection

Compilation 1

Group involvement 1

External:

Component	Weights
Innovation of topic	1
Objective	1
Review	1
Materials & Methods	1
Result	1
Discussion	1
Conclusion/ application	1
Presentation	2

Pattern of Questions & Weights:

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure

that questions covering all skills are set. He/She shall also submit a detailed scheme of 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. Different types of questions shall be given different weights to quantify their range.

1. The examination has duration of 3 hours
2. Each question paper has four parts A, B, C & D.
3. Part A contains 16 objective type questions of which the candidate has to answer all. Each bunch of 4 questions carries a weightage of 1
4. Part B contains 8 short answer type questions spanning the entire syllabus and the candidate has to answer 5 questions. Each question carries a weightage of 1.
5. Part C contains 6 problem type questions spanning the entire syllabus and the candidate has to answer 4 questions. But, for open courses, Part C contains short essay type questions only. Each question carries a weightage of 2.
6. Part D contains 3 essay type questions spanning the entire syllabus and the candidate has to answer 2 questions. Each question carries a weightage of 4.

Evaluation of problems:

Numerical problems in Physics shall be graded in the following way.

1. Correct formula with correct substitution and answer : **A**
2. Correct formula with correct substitution and

- answer but wrong or no unit. : **B**
3. Correct formula with correct substitution and wrong answer : **C**
4. Formula alone is correct : **D**
5. Even formula is incorrect : **E**

Evaluation of practical examinations:

The Board of Examiners constituted by the University shall have the freedom for formulating the scheme of evaluation of the concerned practical examination.

Student Strength for practical:

There shall be at least one teacher to supervise a batch of not more than 15 students in each laboratory session.

Final Grade Card:

The final Grade Card issued at the end of the final semester shall contain the CGPA of the Core Courses and Complementary Courses of the entire Programme. The **CGPA** shall contain the awarded **GRADE LETTER** and the corresponding **GRADE POINT** in two decimal places

COURSE STRUCTURE

BSc Physics Programme– (Model I):

Se me ster	Title of the Course	N u m b e r o f h o u r s p e r w e e k			Total h o u r s /s e m e s t e r	Univ e r s i t y E x a m D u r a t i o n	Weightage	
							ratio	
	English I	5	4	4	90	3	1	3
	English /Common course I	4	3	3	72	3	1	3
	Second Language I	4	4	4	72	3	1	3

	PHY1CR01 – Methodology in	2	2	3	72	3	1	3
	Physics							
	Practical	2	1					
1	Complementary I	2	2	3	72	3	1	3
	Practical	2	1					
	(If no practical 4 hrs with 3 credits)							
	Complementary II	2	2	3	72	3	1	3
	Practical	2	1					
	English II	5	4	4	90	3	1	3
	English /Common course II	4	3	3	72	3	1	3
	Second Language II	4	4	4	72	3	1	3
	PHY2CRT01 - Mechanics and	2	2	3	72	3	1	3
	Properties of Matter							
	Practical	2	1					
2	Complementary I	2	2	3	72	3	1	3
	Practical	2	1					
	(If no practical 4 hrs with 3 credits)							

	Complementary II Practical	2 2	2 1	3	72	3	1	3
3	English III	5	4	4	90	3	1	3
	Sec. Lang. /Common course I	5	4	4	90	3	1	3
	PHY3CRT01 – Electronics Practical	3 2	3 1	4	90	3	1	3
	Complementary I Practical (If no practical 5 hrs with 4 credits)	3 2	3 1	4	90	3	1	3
	Complementary II Practical	3 2	3 1	4	90	3	1	3
	English - IV	5	4	4	90	3	1	3
	Sec. Lang. /Common course II	5	4	4	90	3	1	3
	PHY4CRT01 – Electricity and Electrodynamics	3	3	4	90	3	1	3

4	Practical	2	1					
	Complementary I	3	3	4	90	3	1	3
	Practical	2	1					
	(If no practical 5 hrs with 4 credits)							
	Complementary II	3	3	4	90	3	1	3
	Practical	2	1					
	PHY5CRT01 – Classical and Quantum Mechanics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY5CRT02 – Physical Optics and Photonics	3	3	4	90	3	1	3
	Practical	2	1					

5	PHY5CRT03 – Thermal and Statistical Physics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY5CRT04 – Digital Electronics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY5CPR01- Project	1	1	1	18	3	1	3
	PH5COT01 – Open course	4	4	4	72	3	1	3
6	PHY6CRT01 - Computational Physics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY6CRT02 – Nuclear and Particle Physics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY6CRT03 - Condensed Matter Physics	3	3	4	90	3	1	3
	Practical	2	1					
	PHY6CRT04 - Relativity and Spectroscopy.	3	3	4	90	3	1	3

Practical	2	1					
PHY6CBT01 – Choice Based Course	5	3	3	90	3	1	3

SYLLABI OF COURSES

CORE COURSES

(Common for the Programme)

Semester I

PHY1CRT01 – Methodology in Physics

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope : This course will be an introduction to the pursuit of Physics, its history and methodology. The course also aims at emphasizing the importance of measurement which is central to physics.

Prerequisites: This is an introductory course. Any student who opts to take Physics as the core subject for B. Sc. should attend this course.

Module I

Historical perspective on Physics and its method (12 hrs)

Ancient perspectives on the universe - Geocentric model of Ptolemy - Copernican revolution. Galileo, and his emphasis on experiments and observations. Kepler's laws. Newton and the deterministic universe - Maxwell and the unification of electricity, magnetism and optics.

Planck's hypothesis of quantum. Quantum mechanics. Einstein and his theories of relativity. Contributions by S. N. Bose, M. N. Saha, C. V. Raman and S. Chandrasekhar. Emergence of modern physics and technology - Semiconductor revolution - nanotechnology. Contemporary worldview - the expanding universe – fundamental particles and the unification of all forces of nature. *(All from a historical perspective – details and derivations not required)*

Physics, and its relation to other branches of Science. Hypotheses; theories and laws in science- verification (proving), corroboration and falsification (disproving), Revision of scientific theories and laws. Significance of Peer Review. Publications and patents.

www.britannica.com. This online Encyclopedia is a good resource for module I (See articles on Ptolemaic System, Copernican System, Galileo, Johannes Kepler, James Clerk Maxwell, Electromagnetism, Max Planck, Quantum Mechanics and Relativity.)

Vignettes in Physics – G. Venkataraman, Universities Press - this series of books gives authentic accounts of contributions of Indian physicists (See ‘Bose and his Statistics’, ‘Saha and his formula’, ‘Raman and his effect’ and ‘Chandrasekhar and his limit’)

Module II

Measuring instruments (12 Hours)

Measurement of time – water clocks – sun dials – pendulum clocks – digital clocks – atomic clocks.

Length measurement – rulers – standard metre – micrometers – screw gauges- travelling microscope – laser range finder- sonar – GPS.

Angle measurement – spectrometer verniers - scale and telescope - measurement of stellar parallaxes .

Electrical measurement - Working principle of galvanometer, voltmeter, ammeter and digital multimeters.

Instrumentation Devices & Systems - C. S. Rangan, G. R. Sarma, V. S. V. Mani

McGraw-Hill

<http://www.howstuffworks.com/> This site provides good information on

measuring instruments

Module III

Error Analysis (12 Hours)

Basic ideas – uncertainties of measurement – importance of estimating errors – dominant errors – random errors – systematic errors - rejection of spurious measurements

Estimating and reporting errors – errors with reading scales, errors of digital instruments – number of significant digits – absolute and relative errors - standard deviation – error bars and graphical representation.

Propagation of errors – sum and differences – products and quotients – multiplying by constants – powers

Calibration – need for calibration – methods of calibration.

An Introduction to Error Analysis: The Study of Uncertainties in Physical

Measurements, John R. Taylor - Univ. Science Books

<http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/>

<http://phys.columbia.edu/~tutorial/index.html>

Reference

1. Gieryn, T.F. **Cultural Boundaries of Science.**, Univ. Chicago Press, 1999.

2. Collins H. and T. Pinch. **The Golem: What Everyone Should Know About Science.**,Cambridge Univ Press, 1993.
3. Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, **Conceptual Integrated Science**, Addison-Wesley, 2007
4. Newton RG. The Truth of Science : New Delhi, 2nd edition
5. Bass, Joel, E and et.al. **Methods for Teaching Science as Inquiry**, Allyn & Bacon,2009
6. <http://www.howstuffworks.com/>
7. John R. Taylor. **An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements**, Univ. Science Books
8. <http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/>
9. <http://phys.columbia.edu/~tutorial/index.html>

10. Scientific Endeavour J A lee Longman

SEMESTER II

PHY2CRT01 - Mechanics and Properties of Matter

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This course would empower the student to acquire engineering skills and practical knowledge, which help the student in their everyday life. This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas.

Prerequisites: Basic mechanics, reasoning power, initiative skills and calculus

Module I

Motion under gravity : 5 hrs

Velocity- acceleration- force – acceleration due to gravity- weightlessness- compound pendulum (symmetric and unsymmetric) radius of gyration- kater's pendulum- centripetal acceleration and force- centrifugal force

Rotational mechanics : 6 hrs

Angular velocity- angular acceleration- angular momentum- conservation- torque- moment of inertia- Parallel and perpendicular axes theorem - calculation of moment of inertia- (rod, ring, disc, cylinder, sphere) flywheel.

**Fundamentals of Physics – Halliday and Resnik (John Wiley & sons);
Principles of Mechanics – John . L. Synge and Byron .A. Griffith (Mc-graw
Hills);**

**Mechanics – D.S.Mathur (S.Chand). Advanced Physics–Materials and
Mechanics – Tom Duncan (John Murray London); Classical Mechanics –
Goldstein ; Classical mechanics – K.SankaraRao (PHI); Refresher course in
Physics. Vol. 1 – C.L.Arora**

Module II

Oscillation and waves: 9 hrs

SHM, equation of motion to SHM- theory of damped oscillation (over, under, critical)- theory of forced oscillation- resonance- solution and equation to

progressive wave- energy of progressive wave- superposition of waves-theory of beats- Doppler effect.

Books of study: Vibration, waves and Acoustics – D. Chattopadhyay (Books and Allied Pvt Ltd, Calcutta); Text book of sound – Brijlal and Subrahmanniam (S.Chand); Classical mechanics – K.SankaraRao (Prentice Hall of India); Refresher course in Physics. Vol. 1 – C.L.Arora

Module III

Elasticity: 8 hrs

Stress- strain- Hooke's law- elastic module- Poisson's ratio- bending of beams- bending moment- Young's modulus (cantilever-mirror and telescope)- Young's modulus (uniform and non uniform bending-microscope) torsional oscillations- rigidity modulus- static torsion(mirror and telescope)- I section girder.

Surface tension: 4 hrs

Molecular theory of surface tension- surface energy- excess pressure in a liquid drop-transverse waves on the surface of a liquid- effect of gravity- effect of surface tension- factors affecting surface tension- applications.

Viscosity: 4 hrs

Streamline and turbulent flow- critical velocity- derivation of Poiseuille's formula-derivation of - Stoke's formula-Lubricants.

Properties of Matter- Brijlal and N. Subrahmaniam (S. Chand.); Refresher course in

Physics. Vol. 1 – C.L.Arora

Reference

1. Fundamentals of Physics - Halliday and Resnik (John Wiley)
2. Principles of Mechanics - John. L. Synge and Byron A Griffith (Mc- Graw Hill)
3. Advanced Physics - Materials and Mechanics - Tom Duncan (John Murray London)
4. Mechanics - D.S.Mathur (S.Chand)
5. Classical Mechanics - Goldstein
6. Classical Mechanics - K. SankaraRao (Prentice. Hall of India- N.Delhi)

7. Text Book of Sound - Brijlal and Subramaniam (S.Chand)
8. Refresher Course in Physics - Vol1- C.L.Arora
9. Vibration, Waves and Acoustics - D.Chattopadhyay (Books and Allied Pvt Ltd)
10. Properties of Matter - Brijlal and Subramaniam (S.Chand)
11. Properties of Matter - -D.S.Mathur (S.Chand)
12. Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
13. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
14. Mechanics- J.C. Upadhyaya (Ram Prasad and Sons)

SEMESTER III

PHY3CRT01 Electronics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope : We are living in a wonder world of Electronics. To know the physical principles and applications of Electronics is most necessary for a Physics student. This course is intended to provide this know-how.

Prerequisites: A basic knowledge of semiconductors, circuit fundamentals, current laws, network theorems, passive elements etc is a must for the deeper understanding of the topics.

Module-I

Basic concepts of semiconductors(15 Hours)

P-N junction Diode-Diode Characteristics-Expression for Diode current (Expression-without derivation)-Static and Dynamic resistances-Junction capacitance-Equivalent circuit-Avalanche and Zener breakdown-PIV.

Rectifiers-Half wave-Centre tapped full wave and Bridge rectifiers-Derivation of efficiency and ripple factor of half wave and full wave rectifiers

Filter circuits- Shunt capacitor filter-Series inductor filter-LC filter- π section filter-

Voltage regulation-Line regulation and load regulation- Zener diode shunt regulator-

Design of circuit-Optimum value of current limiting resistor.

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

A Text Book of Applied Electronics-R.S.Sedha: S.Chand Co. Multi Colour Edn.

Chapters-12,19,20 &33

Basic Electronics-B.L.Theraja: S.Chand Co. Chapters13&14

Module-II

Transistors (18 Hours)

Transistors-Bipolar junction transistors-Mechanism of amplification in a transistor-Common base, common emitter and common collector configurations and their characteristics-Active, saturation and Cut-off regions-Current gain α , β , γ and their relationships-Experiment to draw the characteristics of transistor in the CB and CE modes-Leakage currents-Expressions for output currents in the three modes-Thermal runaway-

Load line, Q-Point- Classification of amplifiers-Class A,B,AB and C amplifiers Need for biasing-Stabilization-Transistor biasing-Fixed bias-Collector to base bias-Self bias(emitter bias)-Voltage divider bias-Transistor as a switch.

AC equivalent circuit using h-parameters-Analysis of a transistor amplifier using h-parameters-Performance of CE,CC and CC amplifiers Basic ideas of FET & MOSFET

**A Text Book of Applied Electronics-R.S.Sedha: Multi colour Edn.
S.Chand Co.Chapters-14, 15,16 &25**

Basic Electronics-B.L.Theraja: S.Chand Co. Chapters 8,19, 20, 22&26.

Module-III

Amplifiers (21 Hours)

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.

Operational amplifiers - Ideal Op-amp - Virtual ground and summing point- Applications-Inverting amplifier - Non inverting amplifier-Unity follower - Summing amplifier (adder).

Modulation and Demodulation -Types of modulation - Amplitude modulation-
Percentage modulation-modulation index - Analysis of AM wave – Sidebands –
bandwidth - Power in an AM wave-Modulating amplifier circuit.

Frequency modulation-Carrier swing-Modulation index-Deviation ratio-
Percentage modulation (Basics only)

Demodulation or detection-Diode detector circuit for AM signals

**A Text Book of Applied Electronics-R.S.Sedha: Multi colour Edn
S.Chand Co.Chapter-29**

**Basic Electronics-B.L.Theraja: S.Chand Co.
Chapters25,30&31 References:**

1. Electronic Principles-Sahdev (Dhanpat Rai Co.)
Electronic Devices and Circuit Theory-Robert L Boylestad&Louis Nashelsky,
2. PHI
3. Electronic Principles and Applications-Schuler(McGrawHill)
4. Foundations of Electronics-D Chattopadhyay,P.C.Rakshit,B
Saha,N.N.Purkait(New Age International Publishers)
5. Principles of Electronics-V.K.Mehta(S.Chand Co.)
6. Electronic Principles-A.P.Malvino 5th Edition(Tata McGrawHill)
7. Electronic Devices and Circuits-Sajeev Gupta(Dhanpat Rai Publications)
8. Basic Electronics and Linear Circuits-
N.N.Bhargava,D.C.Kulshreshtha&S.C.Gupta (Tata McGrawHill)
9. Introduction to Semiconductor Devices, Kevin, Brennan Cambridge Univ. Press

10. Art of Electronics, Thomas C Hayes, Paul Horowitz, Cambridge Univ. Press



SEMESTER IV

PHY4CRT01 – Electricity and Electrodynamics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: Electricity and Electrodynamics have the key role in the development of modern technological world. Without electric power and communication facilities, life on earth stands still. A course in electricity and electrodynamics is thus an essential component of physics programme at graduate level. This course is expected to provide a sound foundation in electricity and electrodynamics.

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

Module I

Varying Currents: (9 hrs)

Growth and decay of current in an inductive circuit-charge and discharge of a capacitor through a resistance - measurement of high resistance by capacitor leak method- DC applied to LCR series circuit(charge case)-discharging of capacitor through LR circuit(discharge case)- Theory of BG-measurement of K of BG using standard capacitance.

Electricity and Magnetism- J.H.Fewkes & John Yarwood Chapters 3 & 5 Alternating currents & Circuit theory (10 hrs)

RMS and peak values-AC through series LCR(acceptor circuit) and parallel LCR circuit(rejecter circuit)-Q factor-power in AC-power factor-measurement of power in AC circuit-AC watt meter- Distribution of three phase current: star connection – delta connection -Ideal voltage and current sources-Thevenin's and Norton's theorems-Maximum power transfer theorem- Superposition Theorem

Electricity and Magnetism- J.H.Fewkes & John Yarwood chapter 6

Module II

Electrostatics- (13 hrs)

Electric field- Continuous charge distribution-Divergence and curl of electrostatic fields, Gauss' Law-Applications Fields due to: Spherically symmetric charge distribution, Uniformly charged spherical conductor, Line charge, Infinite plane sheet of charge, Electric field at a point between two oppositely charged parallel plates. 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-induced charges, Surface charge and force on a conductor-Capacitors.

Introduction to Electrodynamics- David J Griffiths- PHI Chapter 2

Magnetostatics and Maxwell's equations (12 hrs)

Magnetic field of Steady currents - Comparison of magnetostatics and electrostatics – Maxwell's equations and magnetic charge - Maxwell's equations inside matter – Boundary conditions – Scalar and vector potentials –Poynting theorem.

Introduction to Electrodynamics- David J Griffiths- PHI Chapter 5,7 &8

Module III

Electromagnetic waves (10 hrs)

Production and Detection of EM Waves- Hertz Experiment- The wave equation in one dimension – Plane waves - Polarisation – Boundary conditions- Reflection and transmission - Monochromatic plane waves in vacuum - Energy and momentum of

electromagnetic waves – Propagation through linear media — Modified wave equation in conductors - Monochromatic plane waves in conducting media.

Introduction to Electrodynamics- David J Griffiths- PHI Chapter 9

References

1. Electricity and Magnetism – J.H.Fewkes & John Yarwood -University tutorial Press
2. Fundamentals of Magnetism and Electricity D N Vasudeva - S chand
3. Electricity and Magnetism A S Mahajan and AA Rangwala -TMH
4. Introduction to electrodynamics- David J Griffiths- PHI
5. Electromagnetics Matthew N Sadiku- Oxford 4th Edn
6. Electromagnetics with applications Kraus/Fleish 5th Edn – TMH
7. Electromagnetics J A Edminister 2nd Edn - TMH
8. Electromagnetic Fields TVS Arunmurthi – S. Chand

SEMESTER V

PHY5CRT01 – Classical and Quantum Mechanics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course is a prelude to advanced theoretical studies in Condensed Matter Physics, Spectroscopy, Astrophysics, Electrodynamics and Nuclear Physics.

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

Module – I

Lagrange and Hamilton Equations (18 hours)

Constraints and degrees of freedom - Generalized coordinates –
Classification of a dynamical system – Principle of virtual work – D'Alemberts
Principle - Lagrange's equations for general systems - Applications – one
dimensional harmonic oscillator – planetary motion – Hamilton's equations of
motion – Application - One dimensional harmonic oscillator - Hamilton's Principle
for a conservative system – Principle of least action – Calculus of variations -
Lagrange's equation from Hamilton's Principle

Classical Mechanics – K. Sankara Rao, Prentice Hall of India. Chapter – 6

Module – II

Quantum Mechanics

I. Emergence of quantum concepts (9 hours)

Black body radiation - Planck's law - Particle nature of radiation – Photoelectric effect - Compton effect - wave nature of matter – deBroglie hypothesis – Davisson and Germer experiment - Uncertainty principle – probabilistic interpretation of wave function.

Introduction to Quantum Mechanics, Ajoy Ghatak, Macmillan India Ltd. Chapter– 3

II. Time dependent Schrodinger Equation (8 hours)

The Schrodinger equation – Operators - The commutator - Physical Interpretation of wave function – Normalisation probability current density - Expectation value – General eigen value equation – eigen value for momentum operator.

Introduction to Quantum Mechanics, Ajoy Ghatak, Macmillan India Ltd. Chapter– 4

Module – III

I. Propagation of wave packet (4 hours)

General solution of one dimensional Schrodinger equation for a free particle – group velocity and phase velocity.

Introduction to Quantum Mechanics – Ajoy Ghatak, Macmillan India Ltd. Chapter – 5 **II. Time independent Schrodinger Equation (15 hours)**

Stationary state - Time independent Schrodinger equation – boundary and continuity condition for wave functions – degeneracy – orthogonality of wave function – particle in a box (one dimensional) – One dimensional harmonic oscillator – energy eigen value

and zero point energy – Orbital angular momentum – commutation relations – Eigen values of L^2 , L_z - Energy eigen values of rigid rotator

Introduction to Quantum Mechanics, Ajoy Ghatak, Macmillan India Ltd. Chapter– 9

Reference:

1. Classical Mechanics - 3rd Edition: Herbert Goldstein, Charles Poole & John Safk, Pub. Pearson Education (Indian Edn.)
2. Mechanics, Hans & Puri, TMH
3. Classical Mechanics – Rana & Joag, TMH
4. Classical Mechanics – Greiner, Springer International Edn.
5. Classical Mechanics- Vimal Kumar Jain Ane Books Pvt. Ltd.
6. Quantum Physics – Stephen Gasiorowicz Pub. Pearson Education (Indian Edn.)
7. Quantum Mechanics - Greiner, 4th Edition, Springer International Edn.
8. Quantum Mechanics G. Aruldas, Prentice Hall of India.
9. Concepts of Modern Physics - Arthur Beiser, Tata Mc Graw Hill.
10. Applied Quantum Mechanics, A F J Levi, Cambridge Univ. Press.

SEMESTER V

PHY5CRT02 – Physical Optics and Photonics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course aims to provide necessary foundation in optics and photonics which prepare the students for an intensive study of advanced topics at a later stage.

Prerequisites: Concepts of waves, basics in Mathematics.

Module I

Interference (11 hrs)

Review of basic ideas of interference, (Coherent waves-Optical path and phase change-superposition of waves, condition for bright and dark fringes). Thin films- plane parallel film-interference due to reflected light-conditions for brightness and darkness-interference due to transmitted light-Haidinger fringes-interference in wedge shaped film-colours in thin films-Newton's rings. Michelson interferometer-construction-working and applications.

Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand Chapter 14 and 15 Diffraction (11 hrs)

Fresnel Diffraction – Huygens- Fresnel theory –zone plate –Difference between zone plate and convex lens. Comparison between interference and diffraction –diffraction pattern due to a straight edge, single slit. Fraunhofer diffraction at a single slit, double slit, N slits, theory of plane diffraction grating.

Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand Chapter 17 and 18

Module II

Polarization (10hrs)

Concept of polarization – (plane of polarization)-polarization by reflection-Brewster's law-polarization by refraction-pile of plates. Polarization by double refraction-(calcite crystal). Anisotropic crystals –optic axis –Double refraction-Huygens explanation of

double refraction. Positive and Negative crystals-Electromagnetic theory of double refraction. Types of polarized light-Retarders or wave plate- Quarter wave plate – Half wave plate- Production and Detection of elliptically and circularly polarized light-Optical Activity-Fresnel's Explanation of Optical Rotation-(Analytical treatment not needed) – Specific Rotation-Laurent's half shade polarimeter

Optics by Subramanayam, Brijlal, MN Avadhanulu, S.Chand. Chapter – 20

Module-III

Lasers (12hrs)

Absorption and emission of light-Absorption-spontaneous emission and stimulated emission-light amplification by stimulated emission. Einstein's relations-condition for light amplification –population inversion-pumping –pumping methods –optical pumping – electrical pumping -direct conversion. Active medium-metastable states-pumping schemes (two level, three level and four level) Optical resonator (theory not required) Threshold condition. Types of lasers-ruby laser, He-Ne laser, semiconductor laser. Applications of lasers-Holography (principle, recording and reconstruction)

An introduction to lasers theory and applications.MN Avadhanulu.S.Chand

Chapter-1

Fibre Optics and Optical Communication (10hrs)

Optical fibre- Critical angle of propagation-modes of propagation- Acceptance angle-Fractional refractive index change- Numerical Aperture- Types of Optical fibers-Normalized Frequency- pulse dispersion Attenuation- Applications- Fibre optic communication system- Advantages of Optical fibers.

Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand Chapter 24.

References

1. Optics 3rd edition- Ajoy Ghatak, TMH
2. Optical Electronics – Ajoy Ghatak and K Thyagarajan, Cambridge
3. Optics and Atomic Physics D P Khandelwal, Himalaya Pub. House
4. Optics S K Srivastava, CBS Pub. N Delhi
5. A Text book of Optics S L Kakani, K L Bhandari, S Chand.

SEMESTER V

PHY5CRT03 – Thermal and Statistical Physics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course is to develop a working knowledge of statistical mechanic and to use this knowledge to explore various applications related to topics in material science and the physics of condensed matter. **Prerequisites:** Basics of calculus and quantum mechanics.

Module I

Thermal Physics (18 hrs)

Laws of Thermodynamics: Zeroth law. First law- internal energy, Applications of first law, Indicator diagram, Work done during isothermal and adiabatic process, slopes, relation between them , cooling due to Adiabatic reversible processes . Reversible and irreversible processes, Second law, Heat Engines, Carnot cycle and theorem, Work done by the engine per cycle, efficiency, Otto Engine, Petrol engine, Diesel Engine, Third law of thermodynamics -Unattainability of absolute zero

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007) Chapters 4,5

Module II

Thermodynamic relations and Heat Transmission (18 hrs)

Entropy, entropy changes in reversible and irreversible processes, Entropy – temperature diagrams and equations. Physical significance of entropy. Clausius Clepeyron Equation. Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions, Maxwell's relations and applications, Concepts of adiabatic and isothermal elasticity, Modes of heat transfer, Searle's & Lee's experiment, black body radiation, Stefan-Boltzmann Law, Wein's displacement law, Rayleigh -Jean's Law, Planck's law (no derivation).

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007) Chapters 5,6,8,15

Module III

Statistical Mechanics (18hrs)

Micro and Macro states, thermodynamic probability, energy states, energy levels, degenerate energy levels, degenerate gas, phase space, concept of entropy and thermodynamic probability.

Classical Statistics: Maxwell-Boltzmann Distribution law, thermodynamics of an ideal monoatomic gas, Classical entropy expression, Gibbs' paradox.

Quantum Statistics:

Need of quantum statistics- Indistinguishability of particles- Spin and Statistics- Ideas of Bose Einstein distribution law and its application to black body radiation, Fermi Dirac Statistics and its application to electron gas

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne

(S. Chand & Co, Multi colour edition 2007) Chapters 9,10,11,12

Reference:

1. Heat and Thermodynamics, Mark W Zemaskay and Richard H Dittman, Tata McGraw-Hill Publishing Co. (Special Indian Edition)
2. Thermodynamics and Statistical Mechanics, Greiner, Springer
3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.

Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

SEMESTER V

PHY5CRT04 - Digital Electronics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course is expected to provide necessary back ground for applications of electronics in mathematical computation.

Prerequisites: Basic knowledge of electronics and Mathematics

Module I

Number systems (8 hrs)

Digital and analog systems- Comparison, Different number systems- decimal, binary, octal and hexadecimal-conversion between different systems- Binary arithmetic-addition, subtraction and multiplication. Subtraction with 2's complement and 1's complement- BCD code, ASCII code

Digital design- M Morris Mano PHI Chapter 1

Module II

Boolean algebra (20 hrs)

Binary logic- AND,OR and NOT operators- Logic symbol and truth table-Laws of Boolean algebra- Demorgan's theorem- Duality theorem- Boolean functions- Complement of a function- Reducing Boolean expressions- Canonical and standard form- Conversion between truth table, Boolean expressions and Logic diagrams-Simplification of Boolean functions using Karnauh map(Two, three and four variables) NAND, NOR, XOR, XNOR gates- IC digital logic families (Familiarization only)

Digital design- M Morris Mano PHI Chapter 2 and 3

Module III

Combinational Logic (9 hrs)

Adders- Half and Full adders- Subtractor- Four bit adder- Subtractor. Encoders, Decoders, Multiplexers and Demultiplexers

Sequential logic (17 hrs)

Flip-flops, RS, Clocked RS, MSJK FF, DFF JK, T Flip-flop, Buffer registers- Shift register- Counters- Binary ripple counter- BCD ripple counter- synchronous binary counter- Decade counter. D/A converters (Ladder type), A/D Converter (Counter type).

Digital design- M Morris Mano PHI Ch. 4,5,6 and 7

Digital principles and applications 6th Edn. Malvino, Leach and Saha TMH Ch. 13

Reference:

1. Digital design- M Morris Mano PHI
2. Digital logic and computer design - M Morris Mano PHI
3. Digital Electronics- William H Gothmann PHI
4. Digital principles and applications 6th Edn. Malvino, Leach and Saha TMH
5. Digital circuits and design- S Salivahanan and S Arivazhakan PHI

6. Digital Electronics- Sedha S Chand
7. Pulse, Digital and switching wave forms –Millam and Taub.
8. Digital computer electronics- Malvino, Brown TMH
9. Digital electronics- Tokheim(TMh)

Semester V

PHY5COT01- Open course

Energy and Environmental Studies

Credits – 4

No. of contact hours – 72

Scope: The course creates concern among the students on energy conservation and environmental protection.

Prerequisites: Basic knowledge in science.

Module I

Energy sources (14 hrs)

World's reserve of energy sources - various forms of energy - non-renewable energy sources:- coal, oil, natural gas; merits and demerits - renewable energy sources:- solar energy, biomass energy, biogas energy, wind energy, wave energy, tidal energy, hydro energy, geothermal, fusion energy, hydrogen; merits and demerits - storage of intermittently generated renewable energy (qualitative).

Text Books for study

1. Renewable Energy sources; Their impact on Global Warming and Pollution, Tasneem Abbasi and S.A. Abbasi (PHI Pvt. Ltd)

2. Non- conventional energy resources D.S Chauhan and S.K Srivastava (New Age International)

Solar energy utilization (16 hrs)

Sun as a source of energy - solar radiation - spectral distribution - flat plate collector- solar water heating – different types of solar water heaters - solar pond - convective and salt gradient types - optical concentrator - solar desalination - solar dryer – direct and indirect type - solar cooker - direct and indirect type - solar heating of buildings - solar green houses- solar photovoltaics - working principle.

Text Books for study

1. Non-conventional Energy Sources- G.D. Rai (Khanna Publishers).

Module II

Environmental pollution (20 hrs)

Basic concepts of ecology and environment - environmental pollution:- primary and secondary pollutants, classification - environmental degradation (causes, effects and control/treatment methods):- air pollution:- green house gases, global warming, climatic effects, water pollution, soil pollution, groundwater pollution, marine pollution, noise pollution, nuclear hazards - environmental pollution due to environmental disasters.

Text Books for study

1. Essential Environmental Studies S.P Misra, S.N Pandey (Ane Books Pvt Ltd)
2. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera (PHI Pvt. Ltd)
3. Environmental chemistry and pollution control S.S Dara (S. Chand)

Module III

Environment impact assessment and control (8 hrs)

Basic ideas of environment impact assessment - environment ethics - environmental laws and constitutional provisions to control pollutions in India:- the general acts , water and air acts , environment protection acts.

1. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera (PHI Pvt. Ltd)
2. Environmental Pollution - R K Khitoliya (S Chand)

3. Essential Environmental Studies S.P Misra, S.N Pandey (Ane Books Pvt Ltd)

Waste management (14 hrs)

Waste minimization and resource conservation:- source reduction, recycling , conservation and waste minimization - management of solid wastes (management and handling):- hazardous solid waste, municipal solid wastes, biomedical solid wastes - waste treatment and disposal methods:- physical, biological and chemical process- biogas plant-moving dome type.

Text Books for study

1. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera (PHI Pvt. Ltd)
2. Environmental chemistry and pollution control S.S Dara (S. Chand)
3. Biotechnology for waste and wastewater treatment- N.P. Cheremisinoff (PHI Pvt. Ltd)
4. Environmental management- B. Krishnamoorthy (PHI Pvt. Ltd)

References

1. Essential Environmental Studies S.P Misra, S.N Pandey (Ane Books Pvt Ltd)
2. Environmental Science G Tyler Miller (Cengage Learning)
3. Introduction to Environmental Science Y Anjaneyulu (B S Publications)
4. Introduction to Environmental engineering and science- G.M. Masters and W.P. Ela(PHI Pvt. Ltd)
5. Environmental management- B. Krishnamoorthy (PHI Pvt. Ltd)
6. Solar energy- fundamentals and applications- H.P. Garg and J. Prakash (Tata Mc Graw Hill).
7. Solar energy-fundamentals, design, modeling and applications- G.N. Tiwari (Narosa Pub. House).

SEMESTER VI

PHY6CRT01 - Computational Physics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54.

Scope: This course is intended to give an insight to computer hardware and computer applications.

Prerequisites: Basic mathematics and electronics

Module 1

Microprocessors (20 hrs)

Introduction to microprocessors- microprocessor operations (with relevance to 8085 microprocessor): 8085 bus organization-address bus- data bus- control bus, internal data operations- 8085 registers- accumulator- flags- program counter- stack pointer, externally initiated operations

The 8085 microprocessor architecture- pinout and signals- internal architecture of 8085 microprocessor

Machine language- assembly language- high level language.

Instruction cycle, machine cycle and T state- instruction format- addressing modes. The 8085 instruction set- simple programmes for data transfer, addition and subtraction.

Microprocessor architecture, programming and applications- Ramesh S. Gaonkar (Penram Int. Pub.) Chapter.1,2,3,5,6,7

Module II

Computer hardware (5 hrs)

Characteristics of a computer- I/O devices- memory and storage devices- RAM, ROM,

Primary and secondary memory

Fundamentals of Microprocessors and microcomputers- B. Ram (Dhanpat Rai Pub.)

Chapter 1

Programming in C⁺⁺ (17 hrs)

Introduction- C⁺⁺ programming basics- loops and decisions- basic ideas of structures, arrays, functions, objects and classes

Object oriented programming in Turbo C⁺⁺ - Robert Lafore (Galgotia Pub.)

Chapter 1,2,3,4

Module III

Numerical methods (12 hrs)

Iteration principle- solution of algebraic and transcendental equations- bisection, false position and Newton-Raphson methods- algorithms - numerical integration-trapezoidal rule and Simpson's 1/3 rule - algorithm- Numerical solution of differential equation- Euler's method and second order Runge-Kutta method-algorithm. Computer oriented numerical methods using C⁺⁺

Computer oriented numerical methods. V Rajaraman 3rd Edn PHI, Ch. 3,8and 9 References

1. Microprocessor architecture, programming and applications- Ramesh S. Gaonkar (Penram Int. Pub.)
2. Fundamentals of Microprocessors and microcomputers- B. Ram (Dhanpat Rai Pub.)
3. Microcomputers and Microprocessors- John Uffenbeck (PHI Pub.)
4. Object oriented programming in Turbo C⁺⁺ - Robert Lafore (Galgotia Pub.)
5. Programming with C⁺⁺ - John R. Hubbard (Mc Graw Hill Pub.)
6. Numerical method- V. Rajaram (PHI Pub.)
7. Introductory methods of Numerical methods -S.S .Sastry (PHI Pub.)
8. Numerical method with computer programming in C⁺⁺ - Ghosh (PHI Pub.)

PHY6CRT02 – Nuclear and Particle Physics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course intended to explore the interior of nucleus and interaction between nucleons

Prerequisites: Basic mathematics and quantum mechanics.

Module I

Nuclear structure & General properties of nuclei (15 hr)

Classification of nuclei – Isotopes, Isobars, Isomers, Mirror nuclei. General properties of nucleus – size, nuclear mass, density, charge, angular momentum, nuclear magnetic dipole moments, electric quadrupole moment, Mass defect, B.E, B.E. curve, packing fraction, nuclear stability. Theories of nuclear composition – proton-electron hypothesis – proton-neutron hypothesis. Properties of Nuclear forces – Meson theory of nuclear forces. Nuclear shell model. Determination of nuclear mass by Bainbridge’s mass spectrograph. Detectors of nuclear radiations – ionisation chamber - G.M Counter.

Modern Physics	(Ch. 8)	R. MurugeshanS.Chand
Modern Physics	(Ch.3)	R. MurugeshanS.Chand
Atomic and Nuclear Physics	(Ch.2)	S.N Ghoshal)S.Chand
Modern Physics	(Ch. 9)	R. MurugeshanS.Chand

Module II

Radioactivity (18 hr)

Natural radioactivity – Radioactive disintegration law – half life – Mean life
 Radioactive series. Radioactive dating – Uranium dating & Carbon dating Range of
 α particles – range – energy relationship. Geiger – Nuttal law Alpha particle
 disintegration energy Theory of α - delay – Gamow’s theory β - decay - β ray
 energy spectrum Neutrino hypothesis Positron emission, orbital electron capture
 (Basic ideas only) γ decay – Internal conversion Electron positron pair production
 by γ rays. Electron positron annihilation. Artificial radioactivity & Transuranic
 elements. (Basic ideas only)

**Atomic and
 Nuclear
 Physics
 Modern
 Physics**

**(Ch.3)

 (Ch. 11)**

**S.N Ghoshal
 S.chand R
 MurugesanS.Ch
 and**

Module III

Nuclear fission & Fusion (11 hr)

Discovery of nuclear fission – Fission products. Neutron emission in fission. Energy
 release in fission. Nuclear fission on the basis of liquid drop model chain reaction –
 Nuclear reactor – Breeder reactor Nuclear fusion Energy production in stars –
 Proton-Proton cycle and Carbon - Nitrogen cycle Peaceful utilization fusion power
 Controlled thermo nuclear reactions Toroidal confinement – Tokamak Nuclear
 waste disposal and radiation hazards from nuclear explosion – radiation dosage.

Modern Physics

(Ch. 13)

**R.
 Murugesan**

Atomic and Nuclear Physics

(Ch. 14)

S.N Goshal

Elementary particles (10 hr)

Particles and antiparticles – Fundamental interactions in nature. Classification of
 elementary particles according to nuclear interactions. Resonance particles
 Elementary particle quantum numbers and conservation laws. The quark model –

compositions of hadron according to quark model. Cosmic rays – Primary and secondary- latitude effect- altitude effect- eastwest effect

Modern Physics	S.N Ghoshal (Ch. 18) S.Chand
Atomic and Nuclear Physics	(Ch. 15) R. Murugesan S.Chand

References:

1. Nuclear Physics Principles and Applications. Lilley, Pub. John. Wiley
2. Nuclear and Particle Physics S L Kakani and Subhra Kakani -Viva Books 2008

SEMESTER VI

PHY6CRT03 -- Condensed Matter Physics

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course is intended to provide an introduction to the physics of Condensed Matter. This study attempts to explain various types of phenomena like electro-magnetic properties, super-conductivity and super fluidity.

Prerequisites: Basics of Mathematics, quantum mechanics

Module I

Crystal structure and Bonding (12 hrs)

Crystal Structure - Crystalline Matter - Bravais Lattice - Crystal Systems - Crystal Planes - and Miller Indices - Lattice Constants - Reciprocal Lattice - Crystal Structures - sc, bcc, fcc and hcp - Bragg's Law - Experimental Methods of X-Ray diffraction - Powder method.

Bonding in Solids - Ionic, Covalent, Van der Waal and Metallic Bonding (qualitative) - Binding Energy in Crystals - Madelung Constant.

Free Electron Theory and Band Theory of Solids (15 hrs)

Free Electron theory in one dimension- Formation of Energy Bands-Bloch Theorem (Statement) - Kronig Penney Model –Brillouin Zones (qualitative) – Effective Mass-Carriers in Solids- Metals, Insulators and Semiconductors-Band Structure-Intrinsic and Extrinsic Semiconductors- Electric Conductivity-Temperature Dependence-Hall effect.

M. Elementary Solid State Physics: (Pearson) Chapter1,2,5&6, Ali Omar Solid State Physics, P.K. Palanisamy, Scitech publications Chapter 1,2&6 Solid State Physics, S.Chand R.K Puri & V.K.Babber, Chapter 3&6.

Module II

Dielectric and Magnetic Properties of Solids (10Hrs)

Review of Basic Equations - Dielectric Constant - Dipole Moment-Polarizability- Clausius-Mosotti Relation- Ferroelectricity - Classification of Magnetic Materials- Langevin's theory - Paramagnetism - Curie-Weiss Law- Curie temperature - Antiferromagnetism and Ferrimagnetism – Magnetisation - Magnetic Domain Structure – Spintronics - Spin Waves.

M. Elementary Solid State Physics: Ali Omar (Pearson) Chapter 8& 9 Solid State Physics, P.K. Palanisamy, Scitech publications , Chapter 7&8 Solid State Physics, R.K Puri & V.K.Babber, S.Chand Chapter8 Mircea.S.Rogalski & B.Palmer, Solid State Physics. Chapter 8&9

Module III

Superconductivity (10 hrs)

Zero resistance - Superconducting Phenomenon - Critical Temperature - Meissner Effect-Type I& II Superconductors - BCS theory (qualitative) - London Equation - Josephson Effect – SQUID - High Tc superconductors and applications.

Elementary Solid State Physics: Ali Omar (Pearson) Chapter 10

Solid State Physics, P.K. Palanisamy, Scitech publications , Chapter 10

Materials Science and Technology (7hrs)

Amorphous Semiconductors - Liquid Crystals – Polymers - Thin films - Properties-Crystalline Materials and Applications - Nanostructures and Nanomaterials-Applications.

Elementary Solid State Physics: Ali Omar (Pearson) Chapter 12

Thin film fundamentals, A.Goswami.New Age International,2008. Chapter1 Nanostructures And Nanomaterials Synthesis, Properties, And Applications, Guozhong Cao, Imperial College Press, 2004 Chapter 3 And 5.

References

1. Kittel, C. Introduction to Solid State Physics, 8th edition (Wiley)
2. Ashcroft, N.W. & Mermin, N.D. Solid State Physics, TMH
3. Blakemore, J.S. Solid State Physics, 2nd edition (Cambridge)
5. S.O.Pillai, Solid State Physics. New Age International Pub.
6. Superconductivity, Superfluids and Condensate James F Annett Oxford

SEMESTER VI

PHY6CRT04 - Relativity and Spectroscopy

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: This course is intended to introduce principles of spectroscopy and special theory of relativity.

Prerequisites: Basics courses in Mathematics and Quantum mechanics

Module I

Special Theory of Relativity.(18 hours)

Inertial and non inertial frames of reference – Galilean transformation – Significance of Michelson – Morley experiment – postulates of STR- Lorentz transformation – spatial contraction - time dilation – composition of velocities – Mass of a moving particle – Equivalence of mass and energy – Introductory concepts of general theory of relativity

Concepts of modern Physics, Arthur Beiser

Classical Mechanics – K. Sankara Rao, Prentice Hall of India

Module II

Atomic spectroscopy (18 hours)

Historical introduction. Electromagnetic spectrum. Types of spectra. Absorption and emission of light by atoms- quantum theory- early atom models -Bohr model- – electron spin and magnetic moment - Exclusion principle - Stern- Gerlach experiment

- Vector atom model - quantum numbers associated with vector atom models- Total angular momentum and LS coupling– fine structure of Sodium D-lines. Zeeman effect- quantum mechanical explanation for anomalous Zeeman effect – Paschen–Back effect. NMR and ESR spectroscopy (qualitative ideas only)

Concepts of Modern Physics, Arthur Beiser; Tata McGraw-Hill

Fundamentals of Molecular Spectroscopy, C. Banwell and E. Mccash; TMH

Module III

Molecular Spectroscopy (18 hours)

Molecular energy levels. Electronic, rotational and vibrational energies – rotational spectra – explanation in terms of rigid rotator model – vibrational energy levels – explanation in terms of harmonic oscillator. Electronic energy levels of atoms – Fluorescence and phosphorescence – Raman effect – experimental arrangement and results - classical theory and its failure – quantum theory of Raman effect. IR and Microwave spectroscopes.

**Fundamentals of Molecular Spectroscopy, C. Banwell and E. Mccash;
Tata McGraw-Hill**

Molecular structure and Spectroscopy, G. Aruldas, Prentice Hall of India

References:

1. Arthur Beiser; Concepts of modern Physics.
2. C. Banwell and E. Mccash; Fundamentals of Molecular Spectroscopy.
3. G. Aruldas; Molecular structure and Spectroscopy.

SEMESTER VI

Choice Based course:

PHY6CBT01 – Renewable Energy Technology

Credits – 3

No. of contact hours – 90

Scope: This course is designed to make the students aware of challenging energy crisis and alternative energy solutions.

Prerequisites: Concepts of work- power- energy, heat energy- Modes of energy transfer- Heat engines, Concepts of Physical optics, Fundamental of Electricity.

Module I

Introduction to Energy Sources (6 hours)

Energy consumption as a measure of Prosperity – World energy futures – Energy sources and their availability – New energy technologies – Renewable energy sources

Non-conventional Sources of Energy - G D Rai

Chapter 1 Solar Energy (20 hours)

Solar radiation geometry – Solar radiation measurements – Principles of the conversion of solar radiation in to heat – Flat plate collectors – Energy balance equation and collector efficiency – Concentrating collector: Focusing type – Performance analysis of a parabolic collector – Selective absorber coatings – Solar energy storage systems – Solar pond – Principle of operation and extraction of thermal energy – Solar heating and solar cooling of buildings – Solar electric power generation: Solar photo-voltaic cells

Non-conventional Sources of Energy - G D Rai Chapters 2,3,4

Module II

Wind Energy (14 hours)

Basic principles of wind energy conversion – site selection considerations –
Classification of wind energy conversion systems – types of wind machines –
Performance analysis of wind machines – Schemes for electric generation –
Applications of wind energy – Environmental aspects.

Non-conventional Sources of Energy - G D Rai Chapter 6

Geothermal Energy (14 hours)

Nature of geothermal fields - Geothermal resources – Hot dry rock resources –
Magma resources – Geothermal exploration – Advantages and disadvantages
of geothermal energy – Applications of geothermal energy – Operational and
environmental problems.

Non-conventional Sources of Energy - G D Rai Chapter 8

Energy from Biomass (11 hours)

Biomass conversion technologies – Biomass as a source of energy – Energy
plantation – Methods for obtaining energy from biomass – Biogas generation –
Biodegradation – Biogas plants – Biogas from waste – Community biogas
plants – Thermal gasification of biomass.

Non-conventional Sources of Energy - G D Rai Chapter 7

Module III

Energy from the Oceans (15 hours)

Ocean thermal electric conversion (OTEC) – Introduction – Open cycle OTEC system
– Closed cycle OTEC system – Hybrid cycle – Prospects of OTEC in India.

Energy from Tides – Basic principle of tidal power – Operation methods of
utilization of tidal energy – Single cycle and double cycle systems – Advantages
and limitations of tidal power generation - Prospects of tidal energy in India.

Ocean waves – Energy and power from the waves – Wave energy conversion
devices - Advantages and limitations of wave energy.

Non-conventional Sources of Energy - G D Rai Chapter 9

Energy storage (10 hours)

Fuel cells – Design and principle of operation of a fuel cell – Classification of fuel cells

– Conversion efficiency of fuel cells – Applications of fuel cells.

Non-conventional Sources of Energy - G D Rai Chapter 10

Hydrogen energy – Hydrogen production (Electrolysis, thermochemical methods)

– Hydrogen storage – hydrogen as an alternative fuel for motor vehicles.

Non-conventional Sources of Energy - G D Rai Chapter 11

References:

1. Non – Conventional Energy Sources: G D Rai (Khanna Publishers)
2. Renewable Energy Technologies : [Solanki C S](#) (Prentice-hall Of India Pvt Ltd)
3. Renewable Energy Sources & Their Environmental Impact : [Abbasi](#) (Prentice-hall of India Pvt Ltd)
4. Renewable Energy Sources for Sustainable Development
[N.S.Rathore N.L.Panwar](#) (New India Publishing Agency)
5. Renewable Energy : [Ulrich Laumanns And Dieter Uh Dirk Abmann](#)
(James & James Science Publishers)
6. Understanding Renewable Energy Systems : [Volker Quaschnig](#) (James & James Science Publishers)
7. Renewable Energy: Global Perspectives : [Azmal Hussain](#) (Icfai University Press)
8. New And Renewable Energy Technologies For Sustainable Development :
Naim Hamdia Afgan, [Da Graca Carvalho Maria](#), [Maria Da Graca Carvalho](#)
(Taylor & Francis Group)
9. Renewable Energy from the Ocean : [Avery, William H.](#); [Wu, Chih](#); Craven,
John P. (Oxford University Press)

10. Fundamentals of Renewable Energy Systems : [Mukherjee D](#) (New Age International (p) Limited)
11. Renewable Energy Sources & Emerging Tech., : [Kothari D P](#) (Prentice-hall Of India Pvt Ltd)
12. Energy From Biomass : [Willeke Palz](#), [D. Pirrwitz](#) (Springer)
13. Understanding Renewable Energy Systems : [Volker Quaschnig](#) (James & James Science Publishers)
14. Ocean, Tidal, And Wave Energy: Power From The Sea : [Lynn Peppas](#) (Crabtree Publishing Company)
15. Fuel Cells, Geothermal Energy And Tidal Power: Emerging Scenario In Alternate Energy : [Sameer A Zodgekar](#) (Icfai University Press)

SYLLABUS FOR PRACTICAL – CORE COURSES

A minimum of 8 experiments should be done in each practical course component

SEMESTER I

PHY1CRP01

- | | | |
|----|-----------------------|---------------------------------------------------------------------------------------------|
| 1. | Vernier Calipers | - Volume of a cylinder, sphere and a hollow cylinder |
| 2. | Screw gauge | - Volume of a sphere and a glass plate |
| 3. | Spherometer | - Thickness of a glass plate, radius of curvature of a convex surface and a concave surface |
| 4. | Beam balance | - Mass of a solid (sensitivity method), radius measurement of capillary tube using mercury |
| 5. | Travelling microscope | - Radius of a capillary tube |
| 6. | Multimeter | -Measurement of resistance, potential difference, current |
| 7. | Multimeter | -Checking of capacitor ,diode ,inductance and transistor |

8. Identification of electronic components- Coil, capacitor, resistor, transistor, triac, diac, I C's 741,555 etc.
9. Viscosity of a liquid -Variable pressure head
10. Spectrometer - Angle of prism

SEMESTER II

Course PHY2CRP01

1. Cantilever- pin & microscope –Determination of Young's modulus
2. Carey Foster's Bridge-Measurement of resistivity
3. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)

4. Surface tension - Capillary rise method
5. Half wave rectifier with and without filter-ripple factor and load regulation
6. Conversion of Galvanometer into voltmeter
7. Viscosity-constant pressure head- coefficient of viscosity (η) of the liquid
8. Spectrometer- Refractive Index of material of Prism
9. Field along the axis of a coil-Variation of magnetic field along the axis of a circular coil
10. Electro chemical equivalent of copper

SEMESTER III

Course PHY3CRP01

1. Cantilever – Scale and Telescope-Determination of Young's modulus

2. Carey Foster's Bridge-Temperature coefficient
3. Asymmetric Compound Pendulum-Determination of K and g
4. Spectrometer-refractive index of a liquid –Hollow prism
5. Diode Characteristics.
6. Potentiometer-Measurement of resistivity
7. Full wave rectifier using diode – Ripple factor and load regulation
8. Transistor characteristics- CE configuration
9. Gates AND,OR,NOT- Verification of Truth Table
10. Torsion pendulum - Rigidity modulus

SEMESTER IV

Course PHY4CRP01

1. Non-uniform bending- Pin and Microscope method
2. Thermal conductivity of bad conductor- Lee's Disc
3. Bridge rectifier with filter and without filter- Ripple factor and load regulation
4. Spectrometer-prism- i-d curve
5. Potentiometer-Calibration of low range voltmeter
6. Searle's Vibration Magnetometer-Magnetic moment
7. Transistor Characteristics - CB configuration
8. Diode clamper- Positive and negative
9. Study of UJT characteristics
10. Sweep generator using transistor

SEMESTER V

Course PHY5CRP01

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. Viscosity- Searle's rotation viscometer method
6. Thermal conductivity of rubber
7. Melde's String – Measurement frequency
8. Sonometer – Verification of laws, Measurement of density of solid.
9. A.C Sonometer- Frequency of a.c.
10. Liquid Lens- Refractive index of Liquid

Course PHY5CRP02

1. Spectrometer – Grating- wave length
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. Potentiometer-Calibration of high range voltmeter.
7. Conversion of Galvanometer into ammeter
8. LCR circuit analysis-Series, parallel and Q-factor
9. Mirror Galvanometer-Figure of merit
10. B.G - charge sensitivity – Standard capacitor method

Course PHYCRP03

1. Characteristics of Zener diode
2. Voltage regulation using Zener diode
3. Voltage multiplier- Doubler and Tripler.
4. Characteristics of FET
5. Regulated power supply using IC 741
6. Wave shaping R C circuits - Integrator and differentiator
7. Diode clipper- Positive, Negative and Biased
8. Hartley Oscillator –frequency
9. Colpitt's oscillator –frequency
10. Phase shift oscillator- frequency

Course PHY5CRP04

1. Spectrometer – Grating- dispersive power
2. Spectrometer – Cauchy's constants
3. Newton's rings- Determination of wave length.
4. Laser- Determination of wave length
5. Ultrasonic- Determination of velocity of ultrasonic waves
6. Single slit – Diffraction using Laser
7. Verification of Thevenin's and Norton's theorem
8. Deflection and Vibration Magnetometer- m & B_H
9. e/m – Thomson's apparatus- Bar magnet/magnetic focusing
10. B.G - Measurement of capacitance

Course PH6B01U

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 material of prism (Supplementary angle method)
4. Field along the axis of circular coil-Moment of magnet (null method)
5. Kater's pendulum- g
6. Kundt's tube- Velocity of sound
7. Sp.heat of liquid –Newton's law of cooling
8. Computer programming – Simple Pendulum –Calculation of 'g' from experimental data.
9. Computer programming – Solving differential equation - Rungekutta method – II order.
Computer programming – Multiplication of any two matrices- $(m \times n)$ and $(n \times q)$

Course PH6B02U

1. Universal gates IC – NAND,NOR-Realize basic gates from universal gates.
2. B.G. –Measurement of high resistance by leakage method
3. BCD to 7 segment decoder (IC)
4. Astable multivibrator – using transistor
5. Monostable multivibrator- using transistor
6. Monostable multivibrator – IC 555
7. 8085 Microprocessor – sorting in ascending and descending order.
8. Computer programming –Conversion of temperature scale

9. Computer programming –sorting the numbers in ascending and descending order C++
10. Computer programming – Solving a quadratic equation

Course PH6B03U

1. Thermistor – Temperature coefficient of resistance
2. Regulated power supply – Transistor and Zener diode
3. Regulated power supply – Using IC's- LM 7805,7905,7809,7909,7812,7912
4. Construction and measurement of a dual Regulated power supply with filter.
5. Op-Amp - Adder and Subtractor
6. R.C. Coupled amplifier - Gain
7. Amplitude modulation
8. Pulse width modulation
9. Ring counter using 74194 and 74151
10. Astable multivibrator – IC 555

Course PH6B04U

1. D/A Converter using IC
2. 4 bit Shift register
3. Flip-Flop – R.S
4. J.K Flip-Flop

5. Schmitt trigger using 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. Computer programming – Solving a linear equation- Bisection method.
10. Computer programming – Solving a equation by Newton – Raphson method
11. Computer programming- Generation of Fibonacci series

References:

1. Properties of Matter - D.S. Mathur
2. Optics - Subramanyan & Brijlal
3. Electricity & Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. A text book of practical Physics _ Indu Prakash and Ramakrishnan.

Complementary Physics for Mathematics and Statistics

SEMESTER I

MT1C01U – Properties of Matter, Mechanics and Fourier analysis

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Prerequisites: Basic knowledge of mechanics, electricity, magnetism, properties of matter and mathematical tools.

Scope: The syllabus will cater into the basic requirements for his/her higher studies.

Module I

Elasticity (12 hrs)

Elastic moduli- Poisson's ratio- twisting couple- determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum- bending of beams- cantilever-uniform and non-uniform bending

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module II

Rotational dynamics of rigid bodies (10 hrs)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems- moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam Co.) (S. Chand and

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module III

Oscillations (9 hrs)

Periodic and oscillatory motion- simple harmonic motion- differential equation- expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion-damped oscillation- forced oscillation and resonance

Fourier analysis (5 hrs)

Fourier's theorem- evaluation of Fourier coefficients- analysis of square wave, saw tooth wave and triangular wave

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Mathematical methods for Physicists – G. B. Arfken and H.J. Weber (Academic press)

Reference:

1. Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
2. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
3. Mechanics- J.C. Upadhyaya (Ram Prasad and sons)
4. Mathematical methods for Physicists – G. B. Arfken and H.J. Weber (Academic press)

SEMESTER II

MT2C01U – Electric and Magnetic phenomena, Thermodynamics and Special theory of Relativity

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies.

Prerequisites: Basic knowledge of electricity, magnetism, heat, thermodynamics, mathematical tools.

Module I

Dielectric materials (7 hrs)

Dielectrics- polar and non-polar dielectrics- polarization- sources of polarization- Gauss's law in dielectrics- permittivity- dielectric displacement vector- dielectric constant-susceptibility- ferroelectricity

Magnetic Materials (7 hrs)

Magnetization in materials- linear and non-linear materials- diamagnetism- paramagnetism-ferromagnetism- hysteresis- ferromagnetic domains- antiferromagnetism- ferrimagnetism

Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

Module II

Thermodynamics (12 hrs)

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes- isothermal process- adiabatic process- zeroth law of thermodynamics-first law of thermodynamics- heat engine- the Carnot engine- refrigerator-concept of entropy- second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations

Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

Module III

Special theory of relativity (10 hrs)

Introduction- Galilean transformation- Newtonian principle of relativity- special theory- postulates- Lorentz transformation- length contraction- time dilation- relativity of simultaneity- addition of velocities- relativistic mass transformation- mass energy relation

Introduction to Modern Physics- H.S. Mani and G.K. Mehta West press Pvt. Ltd) Affiliated East Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Reference:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta East West press Pvt. Ltd) (Affiliated
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugesan (S. Chand and Co.)
4. Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)
5. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
6. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)
7. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

Introduction to Modern Physics- H.S. Mani and G.K. Mehta West press Pvt. Ltd)

Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module III

Basic electronics (13 hrs)

Semiconductors- doping- band structure- PN junction- biasing- Diode equation (derivation not expected) - diode characteristics- Zener diode- voltage regulation- diode circuits- rectification- half wave, full wave and bridge rectifiers- transistors- different configurations- characteristics- biasing-transistor amplifiers- feedback in amplifiers

Digital electronics (7 hrs)

Different number systems – decimal, binary, octal, hexa decimal number systems- conversion between different number systems- binary addition and subtraction- basic theorems of Boolean algebra- de Morgan's theorems AND, OR, NOT, NAND, NOR, XOR gates- truth tables- half adder- full adder

Basic electronics- B. L. Theraja (S. Chand and Co.)

Elements of electronics- M.K. Bagde, S.P. Singh and K. Singh (S. Chand and Co.)

Digital principles and applications- A. P. Malvino and P. Leach

Reference:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
 2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
 3. Modern Physics- R. Murugesan (S. Chand and Co.)
 4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)
 5. Basic electronics- B. L. Theraja (S. Chand and Co.)
 6. Elements of electronics- M.K. Bagde, S.P. Singh and K. Singh (S. Chand and Co.)
 7. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
 8. Digital principles and applications- A. P. Malvino and P. Leach
- Complementary Physics for Mathematics and Statistics

SEMESTER IV

PHY4CMT02 – Physical Optics, Laser Physics and Astrophysics

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 54

Module I

Interference (12 hrs)

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 (division of wave front) – Expression for fringe width- Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings-interference in thin films

Diffraction (8 hrs)

Introduction – Difference between Interference and diffraction- Fresnel and Fraunhofer diffraction- Fresnel Diffraction at a straight edge- Theory of plane transmission grating- Determination of wavelength (normal incidence) – resolving power- dispersive power

A Text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)

Optics- Satyaprakash (Ratan Prakash Mandir)

Optics- A. Ghatak (Tata McGraw-Hill)

Module II

Polarization (15 hrs)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization - polarization by reflection- Brewster's law- polarization by refraction through pile of plates – law of Malus- uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction-polarization by selective absorption- polaroid- polarization by scattering-elliptically and circularly polarized light- half wave and quarter wave plates

A text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)

Optics- Satyaprakash (Ratan prakash Mandir)

Optics- A. Ghatak (Tata McGraw-Hill)

Module III

Laser Physics (10 hrs)

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

Astrophysics (9 hrs)

Temperature and color of a star- brightness- size of a star- elements present in a stellar atmosphere- mass of star- life time of a star- main sequence stars-HR diagram- evolution of stars- white dwarf- supernova explosion- neutron star- black hole- (all topics to be treated qualitatively)

Introduction to Modern Physics- H.S. Mani and G.K. Mehta West press Pvt. Ltd)

(Affiliated East Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

An introduction to Astrophysics- Baidyanath Basu

Reference:

- 1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)**
- 2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)**
- 3. Modern Physics- R. Murugesan (S. Chand and Co.)**
- 4. A text book of optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu(S. Chand and Co.)**
- 5. Optics- Satyaprakash (Ratan prakash Mandir)**

6. **Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)**
7. **An introduction to Astrophysics- Baidyanath Basu**
8. **Optics- A. Ghatak (Tata McGraw-Hill)**

SYLLABUS FOR PRACTICAL – COMPLEMENTARY COURSES

COMPLEMENTARY PHYSICS FOR MATHEMATICS AND STATISTICS

A minimum of 8 experiments should be done in each practical course

SEMESTER I

1. Vernier Calipers - Volume of a cylinder, sphere and a beaker
2. Screw gauge - Volume of a sphere and a glass plate
3. Beam balance - Mass of a solid (sensitivity method)
4. Radius of a capillary tube- using (1) travelling microscope
5. Density of a liquid - U-Tube and Hare's apparatus
6. Viscosity of a liquid - Variable pressure head
7. Surface Tension – Capillary rise method.
8. Cantilever - Pin & Microscope – Determination of Young's Modulus
9. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)
10. Spectrometer – Angle of the Prism.

SEMESTER II

1. Cantilever – Scale and Telescope-Determination of Young's modulus
2. Asymmetric Compound Pendulum-Determination of K and g
3. Coefficient of Viscosity – Constant pressure head
4. Spectrometer - Refractive Index of material of prism.
5. Liquid lens - Refractive Index of glass using liquid of known refractive index
6. Potentiometer-Calibration of low range voltmeter
7. Characteristics of Zener diode
8. Construction of half wave rectifier with and without filter – Ripple factor and Load regulation
9. Mirror Galvanometer – Figure of merit
10. Torsion pendulum - Rigidity modulus

SEMESTER III

1. Non-uniform bending-Young's modulus - Pin and Microscope method
2. Field along the axis of circular coil- Variation of magnetic field and determination of BH
3. Carey Foster's Bridge - Measurement of resistivity
4. Liquid lens - Refractive index of liquid
5. Searle's vibration Magnetometer-Magnetic moment
6. Tangent Galvanometer – Ammeter calibration

7. Spectrometer – Prism – Dispersive power
8. Potentiometer-Calibration of low range ammeter
9. Construction of full wave rectifier with and without filter – Ripple factor and Load regulation
10. Construction of regulated power supply using Zener diode

SEMESTER IV

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 Dispersive power
6. Newton's rings - Wave length
7. Deflection and Vibration Magnetometer- m & Bh
8. Conversion of Galvanometer into voltmeter
9. Transistor characteristics- CE configuration
10. Gates – AND , OR, NOT- verification of truth table
11. Construction of CE amplifier – gain

References

1. Properties of matter - D.S. Mathur
2. Optics - Subrahmanyam & 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. A text book of Practical Physics _ Indu Prakash and Ramakrishnan.

COMPLEMENTARY PHYSICS FOR CHEMISTRY AND GEOLOGY

SEMESTER I

PHY1CMT01 –Properties of Matter, Mechanics and Particle Physics

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas.

Prerequisites: Basic knowledge of mechanics, properties of matter, mathematical tools.

Module I

Elasticity (12 hrs)

Elastic moduli- Poisson's ratio- twisting couple- determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum-bending of beams- cantilever-uniform and non-uniform bending

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module II

Rotational dynamics of rigid bodies (10 hrs)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems- moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module III

Oscillations (9 hrs)

Periodic and oscillatory motion- simple harmonic motion- differential equation- expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion-damped oscillation- forced oscillation and resonance

Particle Physics (5 hrs)

Fundamental interactions in nature- gauge particles- classification of particles- antiparticles- elementary particle quantum numbers- conservation laws- quark model (qualitative)

Modern Physics- R. Murugesan (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

References

SEMESTER II

**PHY2CMT01 – Electric and Magnetic Phenomena, Thermodynamics
and Elementary Solid State Physics**

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies.

Module I

Dielectric Materials

Dielectrics- polar and non-polar dielectrics- polarization- sources of polarization-Gauss's law in dielectrics- permittivity- dielectric displacement vector- dielectric constant- susceptibility- ferro electricity

Magnetic materials (7 hrs)

Magnetization in materials- linear and non-linear materials- diamagnetism- paramagnetism-ferromagnetism- hysteresis- ferromagnetic domains-antiferromagnetism- ferrimagnetism

Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and C

Module II

Crystalline solids (10 hrs)

Crystalline and amorphous solids- crystal lattice- basis- unit cell- lattice parameters- crystal systems- crystal planes and directions- miller indices- simple cubic- fcc -bcc hcp structures- packing fraction- NaCl structure- crystal diffraction- Bragg's law

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

Introduction to Solid State Physics- C. Kittel (John Wiley & Sons, 7th Edn.)

Module III

Thermodynamics (12 hrs)

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes- isothermal process- adiabatic process- zeroth law of thermodynamics- first law of thermodynamics- heat engine- the Carnot engine-refrigerator- concept of entropy- second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations

Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Heat and Thermodynamics- Brijlal and Subrahmanyam(S. Chand &Co)

References:

1. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

2. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

SEMESTER III

CH3C01U – Quantum mechanics, Spectroscopy, Nuclear Physics and Electronics

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours –54

Scope: This syllabus will cater the basic requirements for their higher studies.

Prerequisites: Basic knowledge of electricity, modern physics, mathematical tools.

Module I

Elementary Quantum theory (12 hrs)

Introduction- black body radiation and Planck's quantum hypothesis-photoelectric effect- Einstein's explanation- de Broglie hypothesis- matter wave- Davisson-Germer experiment- uncertainty principle (derivation not expected) -wave function- conditions-normalization- Schroedinger equation-stationary states- non-normalizable wavefunctions- box normalization

Spectroscopy (12 hrs)

Atom models- Thomson's model-Rutherford's nuclear atom model-Bohr atom model-Sommerfeld's relativistic atom model- vector atom model- Fine structure of Hydrogen atom -Rotational and vibrational spectra of rigid diatomic molecules- Raman effect- quantum theory

Introduction to Modern Physics- H.S. Mani and G.K. Mehta

Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module II

Atomic nucleus and radioactivity (10 hrs)

Nuclear constituents- different nuclear types- properties of nuclei- size- mass-charge-density- binding energy- packing fraction -nuclear stability -spin - magnetic dipole

moment -electric quadrupole moment -properties of nuclear forces -radioactivity- radiations -law of radioactive decay - half life- mean life-radioactivity units -radio active series-radio active dating- carbon dating-artificial radioactivity

Nuclear fission and fusion (7 hrs)

Nuclear fission- energy release in fission reactions- liquid drop model of fission-chain reaction- nuclear reactor- power and breeder reactor- atom bomb-nuclear fusion- energy production in stars- thermo nuclear reactions in sun- p-p chain - C-N cycle

Introduction to Modern Physics- H.S. Mani and G.K. Mehta

Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module III

Basic electronics (13 hrs)

Semiconductors- doping- band structure- PN junction- biasing- Diode equation (derivation not expected) - diode characteristics- Zener diode- voltage regulation- diode circuits- rectification- half wave, full wave and bridge rectifiers- transistors- different configurations- characteristics- biasing-transistor amplifiers- feedback in amplifiers

Basic Electronics- B. L. Theraja (S. Chand and Co.)

Elements of Electronics- M.K. Bagde, S.P. Sngh and K. Singh (S. Chand and Co.)

References:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugesan (S. Chand and Co.)
4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)
5. Basic Electronics- B. L. Theraja (S. Chand and Co.)
6. Elements of electronics- M.K. Bagde, S.P. Sngh and K. Singh (S. Chand and Co.)
7. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

SEMESTER IV

CH4C01U – Physical Optics, Laser Physics and Superconductivity

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours –54

Scope: This syllabus will cater the basic requirements for their higher studies.

Prerequisites: Basic knowledge of optics, Properties of matter, mathematical tools.

Module I

Interference (12 hrs)

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 (division of wave front) –Expression for fringe width- Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings-interference in thin films

Diffraction (8 hrs)

Introduction – Difference between Interference and diffraction- Fresnel and Fraunhofer diffraction- Fresnel Diffraction at a straight edge- Theory of plane transmission grating- Determination of wavelength (normal incidence) – resolving power- dispersive power

A text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)

Optics- Satyaprakash (Ratan prakash Mandir)

Optics- A. Ghatak (Tata McGraw-Hill)

Module II

Polarization (15 hrs)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization - polarization by reflection- Brewster's law- polarization by refraction through pile of plates – law of Malus- uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction-polarization by selective absorption- polaroid- polarization by scattering-elliptically and circularly polarized light- half wave and quarter wave plates

A text book of optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)

Optics- Satyaprakash (Ratan prakash Mandir)

Optics- A. Ghatak (Tata McGraw-Hill)

Module III

Laser Physics (10 hrs)

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

Superconductivity (9 hrs)

Super conducting phenomenon- Occurrence- BCS theory (qualitative) Meissner Effect- Type I and Type II superconductors- Josephson effects- High temperature superconductors- Applications of Superconductivity

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

Reference:

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)

Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugesan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

SYLLABUS FOR PRACTICAL – COMPLEMENTARY COURSES

Complementary Physics for Chemistry and Geology

A minimum of 8 experiments should be performed in each practical course

SEMESTER I

1. Vernier Calipers - Volume of a cylinder, sphere and a beaker
2. Screw gauge - Volume of a sphere and a glass plate
3. Beam balance - Mass of a solid (sensitivity method)
4. Radius of a capillary tube- Using (1) travelling microscope
5. Density of a liquid - U-Tube and Hare's apparatus

6. Viscosity of a liquid - Variable pressure head
7. Surface Tension – Capillary rise method.
8. Cantilever - Pin & Microscope – Determination of Young's Modulus
9. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)
10. Spectrometer – Angle of the Prism.

SEMESTER II

1. Cantilever – Scale and Telescope-Determination of Young's modulus
2. Asymmetric Compound Pendulum-Determination of K and g
3. Coefficient of Viscosity – Constant pressure head
4. Spectrometer - Refractive Index of material of prism.
5. Liquid lens - Refractive Index of glass using liquid of known refractive index
6. Potentiometer-Calibration of low range voltmeter
7. Characteristics of Zener diode
8. Construction of half wave rectifier with and without filter – Ripple factor and Load regulation
9. Mirror Galvanometer – Figure of merit
10. Torsion pendulum - Rigidity modulus

SEMESTER III

1. Non-uniform bending-Young's modulus-Pin and Microscope method
2. Field along the axis of circular coil- Variation of magnetic field and determination of BH
3. Carey Foster's Bridge - Measurement of resistivity
4. Liquid lens - Refractive index of liquid
5. Searle's vibration Magnetometer-magnetic moment
6. Tangent Galvanometer – Ammeter calibration
7. Spectrometer – Prism – Dispersive power
8. Potentiometer-Calibration of low range ammeter

9. Construction of full wave rectifier with and without filter – Ripple factor and Load regulation
10. Construction of regulated power supply using Zener diode

SEMESTER IV

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 Dispersive power
6. Newton's rings - Wave length
7. Deflection and Vibration Magnetometer- m & B_h
8. Conversion of Galvanometer into voltmeter
9. Transistor characteristics- CE configuration
10. Gates – AND , OR, NOT- verification of truth table
11. Construction of CE amplifier – gain

References

1. Properties of Matter - D.S. Mathur
2. Optics - Subrahmanyam & 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. A text book of Practical Physics _ Indu Prakash and Ramakrishnan.

