St Joseph's College, Devagiri

(Autonomous)

B.Sc. PHYSICS

(CORE AND COMPLIMENTARY PROGRAMMES)

SYLLABUS , SCHEME & MODEL QUESTION PAPERS

w.e.f 2015 admission onwards

B.Sc. DEGREE PROGRAMME (PHYSICS CORE)

COURSE SRTUCTURE

Semester	Course Code	Course Title	Total hours	Hours/ Week	Credits
I	**AENG1A01T**	Common Course I – English	72	4	4
	AENG1A02T	Common Course II – English	90	5	3
	AMAL1A01T	Common Course III – Language other than English	72	4	4
	APHY1B01T	Core course I - Methodology of Science and Physics	36	2	2
		Core Course V - Practical I	36	2	*
		1st Complementary Course I - Mathematics	72	4	3
		2nd Complementary Course I	36	2	2
		2nd Complementary Course Practical I	36	2	*
		Total	450	**25**	**18**
II	**AENG2A03T**	Common Course IV – English	72	4	4
	AENG2A04T	Common Course V – English	90	5	3
	AMAL2A04T	Common Course VI – Language other than English	72	4	4
	APHY2B02T	Core Course II - Properties of Matter, Waves and Acoustics	36	2	2
		Core Course V - Practical I	36	2	*
		1st Complementary Course II - Mathematics	72	4	3
		2nd Complementary Course II	36	2	2
		2nd Complementary Course Practical II	36	2	*
		Total	450	**25**	**18**
III	**AENG3A05T**	Common Course VI – English	90	5	4
	AMAL3A07T	Common Course VIII - Language other than English	90	5	4
	APHY3B03T	Core Course III – Mechanics	54	3	3
		Core Course VI– Practical I	36	2	*
		1st Complementary Course III – Mathematics	90	5	3
		2nd Complementary Course III	54	3	2
		2nd Complementary Course Practical III	36	2	*
		Total	450	**25**	**16**
IV	**AENG4A06T**	Common Course IX – English	90	5	4
	AMAL4A08T	Common Course X - Language other than English	90	5	4

	APHY4B04T	Core Course IV - Electrodynamics I	54	3	3
	APHY4B05P	Core Course Practical V – Practical I	36	2	**5**
		1st Complementary Course IV– Mathematics	90	5	3
		2nd Complementary Course IV	54	3	2
		2nd Complementary Course Practical IV	36	2	4
		Total	450	**25**	**25**
V	**APHY5B06T**	Core Course VI - Electrodynamics II	54	3	3
	APHY5B07T	Core Course VII - Quantum Mechanics	54	3	3
	APHY5B08T	Core Course VIII - Physical Optics and Modern Optics	54	3	3
	APHY5B09T	Core Course IX- Electronics (Analogue and Digital)	72	4	4
	ABCM5D03T, AECO5D01T, AENG5D01T, ABOT5D01T, ACHE5D02T, AMAT5D02T, APSY5D01T, AZOL5D01T, APED5D01T	Open Course – (*course from other departments*)	54	2	2
		Core Course Practical XIV - Practical II	72	4	*
		Core Course Practical XV- Practical III	72	4	*
		Project	36	**2**	*
		Total	450	**25**	**15**
VI	**APHY6B10T**	Core Course X - Thermal and Statistical Physics	72	4	4
	APHY6B11T	Core Course XI - Solid State Physics, Spectroscopy and Laser physics	72	4	4
	APHY6B12T	Core Course XII - Nuclear Physics, Particle Physics and Astrophysics	72	4	4
	APHY6E01T	Core Course XIII (Elective)	54	3	3
	APHY6B13P	Core Course Practical XIV – Practical II	72	**4**	**5**
	APHY6B14 P	Core Course Practical XV – Practical III	72	**4**	**5**
	APHY6B15D	Course XVI Project& Tour report	36	**2**	3
		Total	450	**25**	**28**
Total Credits					**120**

Tour report may be evaluated with Practical III

CREDIT AND MARK DISTRIBUTION IN EACH SEMESTERS

Total Credits: 120; Total Marks: 3600

Semester	*Course*	*Credit*	*Marks*
I	Common course: English	4	100
	Common course: English	3	100
	Common course: Additional Language	4	100
	Core Course I: Methodology of Physics and Science	2	100
	Complementary course: Mathematics	3	100
	Complementary course: II	2	80
	Total	**18**	**580**
II	Common course: English	4	100
	Common course: English	3	100
	Common course: Additional Language	4	100
	Core Course II: Properties of matter ,Waves and Acoustics	2	100
	Complementary course: Mathematics	3	100
	Complementary course: II	2	80
	Total	**18**	**580**
III	Common course: English	4	100
	Common course: Additional Language	4	100
	Core Course III: Mechanics	3	100
	Complementary course: Mathematics	3	100
	Complementary course: II	2	80
	Total	**16**	**480**
IV	Common course: English	4	100
	Common course: Additional Language	4	100
	Core Course IV: Electrodynamics-1	3	100
	Core Course V: Physics Practical 1	5	150
	Complementary course: Mathematics	3	100
	Complementary course: II	2	80
	Complementary course: II Practical	4	80
	Total	**25**	**710**
V	Core Course VI: Electrodynamics II	3	100
	Core Course VII :Quantum Mechanics	3	100
	Core Course VIII: Physical Optics and Modern Optics	3	100
	Core Course IX: Electronics	4	100
	Open course	2	50
	Total	**15**	**450**
VI	Core Course X: Thermal and Statistical Physics	4	100
	Core Course XI: Solid State Physics ,Spectroscopy and Laser	4	100
	Core Course XII: Nuclear Physics ,Particle Physics and Astrophysics	4	100
	Core Course XIII: Elective	3	100
	Core Course XIV: Practical II	5	150
	Core Course XV: Practical III	5	150
	Core Course XVI: Project	3	75

	and Tour report		25
	Total	**28`**	**800**
	Grand Total	**120**	**3600**

COURSE STRUCTURE PHYSICS(CORE)

Credit Distribution

Semester	*Common course*		*Core course*	*Complementary course*		*Open course*	*Total*
	English	*Additional Language*		*Mathematics*	*Chemistry*		
I	4+3	4	2	3	2	-	18
II	4+3	4	2	3	2	-	18
III	4	4	3	3	2	-	16
IV	4	4	3+5*	3	2+4*	-	25
V	-	-	3+3+3+4	-	-	2	15
VI	-	-	4+4+4+3+5*+5*+3**	-	-	-	28
Total	**22**	**16**	**56**	**12**	**12**	**2**	**120**

*Practical **Project

Tour Report to be evaluated with Practical Paper III

Mark Distribution and Indirect Grading System

Mark system is followed instead of direct grading for each question. After external and internal evaluations marks are entered in the answer scripts. All other calculations, including grading, will be done by the controller of examination of the college using the software. Indirect Grading System in 7 point scale is followed. Each course is evaluated by assigning marks with a letter grade (A^+, A, B, C, D, E or F) to that course by the method of indirect grading.

Mark Distribution

Sl. No.	*Course*	*Marks*	*Credits*
1	English	600	22
2	Additional Language	400	16
3	Core course: Physics	1750	56
4	Complementary course I: Mathematics	400	12
5	Complementary course II: Chemistry/….	400	12
6	Open Course	50	2
	Total	**3600**	**120**

Core Course Structure
Total Credits: 56 (Internal: 20%; External: 80%)

Semester	*Code No*	*Course Title*	*Hrs/ Week*	*Total Hrs*	*Credit*	*Marks*
I	APHY1B01T	Core Course I: Methodology of Science and Physics	2	36	2	100
	-	Core Course V : Practical-I	2	36	-*	-
II	APHY2B02T	Core Course II: Properties of matter waves and Acoustics	2	36	2	100
	-	Core Course V : Practical-I	2	36	-*	-
III	APHY3B03T	Core Course III: Mechanics	3	54	3	100
	-	Core Course V : Practical-I	2	36	-*	-
IV	APHY4B04T	Core Course IV: Electrodynamics-I	3	54	3	100
	APHY4B05P	Core Course V : Practical-I	2	36	5	150
V	APHY5B06T	Core Course VI: Electrodynamics-II	3	54	3	100
	APHY5B07T	Core Course VII: Quantum Mechanics	3	54	3	100
	APHY5B08T	Core Course VIII: Physical Optics and Modern Optics	3	54	3	100
	APHY5B09T	Core Course IX: Electronics	4	72	4	100
		Core Course XIV: Practical II	4	72	-**	-
		Core Course XV: Practical III	4	72	-**	-
		Core Course XVI: Project Work	2	36	-**	-
VI	APHY6B10T	Core Course X: Thermal and statistical Physics	4	72	4	100
	APHY6B11T	Core Course XI: Solid State Physics, Spectroscopy and Laser	4	72	4	100
	APHY6B12T	Core Course XII: Nuclear Physics, Particle Physics and Astrophysics	4	72	4	100
	APHY6E01T	Core Course XIII: Elective*** 1. COMPUTATIONAL PHYSICS	3	54	3	100
	APHY6E02T	2. MATERIALS SCIENCE				
	APHY6E03T	3. NANO SCIENCE AND TECHNOLOGY				
	APHY6B13P	Core Course XIV: Practical -II	4	72	5**	150
	APHY6B14P	Core Course XV: Practical-III	4	72	5**	150
	APHY6B15D	Core Course XVI: Project Work &Tour Report	2	36	3**	75 25
				Total	**56**	**1750**

* Exam will be held at the end of 4th semester

** Exam will be held at the end of 6th semester

*** Institution can choose any one among the three courses.

CORE COURSE THEORY: EVALUATION SCHEME

The evaluation scheme for each course contains two parts: *viz.,* internal evaluation and external evaluation. Maximum marks from each unit is prescribed in the syllabus.

1. INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The Department shall send only the marks obtained for internal examination to the controller.

Table 1: Components of Evaluation

Sl. No.	*Components*	*Marks*
1	Attendance	5
2	Test papers: I & II	5 + 5
3	Assignment	2
4	Seminar/ Viva	3
	Total Marks	20

Table 2: Percentage of Attendance and Eligible Marks

% of attendance	*Marks*
90% and above	5
85-89%	4
80-84%	3
76-79%	2
75%	1
Below 75%	0

Table 3: Pattern of Test Papers

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
1.5 hours	Short answer	4	4	1	`4
	Paragraph	5	3	4	12
	Problem	6	4	4	16
	Short Essay	2	1	8	8
				*Total Marks**	40

*90% and above = 5, 80 to below 90% = 4.5, 70 to below 80% = 4, 60 to below 70% = 3.5, 50 to below 60% = 3, 40 to below 50% = 2, 35 to below 40% = 1, below 35% = 0

2. EXTERNAL EVALUATION

External evaluation carries 80% marks. University examinations will be conducted at the end of each semester.

Table 1: Pattern of Question Paper

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
3 hours	Short answer(two or three Sentence)	8	8	1	8
	Paragraph Questions(each in about a page)	9	6	4	24
	Problems	12	8	4	32
	long answer(about two pages)	4	2	8	16
				Total Marks	80

CORE COURSE PROJECT: EVALUATION SCHEME

Project evaluation will be conducted at the end of sixth semester.

Project:

1. Project work should be done as an extension of topics in the syllabus.
2. Project can be experimental / theoretical or done in collaboration (association) with a recognised lab or organisation.
3. Project work may be done individually or as group of maximum of six students.
4. A supervisor has to guide a batch of maximum 6 students. For every additional batch of 6 students, supervisors has to be appointed. However the existing work load should be maintained.

Guidelines for doing **project**

The project work provides the opportunity to study a topic in depth that has been chosen or which has been suggested by a staff member. The students first carryout a literature survey Which will provide the background information necessary for the investigations during the research phase of the project.
The various steps in project works are the following:-
a) Wide review of a topic.
b) Investigation on an area of Physics in systematic way using appropriate techniques.
c) Systematic recording of the work.
d) Reporting the results with interpretation in written and oral forms.

Use of Log Book

- During the Project the students should make regular and detailed entries in to a personal laboratory log book through the period of investigation.
- The log book will be a record of progress on project and will be useful in writing the final report. It contains experimental conditions and results, ideas, mathematical expressions, rough work and calculation, computer file names etc. All entries should be dated.
- The students are expected to have regular meeting with their supervisor to discuss progress on the project and the supervisor should regularly write brief comments with dated signature.
- **The log book and the report must be submitted at the end of the project**.

Table 1: Internal Evaluation

Sl. No	*Criteria*	*Marks*
1	Punctuality &Log book	3
2	Skill in doing project work/data	3
3	Scheme Organisation of Project Report	4
4	Viva-Voce	5

Table 2: External Evaluation

Individual presentation is compulsory and individual Log book should be submitted

Sl. No	*Criteria*	*Marks*
1	Content and relevance of the project, Methedology, Reference, Bibliography	12
2	Project Presentation, Quality of analysis, statistical tools, findings, recommendations	18
3	Project Report and Log Book	10
4	Viva-voce	20
	Total Marks	60

STUDY TOUR

Minimum two days visit to National research Institutes, Laboratories and places of scientific importance. **Study tour report** has to be submitted with photos and analysis along with Practical Paper III for evaluation

Distribution of marks EXTERNAL

No	Items	External (20)
1	Report	10
2	Outcome/Analysis	6
3	Photos (five photos)	4
	TOTAL	**20**

Practical Evaluation (Core)

Internal		**External**	
Items	**Marks**	**tems**	**Marks**
Record	6	Record with 24 expts Deduct one mark for each expt. not done	20
Regularity in getting the expts done	6	Formulae, Theory, Principle/ Programme	30
Attendance	6	Adjustments& setting / Algorithm	20
Test 1	6	Tabulation, Observation and performance/ Execution	30
Test 2	6	Calculation, result, graph, unit/ Result	15
		Viva	5
Total	**30**	**Total**	**120**

CORE COURSE – XIII (ELECTIVE) :		
1	APHY6E01T	COMPUTATIONAL PHYSICS
2	APHY6E02T	MATERIALS SCIENCE & THIN FILMS
3	APHY6E03T	NANO SCIENCE AND TECHNOLOGY

OPEN COURSES OFFERED BY PHYSICS DEPARMENT (For students from other streams)		
1	APHY5D01T	NON CONVENTIONAL ENERGY SOURCES
2	APHY5D02T	AMATEUR ASTRONOMY AND ASTROPHYSICS
3	APHY5D03T	PHYSICS IN EVERY DAY LIFE (SYLLABUS UNDER PREPARATION)

PHYSICS COMPLEMENTARY COURSE STRUCTURE

Total Credits: 12 (Internal: 20%; External: 80%)

Semester	*Code No*	*Course Title*	*Hrs/ Week*	*Total Hrs*	*Credit*	*Marks*
I	APHY1C01T	Complementary Course I: Properties of matter and Thermodynamics	2	36	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
II	APHY2C02T	Complementary Course II: Mechanics, Relativity, Waves and Oscillations	2	36	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
III	APHY3C03T	Complementary Course III: Optics ,Laser, Electronics and Communication	3	54	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
IV	APHY4C04T	Complementary Course IV: Electricity ,Magnetism and Nuclear Physics	3	54	2	80
	APHY4C05P	Complementary Course V: PHYSICS Practical	2	36	4*	80
				Total	**12**	**400**

* Examination will be held at the end of 4th semester

COMPLEMENTARY COURSE THEORY: EVALUATION SCHEME

The evaluation scheme for each course contains two parts: *viz.,* internal evaluation and external evaluation. Maximum marks from each unit is prescribed in the syllabus.

1. INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The Department shall send only the marks obtained for internal examination to the controller.

Table 1: Components of Evaluation

Sl. No.	*Components*	*Marks*
1	Attendance	4
2	Test papers: I & II	4 + 4
3	Assignment	2
4	Viva-Voce	2
	Total Marks	16

Table 2: Percentage of Attendance and Eligible Marks

% of attendance	*Marks*
90% an above	4
85-89%	3.2
80-84%	2.4
76-79%	1.6
75%	0.8
Below 75%	0

Table 3: Pattern of Test Papers

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
1.5 hr	Short answer	6	6	1	6
	Paragraph	5	3	3	9
	problems	5	3	3	9
	Essay	2	1	8	8
				Total Marks[*]	32

[*]Marks: 80% and above = 2, 60 to below 80% = 1.5, 50 to below 60% = 1, 35 to below 50% = 0.5, below 35% = 0.

2. EXTERNAL EVALUATION

External evaluation carries 80% marks. University examinations will be conducted at the end of each semester.

Table 1: Pattern of Question Papers

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
3 hours	Short answer- two or three sentences	9	9	1	9
	Paragraph- about a page	10	7	3	21
	Problems	9	6	3	18
	Essay-about two pages	4	2	8	16
				Total Marks	64

Practical Evaluation (Complementary)

Internal		External	
Record	4	Record with 24 expts (Deduct ½ mark for each expt less)	10
Regularity	3	Formulae, Theory, Principle	12
Attendance	3	Adjustments, setting	12
Test I	3	Tabulation & Observation	16
Test II	3	Calculation, graph, result, unit	10
		Viva	4
Total	**16**	**Total**	**64**

OPEN COURSE STRUCTURE
(FOR STUDENTS OTHER THAN B.Sc. Physics)
Total Credits: 2 (Internal 20%; External 80%)

Semester	*Code No*	*Course Title*	*Hrs/ Week*	*Total Hrs*	*Marks*
V	APHY5D01T	Open Course 1: Non conventional Energy Sources	2	36	50
	APHY5D02T	Open Course 2: Amateur Astronomy and Astrophysics			
	APHY5D03T	Open Course 3: Physics in Everyday life			

OPEN COURSE: EVALUATION SCHEME

The evaluation scheme contains two parts: *viz.*, internal evaluation and external evaluation.

Maximum marks from each unit are prescribed in the syllabus.
Problems are not compulsory

1. INTERNAL EVALUATION

20% of the total marks are for internal evaluation. The departments shall send only the marks obtained for internal examination to the controller.

Table 1: Components of Evaluation

Sl. No.	*Components*	*Marks*
1	Attendance	2.5
2	Test papers: I & II	2.5 + 2.5
3	Assignment / Viva	2.5
	Total Marks	10

Table 2: Percentage of Attendance and Eligible Marks

% of attendance	*Marks*
90% and above	2.5
85-89%	2
80-84%	1.5
76-79%	1
75%	0.5
Below 75%	0

Table 3: Pattern of Question Paper (Internal)

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
	Short answer	5	5	1	5
	Paragraph/problem	5	3	4	12
	Essay	2	1	8	8
				Total Marks	25

*Marks: 80% and above = 2.5, 60 to below 80% = 2, 50 to below 60% = 1.5, 40 to below 50% = 1, 35 to below 40% = 0.5, below 35% = 0.

2. EXTERNAL EVALUATION

External evaluation carries 80% marks. End semester examination will be conducted at the end of 5th semester.

Table 1: Pattern of Question Paper

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
2 hours	Short answer- one or two sentence	10	10	1	10
	Paragraph- half page/problem	8	5	4	20
	Essay- within 2 pages	4	2	10	20
				Total Marks	50

Core Course I

APHY1B01T: METHODOLOGY OF SCIENCE AND PHYSICS– 36 hours (Credit - 2)

Unit I: Methodology And Perspectives Of Sciences (6 Hours) – 21 marks*

Types of knowledge: Practical, Theoretical, and Scientific knowledge, Information.

What is Science; what is not science; Formulation of hypothesis; Hypothetico-deductive model, Inductive model. Galelios experiment on falling objects, Significance of verification (Proving), Corroboration and falsification (disproving), Auxiliary hypothesis, Ad-hoc hypothesis. Basis for scientific laws. Criteria for scientific theories. Design of an experiment , experimentation , Observation, data collection, Scientific temper. Scientific Revolution

Reference Books:

1. Gieryn, T F. Cultural Boundaries of Science., Univ. of Chicago Press, 1999
2. Collins H. and T Pinch., The Golem: What Everyone Should Know About Science., Cambridge Uni. Press, 1993
3. Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, Conceptual Integrated Science. Addison-Wesley, 2007
4. Newton R G. 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. Scientific Revolution - Very short introduction, Lawrence M. Principe, Oxford University Press, 2011
7. Scientific Method – An Historical and Philosophical Introduction- Barry Gower -Taylor & Francis e-Library, 2002

Unit - II: Methodology and Perspectives of Physics (6 Hours) – *21 marks**

(† All topics in this part require qualitative study only on historical perpective, derivations are not required)

What does physics deal with? - Ancient perpectives of universe. Models of Ptolemy, Copernicus Galileo, Kepler, Newotn. The inconsistency between experiments and theories- Birth of new science concepts - Quantum concepts -Black body radiation, Photoelectric effect, Compton effect, De Broglie waves, Sections 2.2, 2.3, 2.5, 2.7, 3.1, of Arthur Beisser). †

References:

Scientific Method – An Historical and Philosophical Introduction- Barry Gower -Taylor & Francis e-Library, 2002

Scientific revolution - Very short introduction , Lawrence M. Principe, Oxford University Press, 2011

Concepts of Modern physics- Arthur Beisser

A brief history and philosophy of Physics - Alan J. Slavin- http:/ www.trentu. Ca/ academic / history- 895 .html

The inspiring History of Physics in the Last One Hundred Years : Retrospect and prospect Prof. Dr-lng . Lu Yongxiang http :// www.twas .org.cn/twas/proLu.asp

Unit III – Mathematical Methods in Physics (18 Hours) 62 marks*

Vector Analysis: – Vector Operations - Vector Algebra – Component form – How vectors transform, Applications of vectors in Physics. (4 hrs)

Differential Calculus: – The operator ∇ - Gradient, Divergence, Curl – Physical interpretation - Product rules of ∇ - Second derivatives.

Integral Calculus: – Line integral, surface integral and volume integral - Fundamental theorem of Gradients – Gauss's Divergence Theorem (Statement only)– The fundamental theorem of curl – Stoke's theorem(Statement only). Divergence less and curlless fields.

Curvilinear co-ordinates: – Spherical polar coordinates – cylindrical coordinates(Basic ideas). - (8 hrs)

References:

1. Introduction to electrodynamics – David J . Griffiths, Prentice Hall India Pvt. Ltd., Chapter – 1
2. Mathematical Physics - Satya Prakash, Sultan Chand &Sons, New Delhi

Unit IV – Errors in Experiment (6 hours) – 20 marks*

Errors of Observation – Random error, systematic error. Normal laws of errors, Average error, Standard deviation, Probable error. Practical determination of error, Significant figures, Percentage error. (Part 1A of ref 1)

Reference:

1. Advanced course in practical physics, B Chathopadhyay and P C Rakshit, New Central Book Agency

NB. Qestion paper should contain questions from all unit and must comply with the distribution of mark shown in the syllabus (Marks shown in the syllabus is total maks including choices)

Reference

1. Advanced Engineering mathematics –Erwin Kreyszig(8^{th} Edition)
2. Practical Physics, G L Squires, Cambridge University Press.

Semester -2

Core course –II - 36 hours (Credit – 2)

APHY2B02T: PROPERTIES OF MATTER, WAVES & ACOUSTICS

Unit-1: Properties of Matter 9 Hours Max marks 28

Elasticity: Basic ideas, Work Done per Unit Volume, Relations between elastic constants, Poisson's Ratio, Limiting Values of Poisson's Ratio, Twisting Couple on a Cylinder (or a Wire), Torsion pendulum, Determination of Rigidity Modulus, Bending of Beams, Bending Moment, Cantilever Loaded at Free End, Depression of a Beam Supported at the Ends and Loaded at the Centre (weight of the beam neglected), Determination of Y by Bending of a Beam, I form of Girders.

(Sections: 8.1 to 8.18, 8.22 to8.23, 8.26 to 8.27, 8.29 to 8.30, 8.33 to 8.34

Elements of Properties of Matter by D.S. Mathur)

Unit-2 Harmonic Oscillator 14 hours Max marks 54

Periodic Motion, Simple Harmonic Motion and Harmonic Oscillator, Energy of a Harmonic Oscillator, Examples of Harmonic Oscillator, Anharmonic Oscillator, Composition of Two Simple Harmonic Motions of Equal Periods in a Straight Line, Composition of Two Rectangular Simple Harmonic Motions of Equal Periods: Lissajous Figures, Damping Force, Damped Harmonic Oscillator, Examples of Damped Harmonic Oscillator, Power Dissipation, Quality Factor, Forced Harmonic Oscillator

(Sections: 9.1 to 9.4, 9.7, 9.10 to 9.11, 10.1 to 10.4 to 10.6 of Mechanics by J.C Upadhyaya)

Unit-3 Waves 8 hours Max marks 28

Wave Motion, General Equation of Wave Motion, Plane Progressive Harmonic Wave, Energy Density for a Plane Progressive Wave, Intensity of a Wave, Transverse Waves in Stretched Strings, Modes of Transverse Vibrations of Strings, Longitudinal Waves in Rods and Gases, Fourier's Theorem, Wave Velocity and Group Velocity

(Sections:11.1 to 11.9 , 11.12 to 11.13 of Mechanics by J.C Upadhyaya)

Unit-4 Acoustics 5 hours Max marks 20

Intensity of Sound- Decibel and Bel, Loudness of Sound, Noise Pollution, Ultrasonics: Production of Ultrasonic Waves- Piezo Electric Crystal Method, Determination of Velocity of Ultrasonic Waves in a Liquid - Acoustic Grating , Application of Ultrasonic Waves, Reverberation, Sabine's Formula (Derivation not required), Absorption Coefficient, Acoustics of Buildings

(Sections: 4.10 to 4.13, 5.1 to 5.3, 5.7 to 5.10, 5.12 to 5.15 of Properties of Matter and Acoustics by R.Murugeshan & Kiruthiga Sivaprasath)

Text books for Study

1. Elements of Properties of Matter by D.S. Mathur 2008
2. Mechanics by J.C Upadhyaya 2003
3. Properties of Matter and Acoustics by R.Murugeshan & Kiruthiga Sivaprasath 2005

Reference

1. Mechanics -- D.S. Mathur
2. Text book of Sound –Brij Lal& Subramaniam
3. Text book of Sound –Khanna .D.R. & Bedi.R.S.
4. Berkeley Physics course Vol 3 on Waves
5. Elements of Mechanics – K Rama Reddy, S Raghavan & D V N Sarma- Universities Press
6. Introduction to Mechanics – Mahendra K Verma – Universities Press
7. Feynman lectures Vol II

Semester-3

Core Course – III - 54 hours (Credit –4)

APHY3B03T: MECHANICS

UNIT-1

1. Frames of reference **8 hours** **Max marks 21**

Laws of Mechanics, Inertial frames of reference, Galilean transformation equations, Hypothesis of Galilean invariance, Conservation of Momentum, Non inertial frames and fictitious forces, Rotating frames of reference, Centrifugal force and Coriolis force, Foucault's pendulum (Section 2.1 to 2.11of Mechanics by J C Upadhyaya)

2. Conservation of Energy **6 hours** **Max marks 15**

Conservation laws, Conservative forces, Conservation of energy for a particle: Energy function, Potential energy curve, Non conservative forces

(Section 5.1to 5.7, 5.10, 5.11of Mechanics by J C Upadhyaya)

3. Linear and Angular Momentum **9 hours** **Max marks 22**

Conservation of linear momentum, Centre of mass, ,Centre of mass frame of reference, Collision of two particles ,Deflection of a moving particle by a particle at rest, Rockets, Angular momentum and torque, Motion under central force, Areal velocity, Conservation of angular momentum with examples

(Section 6.1 to 6.4 ,6.6 to 6.9 of Mechanics by J C Upadhyaya)

4. Potentials and Fields **9 hours** **Max marks 22**

Central force, Inverse square law force, Potential energy of a system of masses, Gravitational field and potential, Escape velocity, Keplar's laws, Newton's deductions from Keplar's laws

(Section 7.1 to 7.4, 7.6to7.9, 7.18, 7.19 of Mechanics by J C Upadhyaya)

UNIT-2

5. Lagrangian formulations of Classical Mechanics **9 hours** **Max marks 22**

Constraints, Generalized co-ordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equations, Kinetic energy in generalized co-ordinates, Generalized momentum, Cyclic co-ordinates, Conservation laws and symmetry properties-Hamiltonian of a system Classical Mechanics by Takwale and Puranik(8.1-8.7)

UNIT-3

6. Special Theory of Relativity **13 hours** **Max marks 28**

Electromagnetism and Galilean transformation, Michelson Morley experiment, Ether hypothesis, Postulates of Special Theory of Relativity, Lorentz transformation equations, Velocity transformation, Length contraction, Time dilation, Simultaneity, Mass in relativity, Mass and energy ,Space time diagram, Geometrical interpretation of Lorentz transformation, Principle of covariance, Four-vectors in Mechanics

Classical Mechanics by Takwale and Puranik(14:1-9)

Text books for study

1. Mechanics by J C Upadhyaya 2003 edition
2. Classical Mechanics by Takwale and Puranik
3. Classical Mechanics by Hans and Puri
4. Classical Mechanics by J C Upadhyaya
5. Classical Mechanics by Kibble

References

1. Mechanics by D.S.Mathur
2. Classical Mechanics by Goldstein
3. Berkeley Physics course Vol 1
4. Feynman Lectures on Physics Vol 1
5. Elements of Mechanics – K Rama Reddy, S Raghavan & D V N Sarma- Universities Press
6. Introduction to Mechanics – Mahendra K Verma – Universities Press
7. Classical Mechanics-Aruldas

Semester-4

Core Course – IV 54 hours (Credit – 4)

APHY4B04T: ELECTRODYNAMICS – I

UNIT I

1. Electrostatics 20 hours Max marks 38

Electrostatic field – Coulomb's law, Electric field, Continuous charge distributions - Divergence and curl of electrostatic field, Field lines and Gauss law, The divergence of **E**, Applications of Gauss law, Curl of **E** - Electric potential – Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution, Electrostatic boundary conditions – Work and energy in electrostatics, The work done in moving a charge, The energy of point charge distribution, The Energy of a continuous charge distribution, Comments on Electrostatic energy – Conductors, Basic properties of conductors, Induced charges, The Surface charge on a conductor, The force on surface charge, Capacitors.

(Sections 2.1 to 2.5 of Introduction to Electrodynamics by David J Griffiths)

2. Special Techniques for Calculating Potentials 6 hours Max marks 16

Laplace's equation in One Dimension, Two Dimensions and Three Dimensions, Uniqueness theorems - Method of images, the classic image problem, induced surface charge, force and energy. (Sections 3.1 to 3.2.3 of Introduction to Electrodynamics by David J Griffiths)

UNIT II

3 . Electric fields in matter 8 hours Max marks 22

Polarization – Dielectrics, Induced dipoles, Alignment of polar molecules, Polarization – The field of a polarized object , Bound charges, Physical interpretation of bound charges, The field inside a dielectric – The electric displacement – Gauss's law in presence of dielectrics, Boundary conditions for **D** – Linear dielectrics, Susceptibility, Permittivity, Dielectric constant, Energy in dielectric systems, Forces on dielectrics, Polarizability and susceptibility.

(Sections 4.1 to 4.4.1, 4.4.3, 4.4.4 of Introduction to Electrodynamics by David J Griffiths)

UNIT III

4 . Magnetostatics **12 hours** **Max marks 32**

The Lorentz force law – Magnetic fields, Magnetic forces, cyclotron motion, cycloid motion, Currents, Linear, Surface and Volume current density – Biot -Savart law, The magnetic field of steady current – Divergence and curl of **B,** Straight line currents, Applications of Ampere's law, Magnetic field of a toroidal coil, Comparison of magnetostatics and electrostatics – Magnetic vector potential , Vector potential, Magnetostatic boundary conditions.

(Sections 5.1 to 5.4.2 of Introduction to Electrodynamics by David J Griffiths)

5. Magnetostatic fields in matter **8 hours** **Max 22 marks**

Magnetisation – Diamagnets, Paramagnets and Ferromagnets, Torques and forces on magnetic dipoles, Effect of a magnetic field on atomic orbits, Magnetization – Field of a magnetised object, Bound Currents, Physical interpretation, Magnetic field inside matter – Auxiliary field **H**, Ampere's law in magnetised materials, Boundary conditions – Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism.

(Sections 6.1 to 6.4 of Introduction to Electrodynamics by David J Griffiths)

Textbook for study

Introduction to Electrodynamics by David J Griffiths, 3rd Ed.

References

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism- Berkley series
4. Electricity and Magnetism-Hugh D Young and Roger A Freedman
5. Theory and Problems of Electromagnetics- second edition by Joseph A Edminister – Schaum's Series

Semester-5

Core Course – V 54 hrs (Credit – 3)

APHY5B06T: ELECTRODYNAMICS-II

UNIT I (27 hours)

1. Electrodynamics 15 hours Max marks 34

Electromagnetic induction - Faraday's law, induced electric field, inductance, energy in magnetic fields – Maxwell's equations, Electrodynamics before Maxwell, Maxwell's modification of Ampere's law, Maxwell's equations and magnetic charges, Maxwell's equations inside matter, Boundary conditions.

(Sections 7.2 to 7.3 of Introduction to Electrodynamics by David J Griffiths)

2. Electromagnetic waves 12 hours Max marks 28

Waves in one dimension, The wave equation, sinusoidal waves, boundary conditions : reflection and transmission, Polarization – Electromagnetic waves in vacuum , Wave equation for **E** and **B**, monochromatic plane waves in vacuum, energy and momentum of E.M. waves, Poynting vector - Electromagnetic waves in matter, Propagation through linear media, reflection and transmission at normal incidence.

(Sections 9.1 to 9.3.2 of Introduction to Electrodynamics by David J Griffiths)

UNIT II (27 hours)

3. Transient currents 7 hours Max marks 20

Growth and decay of current in LR and CR circuits – measurement of high resistance by leakage. Growth of charge and discharge of a capacitor through LCR circuit – theory of BG – experiment to determine charge sensitiveness of BG using a standard condenser and HMS.

(Sections 12.1 to 12.6, 10.10 to 10.13 and section 11.14 of Electricity and magnetism by R. Murugeshan)

4. AC circuits 12 hours Max marks 28

AC through L, C, R, LC, CR, LR and LCR – resonance and resonant circuits – repulsion between coil and conductor – j operators, application to AC circuits – AC bridges – Anderson and Rayleigh bridge.

(Sections 22.1, 22.2, 22.3, 22.6, 22.7, 22.10, 22.11, 22.13, 22.18 to 22.22.1, 22.23 of Electricity and Magnetism by D.N. Vasudeva and sections 11.5 to 11.6 of Electricity and Magnetism by R. Murugeshan)

5. Network theorems **8 hours** **Max marks 20**

Kirchhoff's laws, Voltage sign and current direction, Solution of simultaneous equations using determinants, Source conversion, Superposition theorem, Ideal equivalent circuits, Thevenin's theorem, Thevenizing a given circuit, Norton's theorem, Maximum power transfer theorem.

(Sections 2.2, 2.3, 2.4, 2.5, 2.6, 2.14, 2.15, 2.16, 2.17, 2.18, 2.19 and 2.30 from Electrical technology by Theraja)

Textbooks for study

1. Introduction to Electrodynamics by David J Griffiths, 3rd ed.
2. Electricity and Magnetism by R.Murugeshan (Third revised edition)
3. Electrical technology by Theraja

References

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism by D.N Vasudeva (Twelfth revised edition)
4. Introductory AC Circuit theory – K Mann & G J Russell- Universities Press
5. Electrical Circuit analysis –K Sureshkumar,NIT
6. Theory and problems of Electromagnetics by Joseph A Edminister – Schaum Series

Semester-5

Core Course – VI 54 hrs (Credit – 3)

APHY5B07T: QUANTUM MECHANICS

UNIT 1 (24 hrs)

1. **Particle Properties of Waves** **8 hours** **Max marks 18**

Electromagnetic waves, black body radiation, ultraviolet catastrophe, Photoelectric effect, nature of light, wave particle duality, Compton Effect & its demonstration. Pair production, photons & gravity. (Sections 2.1 to 2.4 & 2.7 to 2.9 of Modern Physics-Arthur Beiser)

2. **Wave Properties Of Particles** **10 hours** **Max marks 23**

De Broglie waves, waves of probability, phase velocity & group velocity, particle diffraction, Davisson And Germer experiment, Electron Microscope, Uncertainty principle I, Uncertainty principle II, Applying the uncertainty principle, Energy & time uncertainty.
(Sections 3.1 to 3.5 & 3.7 to 3.9 of Modern Physics by Arthur Beiser)

3. **Atomic Structure** **6 hours** **Max marks 14**

The Bohr atom-energy levels and spectra, correspondence principle, nuclear motion, atomic excitation, Frank-Hertz experiment
(Sections 4.4 to 4.8 of Modern Physics by Arthur Beiser)

UNIT 2 (30 hrs)

4. **Wave Mechanics** **16 hours** **Max marks 37**

Classical mechanics is an approximation of quantum mechanics, wave function, Schrodinger equation-time dependant form, linearity & super position, expectation values, operators, Schrodinger equation-steady state form, eigen values & eigen functions, postulates of quantum mechanics, particle in a box, finite potential well, tunnel effect-scanning tunneling microscope, harmonic oscillator wave function, energy levels, zero point energy.
(Sections 5.1, 5.3 to 5.11 & appendix to chapter 5 of Modern Physics by Arthur Beiser and Section 3.5 of Quantum Mechanics by G Aruldhas]

5. **Hydrogen Atom** **14 hours** **Max marks 32**

Schrodinger equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, electron probability density, radiative transitions, selection rules, Zeeman effect, electron spin, exclusion principle, Stern-Gerlach experiment.

(Sections 6.1 to 6.10 & 7.1, 7.2 of Modern Physics by Beiser]

Textbooks for study

2. Concepts of Modern Physics 6th Edition-By Arthur Beiser

References

1. Modern Physics (II Edn.)-Kenneth Krane
2. Quantum Physics Of Atom, Molecules, Solids, Nuclei & Particles By R.Eisberg & R. Resnick (John Wiley)
3. Quantum Mechanics By G. Aruldhas
4. Berkeley Physics Course: Quantum Physics By Wichmann
5. University Physics – Zemansky
6. Quantum Mechanics – Trilochan Pradhan – Universities Press
7. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press
8. Introduction to Vector spaces in Physics - K A I L Wijewardena Gamalath – Foundation Books
9. Quantum Mechanics –Iswarsingh Thyagi
10. Feynman Lectures

Semester-5

Core Course – VII - 54 Hours (Credit – 3)

APHY5B08T PHYSICAL OPTICS AND MODERN OPTICS

UNIT I (5 hours) **Max marks 12**

1.Fermat's Principle, verification of laws of reflection and refraction.

(Sections 2.1-2.6 (Brijlal, Subramaniyam, & Avadhanulu Section 2.1-2.2 Ajoy Ghatak)

Matrix methods

Refraction and translation, translation matrix, refraction matrix, system matrix, position of the image plane, magnification, system matrix for thick lens, system matrix for thin lens. (Sections 7.1-7.9 (Brijlal, Subramaniyam, & Avadhanulu)

UNIT II (14 hours)

2. Interference by division of wavefront **6 hours** **Max marks 14**

Superposition of two sinusoidal waves, Interference, coherence ,conditions for interference, the intrference patterns, intensity distribution .Fresnel's two mirror arrangement, Fresnel's Biprism, Determination of λ and $d\lambda$ of Sodium Light (Sections:14.1-14.4,14.6-14.9 (Brijlal, Subramaniyam, & Avadhanulu, Sections 12.1-12.9 Ajoy Ghatak)

3. Interference by division of amplitude **8 hours** **Max marks 18**

Interference by a plane film illuminated by a plane wave, cosine law, non reflecting films (the subsections excluded), interference by a film with two nonparallel reflecting surfaces, colours of thin films, Newton's rings, The Michelson interferometer, white light fringes (Sections 13.1-13.3,13.4,13.813.9-13.11Ajoy Ghatak, Sections 2.1-2.6 (Brijlal, Subramaniyam, & Avadhanulu)

UNIT III (13 hours)

4. Fraunhofer Diffaraction **9 hours** **Max marks 21**

Preliminaries, single slit diffraction pattern, diffraction by circular aperture, limit of resolution, two slit Fraunhofer diffraction pattern, N slit diffraction pattern, plane diffraction grating, resolving power. Sections 16.1-16.7. (Ajoy Ghatak)

5. Fresnel Diffraction **4 hours** **Max marks 9**

Preliminaries, Fresnel half period zones, explanation of rectilinear propagation of light, zone plate, diffraction at straight edge (Sections 17.1-17.4. Ajoy Ghatak)

UNIT IV **8 hours** **Max marks 18**

6. Polarization

Huygene's explanation of double refraction, positive and negative uniaxial crystals, quarter and half wave plates, types of polarized light, production and analysis of plane, circularly and elliptically polarized light, optical activity,

Laurentz half shade polarimeter (Sections 20.9,20.17-20.20,20.24 Brijlal, Subramaniyam, & Avadhanulu and Ajoy Ghatak)

UNIT V **6 hours** **Max marks 14**

7. Holography

Principles of holography, Theory of construction and reconstruction, of Hologram, Applications of Holography. (Sections 23.1-23.6 Brijlal, Subramaniyam, & Avadhanulu, Sections 18.1-18.4. Ajoy Ghatak)

UNIT VI **8 hours** **Max marks 18**

8. Fiber Optics

Optical fibre, Numerical aperture, step index fiber, pulse dispersion, graded index fibre, fiber optic communication system, fiber optic sensors. (Sections 24.1-24.3,24.5,24.6-24.7,24.11 Ajoy Ghatak, corresponding sections from Brijlal, Subramaniyam, & Avadhanulu)

References

1. Optics by Ajoy Ghatak
2. Optics by Subramaniam, Brijlal & Avadhanulu – New edition
3. Optics by Mathur
4. Nonlinear Optics- B.B.Laud
5. Laser Fundamentals- Silfast
6. Wave Optics and its Applications – Rajpal S Sirohi – Orient Longman
7. Optical Communications – M Mukunda Rao – Universities Press
8. Optics – Hetch and A R Ganesan

Semester-5

Core Course –IX 72 hours (Credit – 4)

APHY5B09T: ELECTRONICS (ANALOG & DIGITAL)

1. Semiconductor rectifiers and DC Power supplies 12 hours, Max marks 21

Semiconductors -variation of resistivity with temperature, P N junction diode characteristics- Crystal Diode Rectifiers - Half Wave, Full Wave (Centre Tapped and Bridge rectifier)- Efficiency, Nature of rectified output, Ripple factor, different types of filter circuits, Zener diode voltage stabilization (sections 6.13-6.15, 6.17 - 6.27 V.K Mehta)

2. Transistors: 14 hours, Max marks 23

Different transistor amplifier configurations:- C-B, C-E, C-C, their characteristics, amplification factors, their relationships, Load line Analysis, Expressions for voltage gain, current gain and power gain of C.E amplifier, cut-off and saturation points, Transistor biasing, Different types of biasing - Base resistor, voltage divider bias method, single stage transistor amplifier circuit, load line analysis, DC and AC equivalent circuits. (Section 8.7 - 8.10, 8.12-8.22, 9.2-9.8, 9.11-9.12, 10.4-10.5, 10.7-10.9 V K Mehta)

3. Transistor amplifiers 5 hours, Max marks 9

Inter stage coupling methods-R.C coupled amplifier- frequency response, and gain in decibels, Classification of power amplifiers, class A, class B and class C amplifiers (qualitative ideas only).

(Section 11.1-11.8, 12.6 VK Mehta)

4. Feedback Circuits -Amplifiers and Oscillators 10 hours, Max marks 17

Basic principles of feedback, negative feedback and its advantages, positive feedback circuits Oscillatory Circuits-Barkusen criterion-LC, RC oscillators, tuned collector oscillator, Hartley, Colpitt's, phase shift and crystal oscillators - their expressions for frequency.

Sections (13.1-13.5, 14.1 - 14.13, 14.15-14.20 VK Mehta)

5. Communication Electronics 7 hours, Max marks 12

Transmission and reception of radio waves, types of modulation, AM, FM their comparison advantages, demodulation, pulse code modulation (qualitative idea only) (Sections: 16.1-16.10, 16.11-16.18, 16.22 VK Mehta)

6. Special Devices and Opamp 8 hours Max marks 14

LED, tunnel diode, basic idea of UJT, FET, MOSFET, OP-amp-basic operation, application, inverting, Non-inverting, summing amplifiers, Differentiator & integrator.

(Sections 7.2-7.4, 19.2-19.14, 19.14, 19.27-19.30, 21.11-21.14, 25.1, 25.16, 25.15-25.17, 25.23-25.26, 25.32, 25.34-25.35, 25.37 VK Mehta)

7. Number Systems 8hr 14 mks

Decimal numbers, Binary Numbers, Decimal to Binary conversion, Binary arithmetic, 1's and 2's complements, floating point numbers, Arithmetic operations with signed integers – addition and subtraction, Hexadecimal- Counting, Binary to Hexadecimal and Hexadecimal to Binary, Octal- Octal to Decimal, Decimal to Octal, Binary to Octal and Octal to Binary. BCD and ASCII (Elementary ideas)

(Sections 2.1 – 2.10 of Floyd)

8. Boolean Algebra & Logic circuits 8 hours 8 Hrs Max marks 14

Logic Gates- Basic logic and universal gates (NOT, AND, OR, NAND, NOR, XOR)., Boolean algebra and logic simplification- Boolean operations & expressions (Boolean addition to multiplication), Laws and rules of Boolean algebra, De Morgan's theorems, Boolean analysis of logic circuits, Simplification using Boolean algebra, Standard forms of Boolean expressions (SoP Form), Boolean expressions and truth tables (SoP to truth table), Karnaugh map (up to 4 variables) Karnaugh map SoP minimization. Combinational Logic – Basic adders (Half adder and full adder), Parallel adder, Flip Flops – RS and D Flip Flops, Edge triggered flip flops- elementary ideas)

Sections 3.1 – 3.6, 4.1 – 4.9, 6.2, 7.1, 7.2 of Floyd)

Text books for study

1. Principles of electronics by VK Mehta - 2008 edition (S. Chand)
2. Digital Fundamentals – 8th edition, Thomas L Floyd and R P Jain, Pearson India
3. Basic Electronics –B L Thereja

References

1. Introduction to Microprocesors by Aditya P Mathur (Tata McGarw Hill)
2. Digital principles- Schaums outlines, Roger L . Tokheim, Tata Mc Graw Hill
3. Digital principles and applications by leach and Malvino (Tata McGraw Hill)
4. Digital Computer Fundamentals (Thomas.C. Bartee)
5. Electronics principles by Malvino
6. Physics of Semiconductor Devices- Second Edition – Dilip K Roy – Universities Press
7. Digital principles-Veerendrakumar

Semester 5

OPEN COURSE –I

(**For students from other streams**)

Objective

To develop scientific temper and attitude in students from other streams.

Scope of the course

Since the course does not require a solid base in physics only qualitative & elementary ideas of the subject are expected from the students.

APHY5D01T **: NON CONVENTIONAL ENERGY SOURCES (36 Hours Credit – 2)**

(Problems not required)

UNIT I .

Solar energy : 10 Hrs Max mark 20

Solar constants, Solar radiation measurements, solar energy collector, Physical principle of the conversion of solar radiation in to heat, solar cookers, solar distillation, solar furnaces, solar greenhouses, solar electric power generation(no need of mathematical equations)

(2:1,2;2,2:5,3:1,-3:3,3:7,3:8,5:6,5:8,5:10-12 Non conventional sources of Energy by G D Rai,Khanna publishers)

UNIT II.

Wind energy: 7Hrs Max mark 14

Basic principle of wind energy conversion, basic components of wind energy conversion system, wind energy collectors. application of wind energy.
(6:1,6:2.1,6:5,6:7,6:8.1,6:8.2,6:8.4,6:13 Non conventional sources of Energy by G D Rai, Khanna publishers)

UNIT III.

Geothermal energy and energy from biomass: 10 Hrs Max mark 18

Geothermal sources, geo-pressured resources, advantages and disadvantages of geothermal energy over other energy forms, application of geothermal energy. introduction to bio mass Method of obtaining energy from biomass.
(8:4,8:6,8:12,8:13,7:1,7:23 Non conventional sources of Energy by G D Rai, Khanna publishers)

UNIT IV .

Energy from Oceans and Chemical energy resources: 9 Hrs Max mark 16

Ocean thermal electric conversion. Energy from tides, Basic principle of tidal power, advantages and limitation of tidal power generation. advantages and disadvantages of wave energy wave energy conversion devices. batteries, advantages of battery for bulk energy storage
(9:1,9:2.1-9:2.4,9:3.1,9:3.2,9:3.9,9:4.2,9:4.4,10:3.1-10;3.3,10:3.7 Non conventional sources
of Energy by G D Rai, Khanna publishers)

Text books:

1. Non – Conventional Energy Resources by G. D. Rai, Khanna Publishers, 2008.

2. Solar Energy Fundamentals and application by H.P. Garg and J. Prakash, Tata McGraw- Hill Publishing company ltd, 1997.
3. Solar energy by S. P. Sukhatme, Tata McGraw- Hill Publishing company ltd, 1997.
4. Solar energy by G.D. Rai, 1995.

References

1. Energy Technology by S. Rao and Dr. B.B. Parulekar, 1997, 2nd edition
2. Power Technology by A. K. Wahil. 1993.

Semester 5

OPEN COURSE –I

(Problems not required)

APHY5D02T: AMATEUR ASTRONOMY AND ASTROPHYSICS(36 Hours Credit – 2)

Unit-1 (12 hours) Max mark 22

Introduction & Brief history of Astronomy Astronomy & Astrology- Fascinations of Astronomy-Two important Branches of Astronomy-Amateur observational Astronomy-Different types of Amateur Observing- Ancient Astronomy & modern astronomy-Indian & western

Unit-2 (8 hours) Max mark 14

Earth The zones of earth-longitude and latitude-shape of earth. Keplers laws-perihelion-aphelionperigee and apogee, year-month-Day. Seasons-causes of seasons

Unit-3 (8 hours) Max mark 16

Solar system sun-structure-photosphere-chromosphere-solar constant- sun temperature-sun spots-solar eclipsecorona-(planets-surfaceconditions and atmosphere, size, period & distance)mercury-venus-earthmars-jupiter-saturn-uranus-neptune-comets-asteroidsmeteors

Unit-4 (8 hours) Max mark 16

The stars Unit of distance-Astronomical units--parsec-light year-Magnitudes of stars-apparent magnitudeabsolute magnitude-Three categories of stars-Main sequence stars-Dwarfs-Giants-star formation lifecycle of stars-Chandra sekher limit- Novae-Binary stars - neutron star-black holes. Expanding universe-Bigbang theory

References Books:

1. A Text book on Astronomy – K K Dey, Book Syntricate Pvt. Ltd.
2. Introduction to Astrophysics – Baidanath Basu, PHI, India
3. Elements of Cosmology – Jayant Narlikar, University Press,
4. Astrophysics of Solar System – K D Abhyankar, University press
5. Chandrasekhar and his limit – G Venkataraman, University Press
6. The Big & The small (Volume II) – G Venkataraman, University Press
7. Joy of Sky Watching – Biman Basu, National Book Trust
8. Astronomy – Principles & practices, A E Roy & D Clarke, Institute of Physics

Semester 5

OPEN COURSE –I

(Problems not required)

APHY5D03T: PHYSICS IN EVERY DAY LIFE (36 HOURS)

(To be framed)

UNIT-1- (12 Hours) Max mark 24

UNIT – 2. (12 Hours) Max mark 22

UNIT-3- (12 Hours) Max mark 22

Books for study

Reference books:

Semester-6

Core Course –X - 72 hrs (Credit – 4)

APHY6B10T: THERMAL AND STATISTICAL PHYSICS

Unit- I

Module 1. . 18 hours Max marks 31

Thermodynamic system- Thermal equilibrium-zeroth law-concept of heat and temperature-thermodynamic equilibrium- quasistatic process -extensive and intensive variables- thermodynamic process (cyclic and non cyclic)-indicator diagram- workdone in isothermal, adiabatic, isobaric and isochoric –cyclic processes- concept ofpath and point functions-internal energy- first law of thermodynamics-relation between P,T,V,in adiabatic process-slope of adiabatic and isothermal process -application of first law to heat capacities-(relation between C_p and C_v) and latent heat– adiabatic and isothermal elasticity of a gas**)**

Module 2. 11 **Hours Max marks 19**

Reversible and irreversible processes , Conditions for reversibility-second law of thermodynamics-heat engine, Carnot engine, derivation for expression for efficiency, efficiency, Carnot's refrigerator-thermodynamical scale of temperature- Carnot's theorem and its proof.- application of second law(Clausius-Clapyron equation)- internal combustion engine-otto engine ,diesel engine -its efficiencies

Module 3. 14 hours Max marks 24

Entropy and adiabatics- definition of entropy-Change of entropy in a Carnot cycle-Change of entropy in an reversible cycle (Claussius theorem) -Change of entropy in an irreversible cycle (Claussius inequality)- Change in entropy of a perfect gas during a process-Change in entropy in a irreversible process-change in entropy due to free expansion-Change in entropy due to spontaneous cooling by conduction, radiation….etc, - Principle of increase of entropy-Entropy and available energy-Entropy and disorder-Nernst heat theorem-entropy temperature diagrams

(Relevant topics from Chapters 8 & 9 – Heat and Thermodynamics by D S Mathur- Revised fifth edition)

Module 4. **10 hours** **Max marks 17**

Thermodynamic functions-Enthalpy, Helmhlotz function, Gibbs function-Maxwell's thermodynamic relations-TdS relations-application of Maxwell's thermodynamical relations-1.variation of intrinsic energy with volume-2.Joule-Kelvin coefficient-3.Claussius-Clapeyron equation from Maxwell's thermodynamic relations- changes of phase. (Relevant topics from Ch. 10-Heat and Thermodynamics by D S Mathur- Revised fifth edition)

UNIT II

Module 5. **8 hours** **Max marks 14**

Statistical distributions-Maxwell-Boltzmann statistics (no derivation)-Distribution of molecular energies in an ideal gas-Average molecular energy- Equi partition theorem-Maxwell-Boltzmann speed distribution law-Expressions for rms speed, most probable speed and mean speed. (Chapter 9.1, 9.2 and 9.3-Concepts of Modern Physics-Arthur Beiser)

Module 6. **11 hours** **Max marks 19**

Bose Einstein and Fermi Dirac distribution laws (no derivations)- Application of BE distribution law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-Fermi energy-Expression for Fermi energy of electron system-electron energy distribution- average electron energy at absolute zero-Degeneracy pressure and its astrophysical significance. (Relevant topics from Chapter 9, Concepts of Modern Physics – Arthur Beiser)

References:

1. Heat and Thermodynamics-DS Mathur (V Edn.)

2. Statistical Mechanics – An Elementary Outline – Avijit Lahiri – Universities Press
3. Physics- Resnick and Halliday
4. Heat and Thermodynamics-Zemansky
5. Thermodynamics – Y V C Rao – Universities Press
6. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press
7. Thermodynamics and statistical mechanics-Brijlal Subramanium
8. Heat and Thermodynamics- A Manna
9. Book of Kenneth crane

Semester-6

Core Course – XI 72 hrs (Credit – 4)

APHY6B11T: SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

UNIT –1 SOLID STATE PHYSICS

1.Crystal Physics 15 hours Max marks 26

Lattice Point & Space Lattice-Basis and crystal structure, unit cells and lattice Parameters, Unit cells v/s primitive cells, Crystal systems, crystal symmetry. The 23 symmetry elements in a cubical crystal, rotation axis and inversion. Symmetry elements, Bravais space lattices-metallic crystal structure , sodium chloride, diamond, zinc sulphide, hexagonal and closed packed structure, directions, planes and Miller indices. (Section 4.1 to 4.8, 4.11 to 4.15 and 4.18 - Solid State Physics by S.O. Pillai**)**

2. X-ray Diffraction: 5 hours Max marks 9

Bragg's law – Braggs X-ray spectrometer-Rotating Crystal method

Section 5.7 to 5.11- Solid State Physics by S.O. Pillai

3.Introduction to solid state physics: 8 hours Max marks 14

A survey of superconductivity-Mechanism of Superconductors-Effects of Magnetic Field-Meissner Effect-isotope Effect-Energy Gap -Coherence Length- Josephson effect-BCS Theory (Qualitative idea only) -Application of Superconductivity, Type I and Type II superconductors. (Section 8.1 to 8.5 & 8.10 of Solid State Physics - S.O. Pillai)

UNIT-2 MOLECULAR SPECTROSCOPY

4 . Basic Elements of Spectroscopy 5 hours Max marks 9

Quantum of Energy-Regions of Spectrum-Representation of Spectrum-Basic Elements of Practical Spectroscopy-Signal to Noise Ratio-Resolving Power-Width & Intensity of Spectral Transitions (Section 1.2 to 1.8 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine Mcash**)**

5. Microwave Spectroscopy 8 hours Max marks 14

Classification of Molecules-Interaction of Radiation with Rotating Molecules-Rotational Spectrum of Rigid Diatomic Molecule-Example of CO-Selection Rule-Intensity-Spectrum of non –rigid Rotator-Example of HF- Spectrum of symmetric Top molecule- Example of Methyl chloride-Enformation derived from Rotational Spectrum. (Section 6-Rotation of Molecules, Section 6.1 to 6.6, 6.9, 6.13, 6.14 of Molecular Structure & Spectroscopy by G Aruldhas & Chapter 2 - Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash

6. Infra Red Spectroscopy: 9 hours Max marks 16

Vibrational Energy of an Anharmonic Oscillator-Diatomic Molecule (Morse Curve)-IR Spectra-Spectral Transitions & Selection Rules-Example of HCL-Vibration-Rotation Spectra of Diatomic Molecule-Born Oppenheimer Approximation-Instrmentation for Infra Red Spectroscopy

(Section 7 to 7.5, 7.15, 7.16 of Molecular Structures & Spectroscopy by G Aruldhas & Chapter 3 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash)

7. Raman Spectroscopy **10 hours** **Max narks 15**

Raman Effect, Elements of Quantum theory & Applications-Pure Rotational Raman Spectrum-Examples of Oxygen and carbon-dioxide-Rotational Raman spectrum of symmetric Top molecule-Example of chloroform.Vibrational Raman spectrum of Symmetric Top Molecule-Example of Chloroform. (Molecular Structures & Spectroscopy by G Aruldhas & Chapter 4 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash)

8. Laser Physics **12 hours** **Max marks 21**

Induced Absorption-Spontaneous Emission & Stimulated Emission-Einstein Coefficients Principle of Laser-Population inversion-Pumping-Properties of Laser-Types of Laser-Principle & working of Ruby laser, Helium Neon Laser & Semiconductor Laser- -Yag Lasers (Qualitative ideas only). Application of Lasers

(Chapter 12 Masers & Lasers, Solid State Physics by S.O. Pillai, Lasers –Theory & Applications by K Thyagarajan & Ajoy Ghatak)

Text Books for Study :

Solid State Physics by S O Pillai

Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash

Molecular Structure & Spectroscopy by G Aruldhas

References

1. Solid Sate Physics by M A Wahab
2. Introduction to Molecular Spectroscopy by G M Barrow
3. Raman Spectroscopy by Long D A
4. Modern Physics by R Murugeshan
5. Concepts of Modern Physics-Arthur Beiser (5^{th} Edition)
6. Optical Communications – M Mukunda Rao – Universities Press
7. Principles of Condensed Matter Physics – P M Chaikin & T C Lubensky – Cambridge University Press

Semester-6

Core Course – XII 72 hrs (Credit – 4)

APHY6B12T: NUCLEAR PHYSICS, PARTICLE PHYSICS & ASTROPHYSICS

1. **Nuclear Structure** 13**hours** **Max marks 24**

Nuclear composition – nuclear electrons – discovery of neutron, Nuclear properties – nuclear radii –spin and magnetic moment - nuclear magnetic resonance, Stable nuclei, Binding energy, Liquid drop model -semi empirical binding energy formula- mass parabolas, Shell model, Meson theory of nuclear forces – discovery of pion.

(Text Books: 11.1 to 11.7 Concepts of Modern Physics – Arthur Beiser (5^{th} Edition), Nuclear Physics – Irving Kaplan (17.8)

2. **Nuclear Transformations** : **13 hours** **Max marks 23**

Elementary ideas of radio activity- Alpha decay-tunnel theory of alpha decay-derivation for the formula for decay constant-Beta decay-negatron emission-positron emission-electron capture-inverse beta decay and the discovery of neutrino, Gamma decay-fundamental ideas of nuclear isomerism and internal conversion, The concept of interaction cross section--reaction rate-nuclear reactions-center of mass frame of reference and Q value of a nuclear reaction, Nuclear fission, Nuclear reactors-breeder reactors, Nuclear fusion-nuclear fusion in stars-proton-proton cycle-carbon nitrogen cycle-formation of heavier elements, Fusion reactors-confinement methods.

(Text Book: 12.1 to 12.12 & Appendix of Chapter 12, Concepts of Modern Physics – Arthur Beiser (5^{th} Edition)

3. **Nuclear Detectors And Counters:** **9 Hours** **Max marks 16**

Interactions of radiation with matter – fundamental ideas, Gas filled counters- ionization chamber – proportional counter – G.M. counter, Cloud chamber, Bubble chamber, Semi conductor detectors and scintillation counters (Qualitative study only. Maximum Weightage: 2) (Text Book: 17 to 17.6 Atomic and Nuclear Physics-An Introduction: T.A. Littlefield and N. Thorley)

4. **Cosmic Rays:**& **Particle Accelerators** 12 **hours** **Max 20Marks**

Classification of accelerators-electrostatic accelerators-cyclic accelerators, the linear accelerator, the cyclotron, the betatron, the electron synchrotron .

(Text Books: 18.4 to 18.8 Atomic and Nuclear Physics- An Introduction: T.A. Littlefield and N. Thorley, 21.3 to 21.5 Nuclear Physics-Irving Kaplan)

Nature of Cosmic rays, the origin of cosmic rays, geomagnetic effects, Cosmic ray showers (Text Book: 25.1 to 25.6 Atomic and Nuclear Physics-An Introduction: T.A. Littlefield and N. Thorley)

5. Particle Physics: 15 hours Max marks 26

Leptons –electron and positron-neutrinos and anti-neutrinos-other leptons, Hadrons-resonance particles, Elementary particle quantum numbers-baryon number- lepton number-strangeness-isospin-electric charge-hyper charge-basic ideas on symmetries and conservation laws, Quarks -color and flavor, Fundamental interactions (Text Books: 13.2 to 13.6 Concepts of Modern Physics-Arthur Beiser (5th Edition)

6. Astrophysics and astronomy 10 hours Max marks 15

Stellar magnitudes an sequences, Absolute magnitude, The bolometric magnitude - Different magnitude standards, The colour index of a star, Luminosities of stars, Stellar parallax and the units of stellar distances, Stellar positions: The celestial co-ordinates. A Qualitative study on stellar positions and constellations

(Text Book: 3.1 to 3.9 An introduction to Astro Physics-Baidyanath Basu)

References

1. Nuclear Physics: D.C. Tayal
2. V K Mittal, R C Verma & S C Gupta-Introduction to Nuclear and Particle Physics PHI learning Pvt Ltd(2009)
3. Atomic Physics: J.B. Rajam
4. Atomic Physics: John Yarwood
5. Introduction to Astrophysics: H L Duorah & Kalpana Duorah
6. Mayer – Jensen Shell Model and Magic Numbers: R Velusamy, Dec 2007
7. The Enigma of Cosmic Rays: Biman Nath, Resonance – Feb 2004, March 2004
8. Black body radiation: G.S. Ranganath, Resonance – Feb. 2008.
9. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

Semester-6

Core Course – XIII

APHY6E01T: Elective- Computational Physics (54 hrs – 3 credits)

UNIT I.

Introduction to Python Programming: 20 hours Max marks 44

Concept of high level language, steps involved in the development of a Program – Compilers and Interpreters - Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs - Variables, operators, expressions and statements -- Strings, Lists, list functions (len, append, insert, del, remove, reverse, sort, +, *, max, min, count, in, not in, sum), sets, set functions(set, add, remove, in, not in, union, intersection, symmetric difference)-Tuples and Dictionaries, Conditionals, Iteration and looping - Functions and Modules - File input and file output, Pickling.

UNIT II. 22 hours Max marks 54

Numerical Methods in physics *(Programs are to be discussed in Python)*

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

UNIT III

Introduction to Computational approach in physics 12 hours Max marks 26

(Programs are to be discussed in Python)

One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium - Simulation of free fall and numerical integration, Two dimensional motion: Projectile motion (by Euler method)-Motion under an attractive

Inverse Square- law force Accuracy considerations .(elementary ideas)*(Graphics not required, data may be presented in table form)*

References:

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

1. www.python.org
2. Python Essential Reference, David M. Beazley, Pearson Education
3. Core Python Programming, Wesley J Chun, Pearson Education
4. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website (http://www.altaway.com/resources/python/tutorial.pdf)
5. How to Think Like a Computer Scientist: Learning with Python, Allen Downey , Jeffrey Elkner , Chris Meyers, http://www.greenteapress.com/thinkpython/thinkpython.pdf
6. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, Newdelhi (or any other book)
7. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
8. Introductory methods of numerical analysis, S.S.Shastry , (Prentice Hall of India,1983)
9. Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books,4821,Pawana Bhawan,first floor,24 Ansari Road,Darya Ganj,New Delhi-110 002 *(For theory part and algorithms. Programs must be discussed in Python)*

Semester-6

Core Course – XIII (ELECTIVE) 54 hrs (Credit – 3)

APHY6E02T: NANO SCIENCE AND TECHNOLOGY

Module 1: Introduction : (6 Hrs) Max marks 14

Length scales in Physics- nanometer- Nanostructures: Zero, One Two and Three dimensional nanostructures (Chapter 3, Text 2)

Band Structure and Density of State at nanoscale: Energy Bands, Density of States at low dimensional structures. (Chapter 3, Text 1)

Module 2:

Electrical transport in nanostructure: (10 hours) Max mark 22

Electrical conduction in metals, The free electron model. Conduction in insulators/ionic crystals - Electron transport in semiconductors - Various conduction mechanisms in 3D (bulk), 2D(thin film) and low dimensional systems: Thermionic emission, field enhanced thermionic emission (Schottky effect), Field assisted thermionic emission from traps (Poole-Frenkel effect), Arrhenius type activated conduction, Variable range, Hopping conduction, Polaron conduction. (Chapter 4, Text 1)

Module 3:

Introductory Quantum Mechanics for Nanoscience: (13 hrs) Max mark 30

Size effects in small systems, Quantum behaviors of nanometric world: Applications of Schrödinger equation – infinite potential well, potential step, potential box; trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials (Chapter 5, Text 1)

Module 4:

Growth techniques of nanomaterials (Elementary ideas only): **(9 hrs) Max mark 21**

Top down vs bottom up techniques, Lithographic process, Non Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam evaporation. Chemical Vapour Deposition (CVD). Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol-Gel Technique, Electro-deposition., Ball-milling. (Chapter 6, Text 1) **(6.1,6.2.6.3,6.4.1,6.4.2,6.4.2.1,6.4.3,6.4.3.1.6.4.3.2,6.4.4,6.4.5,6.4.6,6.4.7,6.4.8,6.4.9)**

Module 5:

Characterisation tools of nanomaterials: (10 hrs) Max mark 23

Scanning Probe Microscopy(SPM) : Basic Principles of SPM techniques, The details of STM, Tunneling current, local barrier height, local density of states. Some applications of STM. (Section 7.1.1 – 7.1.3.3, 7.1.3.5, Text 1), General concepts of AFM (Section 7.2.1 – 7.2.4 , Text1), Electron microscopy (7.3.1-7.3.6, Text -1).

Module 6:

Applications of nanotechnology: (Elementary ideas only) **(6 hrs) Max mark 14**

Buckminster fullerene, Carbon nanotube, nano diamomd, BN Nanotune, Nanoelectronics - single electron transistor (no derivation), Molecular machine, Nanobiomatrics (Chapter 8, Text 1).Applications of nanomaterials in energy, medicine and environment (Text 2)

Text books:

1. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyaya and A. N. Banerjee, Publisher: PHI Learning and Private Limited
2. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi

References:

1. Nanoparticle Technology Handbook – M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama (Eds.), Elsevier 2007
2. Encyclopaedia of Materials Characterization, Surfaces, Interfaces, Thin Films, Eds. Brundle, Evans and Wilson, Butterworth – Heinmann, 1992
3. Springer Handbook of nanotechnology, Bharat Bhushan (Ed.), Springer-Verlag, Berlin, 2004
4. Nano Science and Technology, VS Muraleedharan and A Subramania, Ane Books Pvt. Ltd, New Delhi
5. A Handbook on Nanophysics, John D, Miller, Dominant Publishers and Distributors, Delhi-51
6. Introduction to Nanotechnology, Charles P Poole Jr. and Frank J Owens, Wiley Students Edition
7. Nano-and micro materials, K Ohno et. al, Springer International Edition 2009, New Delhi

Semester-6
Core Course – XII (ELECTIVE) 54 hrs (Credit – 3)
APHY6E03T: MATERIALS SCIENCE

Unit I

Introduction-(15 hrs) Max Mark32

What is material science, Classification of materials-metals, ceramics, polymers, composites, Advanced materials, smart materials.(Section 1.1 to 1.6 of Callister's Material science Text Book)

Bonds in materials

Atomic bonding in solids-bonding forces and energies, Primary bonding - Ionic bonding, Covalent bonding, metallic bonding, Secondary bonding – van der waals bonding, fluctuating induced dipole bonds, polar molecule induced dipole bonds, permanent dipole bonds example of anomalous volume expansion of water.(section 2.5 to 2.8 of Callister's Material science)

Crystals

Crystalline and Non Crystalline materials –Single crystals, polycrystals, Anisotropy, metallic crystal structures, atomic packing factors of FCC, BCC, Hexagonal close packed crystal structure, Density computations, Linear and planar densities, polymorphism and allotropy, non crystalline solids.(Section 3.8 to 3.11, 4.2 to 4.9)

Unit II

Imperfections in Solids –(12 hrs) Max mark 32

Point defects, Vacancies and self interstitials, substitutional impurities, atomic point defects-Schottky defect, Frenkel defect, Dislocations-edge and screw dislocations, burgers vector, Interfacial defects-External surfaces, Grain boundaries, twin boundaries, stacking faults, Bulk and volume defects.(Section 5.2 to 5.8)

Diffusion in solids -

Introduction, Diffusion mechanism, Vacancy diffusion, Interstitial diffusion, Steady state diffusion and Non-steady state diffusion, fick's laws, Factors that influence diffusion-temperature, diffusion species, example of aluminium for IC interconnects. diffusion in ionic and polymeric materials (section 6.1 to 6.8)

Unit III

Ceramics and its properties(15 hrs) Max mark 32

Glasses, Glass ceramics, properties, refractories - fire clay and silica refractories, Abrasives, cements, advanced ceramics-optical fibers, ceramic ball bearings, piezo electric ceramics, stress-strain behaviour of ceramics, flexural strength and elastic behaviour.(Section 12.1 to 12.8, 12.11)

Polymers and its properties

Different forms of Carbon-Diamond, Graphite, Fullerenes, Carbon nano tubes. (Qualitative aspects only)(Section 4.17,)

Hydro carbon molecules, polymer molecules, homo polymers and copolymers, molecular weight calculation, linear polymers, branched polymers, cross linked polymers, network polymers, thermo setting and thermo plastic polymers, stress -strain behaviour and viscoelastic deformation of polymers.(Section 13.1 to 13.9, 14.2, 14.3, 14.4)

Unit IV

Material Analysis Techniques (12 hrs) Max mark 30

Single crystal and powder diffraction techniques with diffractometer, Laue's technique and rotating crystal method, Microscopic techniques-Optical microscopy, electron microscopy, transmission electron microscopy, scanning electron microscopy, Scanning probe microscopy, construction and working of each device, Grain size determination technique. (Section 4.20, 5.12, 5.13)

Book for study –

Material Science and Engineering by William D. Callister, Adapted by R. Balasubramanyam (IIT Kanpur), Published by Wiley India Pvt Ltd (Price -550.00)(Reprint 2011)

Book for reference

1. Materials science and engineering- V Edn- V Raghavan(PHI)
2. Material science by S.L.Kakani & Amit Kakani, 2nd edition 2010, reprint 2011
3. Material Science & Engineering, R.K. Rajput (Jain Book Agency)
4. Material Science and Engineering, I. P . Singh, & Subhash Chander (Jain Book Agency)

B.Sc PROGRAMME IN PHYSICS (CORE)

PRACTICALS

Department must arrange sufficient number of apparatus before the Practical Examination. All apparatus must be in proper condition before the Practical examination.

The external practical examination will be conducted at the end of 4^{th} & 6^{th} semesters. At the time of external examination, a student has to produce **certified fair record** with a minimum of **75%** of the experiments, listed in the syllabus. Valuation of the record must be done internally and externally.. Total mark for record in external valuation is 20. The principle or the logic and the relevant expressions of the experiment must be shown at the time of examination

Two test papers for practical internals could be conducted by including test papers in any two convenient cycles in the place of an experiment. A batch of students can be evaluated in each class. If there are a total of 4 cycles for a practical course, a test paper each can be included in the 3^{rd} and 4^{th} cycles. If there are a total of 3 cycles for a practical course, a test paper each can be included in the 2^{nd} and 3^{rd} cycles. A model examination can also conducted after completion of all cycles. Internal grade for test papers can be awarded based on the best two performances.

NUMBER OF QUESTIONS IN THE QUESTION PAPER SHALL BE

PAPER -1&II EIGHT (8) PAPER- III &IV SIX (8)

OUT OF THESE A MINIMUM OF 75% OF THE QUESTIONS ARE TO BE SET FOR THE EXAMINATION .

Laboratory Teaching

General Instructions

1. Demonstration Lectures on use of measuring instruments - vernier, screw gauge, travelling microscope, Physical balance, Spectrometer, Spherometer, galvanometer. Concept of least count of measuring instruments. Familiarization with basic electronic components. Familiarisation with operation of basic measuring and test equipment (power supplies, multimeter, function generator and CRO). To test a diode and transistor using multimeter and CRO- **3 lab classes**
2. a)Basic ideas of probability and statistics.

   b) Error analysis, significant figures,limit of accuracy of an experiment-associated choice of instruments-**2 Lab classes**.
3. Calculation of error is an integral part of experiment.
4. Graphs are needed to be used for verification of any relations, and plotting of graphs is mandatory for all possible experiments.

5. Semester wise practicals of an year can be combined while preparing a set/cycle for convenience, but minimum required number of experiments for every semester must be completed in that semester itself. Python is optional and only three programs are allowed if opted.

List of Experiments

APHY4B05P: Practical-I (Credit 5)
1st, SEMESTER EXPTS

(Any six)

1. Young's modulus-non uniform bending-using pin and microscope-(load-extension graph).
2. Surface Tension-capillary rise method-radius by vernier microscope
3. Moment of inertia-Flywheel
4. Liquid lens-Refractive index of liquid and glass
5. Deflection magnetometer-Tan A, Tan B positions - moment of a magent
6. Potentiometer-measurement of resistance
7. Newtons law of cooling-emissivity and emissive power
8. Optical constants -convex lens

2nd, SEMESTER EXPTS

(Any six)

9. Young's modulus-Uniform bending-using optic lever
10. Viscosity-Poiseuille's method –(Variable Pressure head, radius by mercury pellet method, sensibility method to find mass)
11. Moment of Inertia-Torsion Pendulum
12. Compound pendulum-acceleration due to gravity, Radius of gyration
13. Spectrometer-solid prism-Refractive index of glass measuring angle of minimum deviation
14. Deflection magnetometer -Tan C Position-moment of a magent.
15. Air Wedge-angle-angle of wedge and diameter/thickness of a thin wire/object
16. HWR- ripple factor-with and without filter

3rd SEMESTER EXPTS

(Any six)

17. Rigidity modulus-static torsion
18. Young's modulus-Angle between the tangents
19. Searle's vibration magnetometer-moment & ratio of moments

20. Spectrometer-solid prism- Dispersive power
21. Melde's string arrangement-Frequency, relative density of liquid and solid (both modes)
22. Ballistic galvanometer-figure of merit
23. Characteristics of zener diode and costruction of voltage regulator
24. Crystal Diode characteristics-forward and reverse

4th SEMESTER EXPTS

(Any six)

25. Potentiometer-calibration of ammeter
26. Ballistic Galvanometer- BG constant using HMS-then find B_h.
27. B.G.-Comparison of capacities Desauty's method.
28. Spectrometer- i-d curve
29. Box type vibration magnetometers-m & Bh
30. Verification of Thevenin's theorem.
31. To study waveforms and to measure amplitude, frequency and phase with CRO
32. Diode -study of knee voltage variations with temperature

APHY6B13P: Practical II (Credit – 5)

5th SEM EXPTS. (Any 24)

1. Spectrometer-Cauchy's constants
2. Diffraction Grating-minimum deviation
3. Y-Cantilever using microscope
4. Newton's rings-wavelength of sodium light
5. Lee's Disc –thermal conductivity
6. Potentiometer-calibration low range voltmeters -direct and null method
7. Potentiometer- Reduction factor of TG
8. Variation of field with distance-Circular coil-moment of magnet & B_h
9. Carey Foster's bridge-resistance & resistivity
10. Conversion of Galvanometer to voltmeter and calibrating using Potentiometer.
11. BG Absolute Capacity
12. BG -Ballistic contant (condenser method)
13. Searls and Box vibration magnetometers- m &Bh.
14. Numerical aperture of an optical fibre by semiconductor laser
15. Construction of full wave, Centre tapped and Bridge rectifiers

16. Transistor characteristics and transfer characteristics in Common Base Configuration- current again
17. CE Transistor Amplifier-Frequency response.
18. Negative feed back amplifier
19. LC Oscillator (Hartley or Colpitt's)
20. Operational Amplifier –inverting, non inverting, Voltage follower
21. LCR circuits-Resonance using CRO
22. Construction of basic gates using diodes(AND, OR) & transistors (NOT), verification by measuring voltages
23. Voltage multiplier (doubler, tripler)
24. CE transistor biasing schemes
25. Study the temperature depedence of the reverse current of a pn junction and determination of the band gap energy Si/Ge.
26. S V P- Joly's Bulb
27. Self inductance of a coil by Anderson's bridge
28. Potentiometer- emf of a thermocouple(assuming emf of Daniel cell)
29. Diode circuits: clipper and clamper

APHY6B14P: Practical III (Credit – 5)

6th SEM EXPTS (Minimum 24 expts)

1. Spectrometer- i_1-i_2 curve stokes formula
2. Spectrometer-Diffraction Grating-Normal incidence
3. Spectrometer -small angled prism
4. To study the angle-wavelength relation and to determine the wavelength of unknown line using diffraction grating
5. Frequency of AC using sonometer
6. Y-Cantilever using optic lever/mirror and telescope
7. Y-nonuniform bending-double mirror method
8. Kundt's tube
9. To verify Stefan's law using torch bulb
10. Laser-wavelength using transmission grating
11. Spectrometer-Quartz prism-Refractive indices of quartz for the ordinary and extra-ordinary rays
12. Potentiometer-calibration high range voltmeters

13. Carey Foster's bridge-Temperature coefficient of Resistance
14. Conversion of Galvanometer to ammeter and calibrating using Potentiometer.
15. BG-High resistance by leakage method
16. BG Mutual inductance
17. BG- Pole strength of a magnet using search coil
18. Planck's constant using LED's (3no.s)
19. Polarimeter-Specific rotation of sugar solution
20. Transistor characteristics and transfer characteristics in Common Emitter Configuration- current again
21. Full adder using NAND gates-construction & varification
22. Phase shift oscillator
23. Multivibrator using transistors.
24. Flip-Flop circuits –RS and JK using IC's
25. Verification of De-Morgan's Theorem using basic gates.
26. Half adder using NAND gates
27. Searl's Rotation Viscometer-coefficient of viscosity
28. Optical constants of a concave lens.
29. Latent heat of steam-radiation correction and watch glass correction.

Numerical Methods Using Python : optional - max 3 experiments may be chosen.

1. Solution of equations by bisection and Newton-Raphson methods
2. Least square fitting – straight line fitting.
3. Numerical differentiation using difference table.
4. Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule.
5. Taylor series - Sin θ, Cos θ
6. Solution of differential equation Runge-Kutta method (Harmonic Oscillator).
7. Simulation of freely falling body. Tabulation of position, velocity and acceleration as a function of time.
8. Simulation of projectile – Tabulation of position, velocity and acceleration as a function of time – Plot trajectory in graph paper from tabulated values.

Reference Books

1. D. Chattopadhyay and P.C. Rakshit, An advanced Course in Practical Physics, New Central, Kolkata (2005) Textbook
2. S.K.Ghosh, A Textbook of Advanced Practical Physics, New Central, Kolkata (2008)
3. C.L.Arora, B.Sc. Practical Physics, S. Chand and Co
4. G.L. Squires, *Practical Physics*, Cambridge (2011)

5. D.W. Preston and E.R. Dietz, The Art of Experimental Physics, Wiley (1991)
6. R.A. Dunlap, Experimental Physics: Modern Methods, Oxford (1997)
7. A.C.Melissinos and J. Napolitano, Experiments in Modern Physics, Academic Press (2003)
8. S. Franco, Design with Operational Amplifiers, McGraw Hill (2002)
9. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website (http://www.altaway.com/resources/python/tutorial.pdf)

COMPLEMENTARY COURSES IN PHYSICS

(For B. Sc Programme In Mathematics, Chemistry Etc.)

Aims & Objectives.

The syllabus is drafted to generate new concepts with practical thinking and multi dimensional applicability of physics in other science programmes so as to empower students who have undergone grading system of education at under graduate level.

It is restructured in order to correlate the concepts of Physics with other core programmes and also to generate exhaustive interest in physics course through series of activities like problem solving, active participation in laboratory programme, smart class room lectures etc.. semesters,.

At the time of external examination, a student has to produce **certified record** with a minimum of **75%** of the experiments, listed in the syllabus.

SEMESTER -1

Complementary course-1

APHY1C01T: Properties of matter & Thermodynamics

(Hrs/ Week -2 , Hrs / Sem -36, Credit-2)

1.**Elasticity 9 Hours Max 26 marks**

Elastic modulii. (Elementary ideas)- Dependence of Young's modulus on temperature (posing one practical application)- Work done per unit volume- Poisson's ratio (Engineering application and theoretical limits)- relation between various elastic constants- Twisting couple on a cylinder- Torsion pendulum-Determination of rigidity modulus of a wire-Bending of beams-bending moment- I-form girders- Cantilever loaded at the free end – Loaded uniformly (Derivation required)

2. Surface Tension & viscosity 9 Hours Max marks 26

Surface tension (Elementary ideas)-Excess pressure inside a liquid drop and bubble (Effect of electrostatic pressure on a bubble-change in radius)-Work done in blowing the bubble (problem based on the formation of bigger drop by a number of smaller drops)- Variation of surface tension with temperature, impurities, contamination- Effect of evaporation and condensation.

Viscosity-Coefficient of viscosity-Derivation of poiseuille's equation, stokes equation-Determination of viscosity by poiseuille's method and stokes method-Brownian motion – Viscosity of gases

3. **Thermo dynamics 18 Hours Max marks 52**

Thermodynamic processes –Indicator diagram (P-V diagram, P-T diagram, T-V diagram, T-S diagram)- Work done in Quasi static process-Work done in Isothermal, Adiabatic, Isochoric, Isobaric processes-First law of thermodynamics-Application to heat capacities-Second law of thermodynamics- Carnot's engine - Derivation of efficiency using Carnot's cycle-Carnot's theorem and its proof- Carnot's refrigerator(coefficient of performance)-

Entropy-Change of entropy in a carnot's cycle, reversible cycle , irreversible cycle-principle of increase of entropy- Entropy and available energy- entropy and disorder

Thermo dynamic functions- concept of enthalpy- Helmholtz function- Gibb's function-Maxwell's thermodynamic relations- Clausius-Clapyron equation-Effect of pressure on melting point and boiling point.

(Heat , Thermodynamics and statistical mechanics- Brijlal, Dr. Subrahmanyam, P.S. Hemne (revised Edition 2010) Sections : 4.4, 4.7, 4.10.1, 4.10.3, 4.10.4, 4.10.5, 4.10.7, 4.11, 4.12, 4.13, 4.14, 4.15, 4.20, 4.21, 4.22, 4.23, 4.24,,4.26, 4.27, 4.28, 4.29, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.8, 6.3, 6.4.7, 6.5, 6.6, 6.7

Text for study: Properties of matter –J.C.Upadhaya

Heat and thermodynamics-Brijlal and Subramanium

Books for reference

1. Properties of matter- D S Mathur
2. Heat and Thermo dynamics- D S Mathur (V Edn)
3. Properties of matter-JC Upadhaya
4. Heat and Thermodynamics - Zemansky

5.Physics- Resnick and Halliday 6. Thermodynamics- Brijlal and Subramanium

SEMESTER - 2

Complementary course-II

APHY2C02T: Mechanics, Relativity, Waves & Oscillations

(Hrs/ Week -2 , Hrs / Sem-36, Credit -2)

1. **Frames of reference . 4 Hours Max marks 12**

Inertial frame of reference-Galilean transformation equations and Invariance- Non inertial frames- Centrifugal force and Coriolis force

2. **Conservation of Energy and Momentum 10 Hours Max marks 29**

Conservation of energy of a particle –Energy function- Potential energy curve- Conservative and Non conservative forces- Conservation of Linear momentum-Center of mass frame of reference- Rockets- motion under central force- Conservation of angular momentum- examples

3. **Relativity 8 Hours Max marks 23**

Postulates of special theory-Michelson Morley experiment-Lorentz transformation equations- Length contraction-Time dilation- Twin paradox- variation of mass with velocity-Mass energy relation- momentum energy relation

4**. Oscillation and waves 8 Hours Max marks 23**

Simple harmonic motion (Elementary idea)- equation –examples like oscillation of simple pendulum, loaded spring-An harmonic oscillator-Damped harmonic oscillator. Wave motion-Equation for plane progressive wave-Energy density- Pressure variations of plane waves-Fourier theorem.

5**. Quantum mechanics 6 Hours Max marks 17**

Postulates of quantum mechanics-Wave function-Schrodinger equation (Time dependent & steady state form)-eigen values and eigen functions-electron microscope and scanning tunnelling microscope (Qualitative study)

Text for Study:Mechanics-J C Upadhaya

Modern Physics-Arthur Bieser

Books for reference-

1. Mechanics – J C Upadhyaya
2. Special theory of relativity- Resnick

3. Modern physics –Arthur Beiser
4. Waves, Mechanics & Oscillations- S B Puri

SEMESTER - 3

Complementary course-III

APHY3C03T: Optics , Laser , Electronics & communication

(Hrs/ Week-3 , Hrs / Sem -54, Credit -2)

1.Fermat's Principle and Interference 13Hrs Max marks 25

Laws of reflection and refraction- verification by Fermat's principle

Superposition of two sinusoidal waves (resultant amplitude and intensity)., constructive and destructive interference- Fresnel's two mirror arrangement and bi-prism- Interference with white light- Interference by a plane film- colours of thin films- Newton's rings (Reflected system)-Determination of wavelength

3.Diffraction 8Hrs Max marks 15

Fresnels and Fraunhoffer class of diffraction -Fraunhofer single slit diffraction pattern- Intensity distribution- plane diffraction Grating-resolving power and dispersive power. Experiment with grating

4. Polarisation 8 Hrs Max marks 15

Elementary idea- Brewster' law- Double refraction- positive and negative crystals- Quarter and half wave plate- production of plane , elliptically and circularly polarized light- optical activity

5. Electronics 14 Hrs Max marks 27

Half wave, Full wave and bridge rectifier circuits- Efficiency & ripple factor- Filter circuits (capacitor filter and π filters) – Zener diode characteristics- Voltage stabilization

Transistors- CB, CE, CC Configurations- characteristics- Current amplification factors- relation connecting α , β and γ – CE Amplifier- frequency response- band width

Basic principle of feedback- L C & RC oscillators- Colpit's & Hartley oscillators .

Logic gates- Universal gates- De- Morgan's theorem – Exclusive OR and Exclusive NOR gate

6. Laser physics **5 Hrs Max marks 10**

Induced absorption- spontaneous emission and stimulated emission- population inversion- Principle of Laser-Types of laser- Ruby laser, Helium Neon laser- semi conductor laser (qualitative study)

7. Principle of Communication **6Hrs Max marks 12**

Transmission and reception of signals- modulation and demodulation- Types of modulation-AM, FM,PM.(Elementary ideas only)

Text for study: Optics-Brijlal&Subramanian

Principles of Electronics-VK Mehta

Books for reference

1. Optics- Ajay Ghatak
2. Optics – Brijlal&Subrahmanian
3. Laser fundamentals – Silfast
4. Lasers – theory & applications- Thyagarajan & Ghatak
5. Principles of Electronics – VK. Mehta

SEMESTER - 4

Complementary course-IV

APHY4C04T: Electricity, Magnetism and Nuclear physics

(Hrs/ Week -3 , Hrs / Sem -54, Credit -2)

1. Electrostatics 12 Hrs Max marks 23

Coulomb's law between charges- Electric field- field lines- Electric potential-Gauss law- application to find field due to plane sheets of charge- Electrostatic shielding (pose practical application) –Dielectrics- capacitors

2. Current electricity 8 Hrs Max marks 15

Drift velocity of charges- electric resistance- super conductivity (basic ideas)- Potentiometer – determination of resistance- carey fosters bridge- temperature coefficient of resistance.

3. Magnetism 8 Hrs Max marks 15

Earths magnetism- magnetic elements- Dia magnets-paramagnets and Ferro magnets- magnetic moment-Deflection magnetometer-Tan A & Tan B - Searle's vibration magnetometer- Tangent galvanometer- Hysteresis

4. Nuclear physics 16 Hrs Max marks 32

Nucleus and its properties- nuclear force- stability of nucleus- binding energy- nuclear fission- fusion- reactors- Nuclear bomb, Hydrogen bomb- Radio activity- α ,β and γ radiations- half life and mean life- C^{14} dating- Effects of radiation- Nuclear waste disposal Particle accelerators- Linear accelerator- cyclotron- Radiation detectors- gas detectors- semi conductor detectors

5. Cosmic rays and Elementary particles 10 Hrs Max marks 19

Cosmic rays (primary and secondary)- cosmic ray showers-latitude effect- longitude effect- Elementary particles- Classification- Leptons- Hadrons- resonance particles- quarks- color and flavour- Higgs boson- L H C- Dark energy- Origin of universe.

Text for study:Electricity and Magnetism-Murukesan

Nuclear Physics-D.C.Tayal

Books for reference

1. Introduction to Electro dynamics-David J Griffith
2. Electricity and Magnetism – Arthur F kip
3. Concepts of Modern physics – Arthur Beiser
4. Nuclear physics – Irvin Kaplan
5. Nuclear physics - D.C.Tayal

LAB PROGRAMME FOR COMPLEMENTARY COURSES

Lab examination will be conducted at the end of fourth semester.

The minimum number of experiments for appearing examination is **75% of total 24 expts** in the syllabus Basic theory of the experiment must be shown at the time of Examination.

Students must submit a certified fair record at the time of Examination.

Number of Questions per session for the practical Examination :8

A minimum of 6 questions in the Question paper shall be set for the Examination .

APHY4C05P: Complimentary Course- (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any Six)

1. Characteristics of Diode and Zener diode
2. Optical constants of convex lens
3. Torsion pendulum- Rigidity modulus
4. Spectrometer- Refractive index of the material of prism
5. Deflection Magnetometer- Moment of a magnet (Tan-A position)
6. Potentiometer-Measurement of resistance
7. Surface tension-capillary rise
8. Sonometer -frequency of A C

Complimentary Course- (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any Six)

1. Young's modulus – Uniform bending –using optic lever
2. Static torsion – Rigidity modulus
3. Spectrometer- Grating- Normal incidence
4. Melde's string- Frequency of fork (Transverse and Longitudinal mode)
5. Half wave rectifier -with and without filter
6. Field along the axis of a circular coil
7. Liquid lens- Refractive index of liquid and glass
8. potentiometer-measurement of current -ammeter calibration

Complimentary Course- (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any Six)

1.Young's modulus- Pin and microscope (Non- Uniform bending)..

2. Potentiometer-Calibration of low range voltmeter

3.Viscosity of liquid- Capillary flow- Variable pressure head method

4. Logic gates – Verification of truth table

5 Carey Fosters bridge- Resistivity of the material of wire

6 Surface Tension-Capillary rise method-Radius by microscope.

7 Air wedge-angle of wedge and diameter of thin wire

8 Full wave rectifier with and without filter

Semester-4

Complimentary Course- (Practical)

Hours per week-2, Hours per semester-36,Credit-2

(Any Six)

1. Young's modulus of a cantilever- Pin and microscope method
2. Potentiometer- Conversion of Galvanometer in to voltmeter –calibration by standard voltmeter
3. Moment of inertia of fly wheel
4.. Tangent galvanometer – Reduction factor
5. Searle's vibration magneto meter – Comparison of moments
6.. Newton's rings- Wavelength of sodium light
7.. Verification of Newton 's law of cooling
8.. Spectrometer grating-minimum deviation

MODEL QUESTION PAPERS

Add here QP of I & II sem etc. Also please arrange them first core QPS then complementary and then open

If possible ensure that the format of all QP you are going to add are in the same title patterns as that of the already shown QPs below

Reg. No……

St Joseph's College, Devagiri, Calicut (Autonomous)

FIFTH SEMESTER B Sc PHYSICS MODEL QUESTION PAPER

APHY5B07T: Quantum Mechanics

Time: **3 hours** Maximum marks: **80**

SECTION A

(*Answer any **eight** questions each in two to three sentences; **8 x 1 = 8** marks***)**

1. What is meant by pair production?
2. "An object of sufficiently high density can trap light forever". Explain the statement.
3. For a material particle show that phase velocity is always greater than *c*.
4. Do nuclei contain electrons? Comment.
5. Explain the principle of an electron microscope.
6. Write down Bohr's correspondence principle.
7. Show that no two electrons have same quantum state.
8. Write Schrodinger's time independent wave equation.

SECTION B

(*Answer any **six** questions each in about a page; **6 x 4 = 24** marks*)

9. What is ultraviolet catastrophe?
10. Explain photoelectric effect on the basis of quantum theory.
11. What is a wave packet? How is it represented (i) geometrically; and (ii) analytically.
12. Explain Frank-Hertz experiment.
13. Explain the significance of wave function.
14. What do you mean by tunneling through a barrier?
15. List and comment on various quantum numbers associated with an atomic electron?
16. Explain the role of magnetic quantum number in space quantization.
17. Explain the selection rules for allowed transitions.

SECTION C

*(Attempt any **eight** problems- separate marks for formulae, substitution and result with units; **8 x 4=32** marks)*

18. While conducting a photoelectric effect experiment with light of a certain frequency, it is found that a reverse potential difference of 1.25 V is required to reduce the current to zero. Find (a) the maximum kinetic energy (b) the maximum speed of emitted photoelectron.
19. X-rays of wavelength 0.112 nm is scattered from a carbon target. Calculate the wavelength of X-ray scattered at an angle of 90^0 with respect to the original direction.
20. Calculate the most probable de Broglie wavelength associated with thermal neutrons. Given temperature = 27°C, k = 1.38 x 10^{-23} J/K and mass of the neutron = 1.6749 x 10^{-27} kg.
21. An electron is confined within a region of width 1.0 x 10^{-10} m. (a) Estimate the minimum uncertainty in the x-component of the electron's momentum. (b) If the electron has momentum with magnitude equal to the uncertainty in (a), what is its kinetic energy?
22. Find the longest wavelength present in the Balmer series of hydrogen, corresponding to the H_α line.
23. Calculate the total energy of the electron in the first Bohr orbit, in electron Volt.
24. The wave function $\psi = A \cos x$ for $0<x< \pi/2$. Find the value of A.
25. The wave function is given by $\psi(x, t) = A \exp [i40(kx-wt)]$. Find the eigen value corresponding to the energy operator.
26. A particle limited to the x axis has the wave function ψ=ax between x=0 and x=1; ψ=0 elsewhere.
    (a) Find the probability that the particle can be found between x=0.45 and x=0.55.
    (b) Find the expectation value <x> of the particle's position.
27. Show that the total number states in each 'n' value is $2n^2$.
28. With the help of a suitable diagram, find the angles that '**L**' make with the z axis for $l = 2$.
29. A spectral line of wavelength 450 nm when produced in a magnetic field of 10 Tesla is observed to be a normal Zeeman triplet. Calculate the wavelength separation between components of this triplet.

SECTION D

(*Answer any **two** questions each in about **two pages**; **2 x 8 = 16** marks***)**

30. Describe Davisson and Germer experiment for the study of diffraction of electrons and show that the results of this experiment are closely in agreement with de-Broglie wavelength of electrons.
31. Write down the Schrodinger's equation for linear Harmonic Oscillator and derive expression for energy eigen values.
32. Write the time –independent Schrodinger equation for the hydrogen atom in spherical polar co-ordinates and separate it into three differential equations for three parts of the total wave function.

33. Explain the postulates of quantum mechanics. Bring out the significance of expectation values with an example.

Reg. No……
Name……...
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THIRD SEMESTER B Sc PHYSICS MODEL QUESTION PAPER

APHY3B03T: Mechanics

Time: **3 hours** Maximum marks: **80**

SECTION A

(*Answer any **eight** questions each in two to three sentences; **8 x 1 = 8** marks***)**

1. What is fictitious force?
2. What is meant by inertial frame of reference? Give examples.
3. What do you mean by time dilation?
4. What are the postulates of special theory of relativity?
5. Give Lorentz transformation equations.
6. What is energy function?
7. Differentiate between conservative and non-conservative forces.
8. State Kepler's laws of planetary motion.

SECTION B

(*Answer any **six** questions each in about a page; **6 x 4 = 24** marks*)

9. What is self energy? Deduce an expression for gravitational self-energy of a uniform sphere of radius 'r'.
10. What are cyclic coordinates? Show that if the lagrangian is cyclic in time, the total energy of the system will be conserved.
11. Show that linear momentum of system of particles about their centre mass is zero.
12. Explain potential energy curve.
13. Write a note on Coriolis force.
14. Write a note on four vectors and four momenta.
15. Why do you feel weightlessness inside a satellite?
16. Show that law of conservation of energy is invariant under Galilean transformation.
17. Explain the law of conservation of angular momentum with an example.

SECTION C

*(Attempt any **eight** problems- separate marks for formulae, substitution and result with units; **8 x 4 = 32** marks)*

18. Calculate the fictious force and total force on a body of mass 10 kg relative to a frame moving vertically upwards on earth with an acceleration of $5ms^{-2}$.

19. Calculate the period of rotation of the plane of oscillation of a Foucault's pendulum (i) at latitude 45^0 (ii) at North Pole (iii) at the equator.

20. If a force $\boldsymbol{F} = (2xy+z^2)\,\boldsymbol{i} + x^2\boldsymbol{j}+2xz\,\boldsymbol{k}$, Show it is conservative. Calculate the amount of work done in by this force in moving a particle from (0,1, 2) to (5,2,7).

21. A sand bag of mass 10 kg is suspended from 3m long weightless string. A bullet of 200g is fired with speed 20m/s into the bag and stay in it. Find the speed acquired by the bag and the maximum displacement of the bag.

22. Two bodies 1kg and 4 kg are kept 12cm apart. If a third mass 1 kg is placed in between them so that net force acting on the mass is zero. Calculate the position of the third mass, the potential energy of the system and energy to remove the third mass alone from the system.

23. If a body of mass 50 kg fall on earth, by how much the self-energy of the mass changes? If its initial velocity is zero, what will be its velocity when it strikes on earth's surface?

24. If the rest mass of proton is $1.67\text{x}10^{-27}$ kg , calculate the velocity and momentum if it moves with $2.7\text{x}10^8$ m/s. If it collides with a stationary nucleus of mass $2.5\text{x}10^{-26}$kg and coalesces, fine the velocity of the combined particle.

25. A particle at rest breaks into two particles of rest mass ratio 1:2. If the heavier particle moves with a velocity $1.8\text{x}10^8$m/s find the velocity of lighter particle. Also find the velocity of lighter particle relative to the heavier one.

26. A rod of length 5m is placed in xy plane of system S1 at an angle of $\sin^{-1}(3/5)$.Calculate its length and orientation in the frame S if the frame S1 is moving with a speed 0.8c $\hat{i}$ relative to S.

27. A cylinder of mass m and radius a slides down an inclined plane of inclination Θ. Using Lagrange's method find the equation of motion.

28. Find the velocity of a proton whose relativistic K.E. is 900 MeV. ($m_0 = 1.67\text{X } 10^{-27}$ Kg).

29. Deduce the velocity at which the mass of a particle becomes 1.25 times its rest mass.

SECTION D

(*Answer any **two** in about two and a half pages; **2** x **8 =16** marks***)**

30. What is principle of virtual work? Derive Lagrangian from that.

31. Derive variation of mass with velocity.

32. Describe the principle of rocket. Derive the expression for acceleration and final velocity if rocket

33. Discuss the deflection of a particle by another at rest in lab and CM frames. Obtain the expressions for final velocities.

Roll No & Name.....

FIFTH SEMESTER B Sc PHYSICS MODEL QUESTION PAPER

APHY5B06T: Electrodynamics II

Time: **3 hours** Maximum marks: **80**

SECTION A

(*Answer any **eight** questions each in two to three sentences; **8** x **1** = **8** marks***)**

1. What is the physical significance of $\nabla . B = 0$?
2. Write down three different forms of Faraday's law and explain the symbols.
3. The leakage method is suitable only for measurement of high resistance. Why?
4. Explain the fact that Lenz's law is a consequence of the law of conservation of energy.
5. Distinguish between a constant voltage source and a constant current source.
6. Why a parallel resonance circuit is called a rejecter circuit?
7. What do you mean by time constant of an RC circuit? Write its formula.
8. What is meant by skin effect?

SECTION B

(*Answer any **six** questions each in about a page; **6** x **4** = **24** marks*)

9. Write down the Maxwell's equations in an isotropic dielectric medium and set up the decoupled differential equations.
10. Show that the magnetic energy stored in an inductor is $\frac{1}{2\mu_0}\int B^2 d\tau$.
11. Derive the boundary conditions for the normal components of **E** and **H**.
12. State and prove maximum power transfer theorem.
13. Explain, with an example, the solution of simultaneous equations using determinants.
14. Show that for plane em waves the electric and magnetic field vectors are at right angles to each other and also perpendicular to the direction of propagation.
15. Derive an expression for refractive index in terms of dielectric constant.
16. Explain the jumping ring experiment.
17. Explain Norton's theorem with an example.

SECTION C

*(Attempt any **eight** problems- separate marks for formulae, substitution and result with units; **8 x 4 = 32** marks)*

18. In an LCR circuit C = 0.2μF, L = 0.05H and R = 100Ω. Check whether it is oscillatory or not. If oscillatory, find the frequency of oscillation.

19. A parallel plate air capacitor has circular plates of radius 5 cm. It is being charged so that the electric field varies at a rate of 10^{12}V/m-sec. Find the displacement current in it.

20. The intensity of sunlight is 1300 watt/ m^2. Find the amplitudes of its electric and magnetic fields. How far a stationary electron would have to be to get a comparable electric field?

21. When a capacitor charged to a pd of 400 V is connected to a voltmeter having a resistance of 25 MΩ, the voltage is observed to have fallen to 50 V at the end of an interval of 2 minutes. Find the value of the capacitor.

22. The refractive index of diamond is 2.42. Calculate ratio of amplitudes at normal incidence and Brewster's angle.

23. What must be the strength of a uniform electric field if it is to have the same energy density as that possessed by a $4x10^{-2}$ T magnetic field?

24. A capacitor of 0.2μF is first charged and then discharged through a resister 10MΩ. Find the time the potential takes to fall to ¼ of its original value.

25. a) What are reflection and transmission coefficients for normal incidence when an EM wave passes from one medium to another? b) Show that R+T =1 assuming that $\mu_0 = \mu_r$.

26. Two cells of emfs E_1 and E_2 having internal resistance r_1 and r_2 respectively connected in parallel. What is the effective emf?

27. Show that good conductors are very good reflectors of electromagnetic waves.

28. Derive an expression for the inductance of a toroid of rectangular cross section with inner radius *a*, outer radius *b* and height *h*.

29. What is the magnetic energy density at the centre of a circulating electron in the hydrogen atom given $v = 6.8 \times 10^{15}$ *rev/s* and $r = 5.1x10^{-11}$ *m*.

SECTION D

(*Answer any **two in about two and a half pages**; **2 x 8 =16** marks***)**

30. Find the boundary conditions for **E**, **B**, **D** and **H** at a surface which carries charge density σ and current density **K**, which separates two media.

31. Two different strings are tied together and kept taut. A wave is setup in it. Derive the reflection and transmission coefficients using boundary conditions.

32. Describe with theory how you will determine the self inductance of a coil using Anderson's bridge.

33. Discuss the LCR series circuit in detail. Obtain an expression for the instantaneous current.

Roll No & Name.....

THIRD SEMESTER B Sc PHYSICS (COMPLEMENTARY) MODEL QUESTION PAPER

APHY4C03T: Optics, Laser, Electronics and Communication

Time: **3 hours** Maximum marks: **64**

SECTION A

(*Answer any **nine** questions each in two to three sentences; **9 x 1 = 9** marks***)**

1. What is Fermat's principle?
2. State and explain superposition principle.
3. What are the necessary conditions for producing sustained interference?
4. What is Rayleigh's criterion for resolution?
5. Define resolving power of a grating.
6. State and explain Brewster's Law.
7. Draw a neat diagram of full wave rectifier.
8. What you mean by Zener breakdown?
9. State the De Morgan's theorem.

SECTION B

(*Answer any **seven** questions each in about a page; **7 x 3 = 21** marks*)

10. Explain superposition principle and obtain the expression for resultant intensity of two waves.
11. Give the theory of plane diffraction grating.
12. Explain how Zener diode is used as a voltage stabilizer?
13. Explain plane polarised light, circularly polarised light and elliptically polarised light.
14. Define β of a transistor and obtain the relation between α and β.
15. Draw the circuit diagram of a Colpitt's Oscillator and briefly explain its working.
16. What are the circuit requirements for converting an amplifier to an oscillator?
17. Explain the symbol and truth table of basic logic gates.
18. Define population inversion. What are the basic requirements for generating a laser beam?
19. Describe the theory of a zone plate? What are the two types of zone plates?

SECTION C

*(Attempt any **six** problems- separate marks for formulae, substitution and result with units;* ***6 x 3 = 18*** *marks)*

20. Calculate the thickness of a half wave plate. Given μ_o = 1.973, μ_e = 2.656 and λ = 590 nm.
21. What is the longest wave length that can be observed in the third order spectrum of a grating with 6000 lines/cm? Assume normal incidence.
22. The diameter of the central zone of a zone plate is 2.3 mm. If a point source of light of wavelength 589.3 nm is placed at a distance of 6 m from it, calculate the position of the first image.
23. In Newton's ring experiment, the diameter of the 15^{th} ring was found to be 0.590 cm and that of the 5^{th} ring was 0.336 cm. If the radius of curvature the plano-convex lens is 100 cm, calculate the wavelength of light used.
24. A biprism is placed 5 cm from a slit illuminated by sodium light (λ= 5890Å). The width of the fringes obtained on a screen 75 cm from the biprism is 9.424 x 10^{-2} cm. What is the distance between the two coherent sources?
25. A 1pF capacitor is available. Find the effective value of the inductor in a Hartley oscillator if the frequency of the oscillator is 1 MHz.
26. A half wave rectifier uses a transformer of turn ratio 3:1. The load resistance is 500 ohm. If the primary rms voltage is 240V find i) DC output voltage ii) PIV.
27. The base current of a transistor is 0.02 mA and α = 0.98. Obtain the values emitter current, collector current and β.
28. The gain of an amplifier without feedback is 100. Calculate the gain when a feedback fraction of 0.01 is applied.

SECTION D

(*Answer any **two** each in about two pages;* ***2 x 8 = 16*** *marks***)**

29. Explain the formation of Newton's rings. How can this be used to determine the wavelength of monochromatic light?
30. Describe in detail the diffraction of a cylindrical wave front at a straight edge.
31. Explain the working of a feedback amplifier in detail and derive an expression for its gain.
32. Describe the principle, construction and working of ruby laser.

V SEMESTER B.Sc. DEGREE EXAMINATION (CCSS), MODEL QUESTION PAPER
APHY5D01T: Open course- NON CONVENTINAL ENERGY SOURCES

Time: 2 hours Maximum Marks: 50

Section A

*(Answer **all** questions each in two to three sentences; **10 x 1=10** marks)*

1. Define Solar constant.
2. What are the factors that determine the output from wind energy converter?
3. What are the two types of battery? Give examples.
4. What are the different categories of geothermal resources?
5. What are the social benefits of bio gas utilization?
6. Define photovoltaic effect.
7. Give the principle of OTEC system.
8. What are the social benefits of bio gas utilization?
9. What are the conventional sources of energy?
10. What is a wind farm?

Section B

*(Answer **any five** questions each in about half a page; **5 x 4 = 20** marks)*

11. What do you mean by solar green house? Explain.
12. Describe with neat diagram the working of open cycle OTEC.
13. List the advantages and disadvantages of geothermal energy.
14. Discuss the advantages and disadvantages of wind energy converters.
15. Explain any one of the solar collectors with the help of a neat diagram.
16. Explain the working of a wind mill with the help of a diagram.
17. Explain the design principle and constructional details of a box type solar cooker.
18. Briefly explain about the material requirement for the construction of a biogas plant.

Section C

*(Answer **any two** questions each in about two pages; **2 x 10 = 20** marks)*

19. Describe the principle of working of solar furnace? What are the main applications? What are the advantages and limitations of solar furnace?
20. Explain how tidal power is used to generate electricity with one tidal energy conversion plant? Give its limits.
21. Discuss the methods to get energy from Bio mass.
22. With the help of a neat diagram, explain the working of a liquid dominated flash steam system.