File Ref.No.25479/GA - IV - J2/2013/CU

UNIVERSITY OF CALICUT

Abstract

BSc programme in Physics-CUCBCSS UG 2014-Core and Complementary Courses-Scheme and Syllabus- Approved- Implemented-w.e.f 2014 Admissions-Orders issued

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G & A - IV - J

U.O.No. 6902/2014/Admn Dated, Calicut University.P.O, 17.07.2014

Read:-1. U.O. No. 3797/2013/CU, dated 07.09.2013 (CBCSS UG Modified Regulations) (File.ref.no. 13752/GA IV J SO/2013/CU).

2. U.O. No. 5180/2014/Admn, dated 29.05.2014 (CBCSS UG Revised Regulations) (File.ref.no. 13752/GA IV J SO/2013/CU).

3. Item no. 1 of the minutes of the meeting of the Board of Studies in Physics UG held on 20.06.2014.

4.Item no. 34 of the minutes of the meeting of the Faculty of Science held on 27.06.2014.

5.Orders of the VC on 14.07.2014, in the file no, 18602/GA IV /J1/2013/CU.

ORDER

The Modified Regulations of Choice Based Credit Semester System for UG Curriculum w.e.f 2014 was implemented under the University of Calicut vide paper read as (1).

The Revised CUCBCSS UG Regulations has been implemented w.e.f 2014 admission, for all UG programme under CUCBCSS in the University, vide paper read as (2).

The Board of Studies in Physics UG approved the new syllabus for **B.Sc**. **Physics Core Course**, B.Sc. Applied Physics, and **Complimentary Courses** according to the new system, which is to be implemented w.e.f 2014 admissions vide paper read as (3).

The Faculty of Science has also approved the minutes of the Board vide paper read as (4).

The Hon'ble Vice Chancellor, considering the exigency, exercising the powers of the Academic Council has approved the items regarding syllabus implementation in the minutes of the concerned Boards of Studies mentioned in the minutes of the Faculty of Science, subject to ratification by the Academic Council, vide paper read as (5).

Sanction has, therefore, been accorded for implementing the Scheme and Syllabus of **BSc. programme in Physics Core and Complementary Courses** under CUCBCSS UG 2014, in the University, w.e.f 2014 Admissions.

Orders are issued accordingly.

(The syllabus is available in the website: universityofcalicut.info)

Muhammed S
Deputy Registrar

To

1. All Affiliated Colleges/SDE/Dept.s/Institutions under University of Calicut.
2. The Controller of Examinations, University of Calicut.
3. The Director SDE, University of Calicut.

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

B.Sc. PHYSICS

(CORE AND COMPLIMENTARY PROGRAMMES)

SYLLABUS & MODEL QUESTION PAPERS

w.e.f 2014 admission onwards

B.Sc. DEGREE PROGRAMME (PHYSICS CORE)

COURSE SRTUCTURE

Semester	Course Code	Course Title	Total hours	Hours/ Week	Credits
I	A 01	Common Course I – English	72	4	4
	A 02	Common Course II – English	90	5	3
	A 07	Common Course III – Language other than English	72	4	4
	PH1 B01	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	A 03	Common Course IV – English	72	4	4
	A 04	Common Course V – English	90	5	3
	A 08	Common Course VI – Language other than English	72	4	4
	PH2 B02	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	A 05	Common Course VI – English	90	5	4
	A 09	Common Course VIII - Language other than English	90	5	4
	PH3 B03	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	A 06	Common Course IX – English	90	5	4

	A 10	Common Course X - Language other than English	90	5	4
	PH4 B04	Core Course IV - Electrodynamics I	54	3	3
	PH4 B05	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	PH5 B06	Core Course VI - Electrodynamics II	54	3	3
	PH5 B07	Core Course VII - Quantum Mechanics	54	3	3
	PH5 B08	Core Course VIII - Physical Optics and Modern Optics	54	3	3
	PH5 B09	Core Course IX- Electronics (Analogue and Digital)	72	4	4
		Open Course – (*course from other streams*)	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	PH6 B10	Core Course X - Thermal and Statistical Physics	72	4	4
	PH6 B11	Core Course XI - Solid State Physics, Spectroscopy and Laser physics	72	4	4
	PH6 B12	Core Course XII - Nuclear Physics, Particle Physics and Astrophysics	72	4	4
	PH6 B13	Core Course XIII (Elective)	54	3	3
	PH6 B14	Core Course Practical XIV – Practical II	72	**4**	**5**
	PH6 B15	Core Course Practical XV – Practical III	72	**4**	**5**
	PH6 B16	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 and Tour report	3	75 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*	*Physics*		
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 university 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*
1	English	600
2	Additional Language	400
3	Core course: Physics	1750
4	Complementary course I: Mathematics	400
5	Complementary course II: Chemistry/….	400
6	Open Course	50
	Total Marks	**3600**

Seven point Indirect Grading System

% of Marks	*Grade*	*Interpretation*	*Grade Point Average*	*Range of Grade points*	*Class*
90 and above	A^+	Outstanding	6	5.5 - 6	First Class with distinction
80 to below 90	A	Excellent	5	4.5 – 5.49	
70 to below 80	B	Very good	4	3.5 – 4.49	First Class
60 to below 70	C	Good	3	2.5 – 3.49	
50 to below 60	D	Satisfactory	2	1.5 – 2.49	Second Class
40 to below 50	E	Pass/Adequate	1	0.5 – 1.49	Pass
Below 40	F	Failure	0	0 – 0.49	Fail

Core Course Structure

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

Semester	*Code No*	*Course Title*		*Hrs/ Week*	*Total Hrs*	*Credit*	*Marks*
I	PH1B01	Core Course I: Methodology of Science and Physics		2	36	2	100
	-	Core Course V : Practical-I		2	36	-*	-
II	PH2B02	Core Course II: Properties of matter waves and Acoustics		2	36	2	100
	-	Core Course V : Practical-I		2	36	-*	-
III	PH3B03	Core Course III: Mechanics		3	54	3	100
	-	Core Course V : Practical-I		2	36	-*	-
IV	PH4B04	Core Course IV: Electrodynamics-I		3	54	3	100
	PH4B05	Core Course V : Practical-I		2	36	5	150
V	PH5B06	Core Course VI: Electrodynamics-II		3	54	3	100
	PH5B07	Core Course VII: Quantum Mechanics		3	54	3	100
	PH5B08	Core Course VIII: Physical Optics and Modern Optics		3	54	3	100
	PH5B09	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	PH6B10	Core Course X: Thermal and statistical Physics		4	72	4	100
	PH6B11	Core Course XI: Solid State Physics, Spectroscopy and Laser		4	72	4	100
	PH6B12	Core Course XII: Nuclear Physics, Particle Physics and Astrophysics		4	72	4	100
	PH6B13(E1)	Core Course XIII: Elective***	1. COMPUTATIONAL PHYSICS	3	54	3	100
	PH6B13(E2)		2. MATERIALS SCIENCE				
	PH6B13(E3)		3. NANO SCIENCE AND TECHNOLOGY				
	PH6B14	Core Course XIV: Practical -II		4	72	5**	150
	PH6B15	Core Course XV: Practical-III		4	72	5**	150
	PH6B16	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

*** An 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 colleges shall send only the marks obtained for internal examination to the university.

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*
Above 90%	5
85-89%	4
80-84%	3
76-79%	2
75%	1

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	One word	4	4	1	4
	Short answer	5	4	2	8
	Paragraph	5	4	3	12
	Problem	4	2	3	6
	Essay	2	1	10	10
				*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	One word or one phrase or true or false	10	10	1	10
	Short answer(one or two Sentence)	7	7	2	14
	Paragraph/half page	7	5	4	20
	Problems	7	4	4	16
	Essay	4	2	10	20
				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 24 students. For an additional batch another supervisor 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 written 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
	Total Marks	15

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 (written copy) 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	Hand written Report	10
2	Outcome/Analysis	6
3	Photos (five photos)	4
	TOTAL	**20**

Practical Evaluation (Core)

Internal		**External**		
Items	**Marks**	**Items**	**Marks**	**Marks for Python Programming**
Record	6	Record with 20 expts Max.one mark for each expt	20	20
Regularity in getting the expts done	6	Formulae, Theory, Principle/ Programme	30	20
Attendance	6	Adjustments& setting / Algorithm	20	20
Test 1	6	Tabulation, Observation and performance/ Execution	30	40
Test 2	6	Calculation, result, graph, unit/ Result	15	15
		Viva	5	5
Total	**30**	**Total**	**120**	**120**

CORE COURSE – XIII (ELECTIVE) :		
1	PH6 B13 (E1)	COMPUTATIONAL PHYSICS
2	PH6 B13 (E2)	MATERIALS SCIENCE & THIN FILMS
3	PH6 B13 (E3)	NANO SCIENCE AND TECHNOLOGY

OPEN COURSES OFFERED BY PHYSICS DEPARMENT (For students from other streams)		
1	PH5 D01(1)	NON CONVENTIONAL ENERGY SOURCES
2	PH5 D01(2)	AMATEUR ASTRONOMY AND ASTROPHYSICS
3	PH5 D01(3)	ELEMENTARY MEDICAL PHYSICS

PHYSICS COMPLEMENTARY COURSE STRUCTURE

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

Semester	*Code No*	*Course Title*	*Hrs/ Week*	*Total Hrs*	*Credit*	*Marks*
I	PH1C01	Complementary Course I: Properties of matter and Thermodynamics	2	36	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
II	PH2C02	Complementary Course II: Mechanics, Relativity, Waves and Oscillations	2	36	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
III	PH3C03	Complementary Course III: Optics ,Laser, Electronics and Communication	3	54	2	80
	-	Complementary Course V: PHYSICS Practical	2	36	-*	-
IV	PH4C04	Complementary Course IV: Electricity ,Magnetism and Nuclear Physics	3	54	2	80
	PH4C05	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 colleges shall send only the marks obtained for internal examination to the university.

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*
Above 90%	4
85-89%	3.2
80-84%	2.4
76-79%	1.6
75%	0.8

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	One word	4	4	1	4
	Short answer	4	4	2	8
	Paragraph/half page	4	2	3	6
	problems	4	2	3	6
	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	One word/one phrase/true or false	10	10	1	10
	Short answer-one or two sentences	7	7	2	14
	Paragraph/Half page	5	3	4	12
	Problems	5	3	4	12
	Essay-within two pages	4	2	8	16
				Total Marks	64

Practical Evaluation (Complimentary)

Internal		External	
Record	4	Record with 20 expts Max. ½ mark for one expt	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	PH5D01	Open Course 1: Non conventional Energy Sources	2	36	50
	PHYD02	Open Course 2: Amateur Astronomy and Astrophysics			
	PHYD03	Open Course 3: Elements of Medical Physics			

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 required

1. INTERNAL EVALUATION

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

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*
Above 90%	2.5
85-89%	2
80-84%	1.5
76-79%	1
75%	0.5

Table 3: Pattern of Test Papers (Internal)

Duration	*Pattern*	*Total number of questions*	*Number of questions to be answered*	*Marks for each question*	*Marks*
1 Hour	One word	4	4	1	4
	Short answer	2	1	2	2
	Paragraph	4	2	3	6
	Essay	2	1	8	8
				Total Marks	20

*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. University 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*
	One word/One Phrase/True or false	6	6	1	6
	Short answer- one or two sentence	5	5	2	10
	Paragraph- half page	6	4	4	16
	Essay- within two pages	3	1	8	8
				Total Marks	40

Core Course I

PH1 B01: METHODOLOGY OF SCIENCE AND PHYSICS– 36 hours (Credit - 2)

(Importance must be given to Part C)

Part A: Methodology And Perspectives Of Sciences 10Hours Max marks 27

Unit I – Science and Science Studies

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

What is Science; what is not science; laws of science. Basis for scientific laws and factual truths.

Science as a human activity, scientific temper, empiricism, vocabulary of science, science disciplines.

Revolution in science and Technology.

Unit II – Methods and tools of science

Hypothesis: Theories and laws in science. Observations, Evidences and proofs.

Posing a question; Formulation of hypothesis; Hypothetico-deductive model, Inductive model. Significance of verification (Proving), Corroboration and falsification (disproving), Auxiliary hypothesis, Ad-hoc hypothesis.

Revision of scientific theories and laws, Importance of models, Simulations and virtual testing, Mathematical methods vs. scientific methods. Significance of Peer Review.

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

Part B: Methodology and Perspectives of Physics 9Hours Max marks 27

What does Physics deal with? - brief history of Physics during the last century-the inconsistency between experiments and theories- Birth of new science concepts - Quantum concepts-Black body radiation, Photoelectric effect, X-rays, De Broglie waves, Sections 2.2, 2.3, 2.5, 3.1, of Arthur Beisser) ***(All topics in this part require qualitative study only, derivations are not required. Detailed study not required)***

Relativity-Special relativity, Time dilation, Length contraction, Twin paradox (Sections 1.1, 1.2, 1.4, 1.5 of Arthur Beisser)

Laser- Concepts of ordinary and monochromatic light, Coherent and incoherent light, Spontaneous and stimulated emission, Metastable state, pumping and population inversion.(Basic ideas only Section 4.9 of Arthur Beisser) ***(All topics in this part require qualitative study only, derivations are not required. Practical Laser not required. Detailed study not required.)***

Design of an experiment , experimentation , Observation, data collection:

Interaction between Physics and technology.

References:

1. Concepts of Modern Physics- Arthur Beisser
2. A brief history and Philosophy of Physics - Alan J. Slavin- http:/ www.trentu. Ca/ academic / history- 895 .html
3. 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

Part C – Mathematical Methods in Physics 17 Hours Max marks 72

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

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).

Matrices: – Basic ideas of matrices – addition, subtraction, scalar multiplication,

Transpose of a matrix, conjugate of a matrix, diagonal matrix - Representation of vectors as column matrix – Determinants – Cramer's rule – Eigen Values and Eigen Vectors - Hermitian Matrix,Unitary Matrix.

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
3. Mathematical Physics – BD Guptha
4. Mechanics-J.C .Upadhyaya

Semester -2

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

PH2 B02: PROPERTIES OF MATTER, WAVES & ACOUSTICS

Unit-1: Properties of Matter 9 Hours Max marks 27

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 52

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 27

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

Semester-3

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

PH3 B03: MECHANICS

UNIT-1

1. Frames of reference 8 hours Max marks 20

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 20

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(8:1-7)

UNIT-3

6. Special Theory of Relativity **13 hours** **Max marks 27**

1. 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
2. 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

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)

PH4 B04: ELECTRODYNAMICS – I

UNIT I

1. Electrostatics 20 hours Max marks 37

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 15

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 20 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

Semester-5

Core Course – V 54 hrs (Credit – 3)

PH5 B06: ELECTRODYNAMICS-II

UNIT I (27 hours)

1. Electrodynamics 15 hours Max marks 32

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 27

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 27

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

Semester-5

Core Course – VI 54 hrs (Credit – 3)

PH5 B07: QUANTUM MECHANICS

UNIT 1 (24 hrs)

1. Particle Properties of Waves **8 hours** **Max marks 20**

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 22**

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 15**

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 Arunldhas]

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

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. Quatum Mechanics –Iswarsingh Thyagi
10. Feynman Lectures

Semester-5

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

PH5 B08 PHYSICAL OPTICS AND MODERN OPTICS

UNIT I (5 hours) **Max marks 15**

1.Fermat's Principle, verification of laws of reflection and refraction. **2 hours**

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

Matrix methods **3 hours**

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 17**

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 22**

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 22**

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 10**

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 15**

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 10**

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 15**

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. 8 Optics – Hetch and A RGanesan

Semester-5

Core Course –IX 72 hours (Credit – 4)

PH5 B09: ELECTRONICS (ANALOG & DIGITAL)

UNIT I

1. Semiconductor rectifiers and DC Power supplies 8 hours. Max marks 15

Preliminaries of rectification, Bridge rectifier, Efficiency, Nature of rectified output, Ripple factor, different types of filter circuits, voltage multipliers, Zener diode voltage stabilization (sections 6.13-6.15, 6.17 - 6.27 V.K Mehta)

2. Transistors: 14 hours Max marks 27

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. Multistage Transistor amplifier 4 hours Max marks 10

R.C coupled amplifier- frequency response, and gain in decibels, Transformer coupled Amplifiers,Direct Coupled Amplifier,Comparison.

(Section 11.1-11.8, VK Mehta)

4. Feedback Circuits and Oscillators 8 hours Max marks 12

Basic principles of feedback, negative feedback and its advantages, positive feedback circuits Oscillatory Circuits-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)

UNIT II

5. Digital Communication 5 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 12 hours Max marks 18

LED, 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 system 8 hours Max marks 12

Positional number system, binary number system, Binary - Decimal conversions, Representation of positive integer, negative number representation, Floating point Binary arithmetic, Compliments and its algebra. (Aditya P Mathur - 2.2 to 2.8).

8. Logic gates and circuits **13hrs.** **Max marks 20**

Fundamental gates, Universal gates, De Morgan's theorem, Exclusive OR gate, Boolean relations, Karnaugh Map, Half adder, Full adder, RS Flip Flop, JK Flip flop

(Sections Malvino - 2.2 to 2.4, 3.1 to 3.5, 5.1 to 5.6, 6.3, 6.4, 7.1, 7.3, 7.5, 7.6, 8.2)

Text books for study

1. Principles of electronics - VK Mehta - 2008 edition (S. Chand)
2. Introduction to Micro Procesors - Aditya P Mathur (Tata McGarw Hill)
3. Digital principles and applications - Leach and Malvino (Tata McGraw Hill)

References

1. Digital Computer Fundamentals (Thomas.C. Bartee)
2. Electronics principles - Malvino
3. Physics of Semiconductor Devices- Second Edition – Dilip K Roy – Universities Press
4. Digital Fundamentals –Thomas L Floyd
5. Digital Technology-Principles and Practice-Virendrakumar
6. The Art of Electronics-Paul Herowitz & Winfield Hill
7. Electronic Principles and applications-A B Bhattacharya
8. Electronics-Classical and Modern-KAR

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.

PH5 D01(1): 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)

PH5 D01 (2): 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)

PH5 D01 (3): ELEMENTARY MEDICAL PHYSICS (36 HOURS)

UNIT-1-NUCLEAR MEDICINE PHYSICS (12 Hours) Max mark 24

Nuclear physics –Introduction to Radioactivity-Artificial and natural-Physical features of radiation, conventional sources of radiation, Interaction of different types of radiation with matter— Ionizing & Non ionizing Radiations- excitation, ionization, and radioactive losses- Neutron interactions, Rayleigh scattering- Compton scattering - photoelectric effect - Pair production (Qualitative Study only), Radiation quantity and quality-Radiation exposure, Units of radiation dose, Measurement of radiation dose, safety, risk, and radiation protection—Radiopharmaceuticals – Radioactive agents for clinical studies—Biological effects & Genetic effect of radiation.

Books for study

1. W.R.Hendee & E.R.Ritenour, Medical Imaging Physics (4th edn) Wiley New York,
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill,New Delhi, 1997.)

UNIT – 2. MEDICAL INSTRUMENTATION- (12 Hours) Max mark 22

Measurements of Non electrical parameters: Respiration-heart rate-temperature-blood pressure –Electrocardiography(ECG):Function of the heart-Electrical behaviour of cardiac cells-Normal and Abnormal cardiac rhythms-Arrhythmias, Electroencephalography(EEG): Function of the brain-Bioelectric potential from the brain-Clinical EEG-Sleep patterns-The abnormal EEG, Electromyography(EMG): Muscular servomechanism-Potentials generated during muscle actions

Books for study

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.,
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill,New Delhi, 1997.)

UNIT-3-MEDICAL IMAGING TECHNIQUES (12 Hours) Max mark 22

X-ray imaging-properties of X -rays- Production of X-rays--Planar X-ray imaging instrumentation-X-ray fluoroscopy. Ultrasound imaging- generation and detection of ultrasound – Properties – reflection -transmission – attenuation –Ultrasound instrumentation- Principles of A mode, B-mode-M-mode Scanning, Hazards and safety of ultrasound.

Books for study

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.,
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill,New Delhi, 1997.)

Reference books:

1 Medical Physics by Glasser O, Vol 1,2,3 Year Book Publisher Inc Chicago

2 Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 1999.

3 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.

4 Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 1997.

5 Joseph J.carr and John M. Brown, "introduction to Biomedical equipment technology", John Wiley and sons, New York, 1997.

6 W.R.Hendee & E.R.Ritenour, Medical Imaging Physics (3rd eds), Mosbey Year-Book, Inc., 1992.

7. Hendee & E.R.Ritenour, Medical Physics.

Semester-6

Core Course –X - 72 hrs (Credit – 4)

PH6 B10: THERMAL AND STATISTICAL PHYSICS

Unit- I

Module 1. . 18 hours Max marks 32

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 20**

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 22

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 15**

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 15**

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 22**

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

Semester-6

Core Course – XI 72 hrs (Credit – 4)

PH6 B11 : SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

UNIT –1 SOLID STATE PHYSICS

1.Crystal Physics 15 hours Max marks 27

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 10

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

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

3. Super conductivity: 8 hours Max marks 12

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 10

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 15

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 15

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 22**

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 :

1. Solid State Physics by S O Pillai
2. Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash
3. 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. Optical Communications – M Mukunda Rao – Universities Press
6. Principles of Condensed Matter Physics – P M Chaikin & T C Lubensky – Cambridge University Press

Semester-6

Core Course – XII 72 hrs (Credit – 4)

PH6 B12 : NUCLEAR PHYSICS, PARTICLE PHYSICS & ASTROPHYSICS

UNIT: 1 (35 hrs)

1. Nuclear Structure 12 **hours** **Max marks 20**

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 : **16 hours** **Max marks 27**

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: **7 Hours** **Max marks 15**

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)

UNIT: 2 (37 hrs)

4. Cosmic Rays: 4 **hours** **Max Marks 10**

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 24

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 (5^{th} Edition)

6. Particle Accelerators 8 hours Max marks 15

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)

7. 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.G. Tayal
2. Atomic Physics: J.B. Rajam
3. Atomic Physics: John Yarwood
4. Introduction to Astrophysics: H L Duorah & Kalpana Duorah
5. Mayer – Jensen Shell Model and Magic Numbers: R Velusamy, Dec 2007
6. The Enigma of Cosmic Rays: Biman Nath, Resonance – Feb 2004, March 2004
7. Black body radiation: G.S. Ranganath, Resonance – Feb. 2008.
8. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

Semester-6

Core Course – XIII

PH6 B13(E1): Elective- Computational Physics (54 hrs – 3 credits)

UNIT I.

Introduction to Python Programming: 20 hours Max marks 47

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 47

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 32

(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)

PH6 B13(E2): NANO SCIENCE AND TECHNOLOGY

Module 1: Introduction : (6 Hrs) Max marks 15

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 26

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 28

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 20**

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 22

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 15**

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)

PH6 B13 (E3): 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

All centres 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. **A maximum of one mark can be awarded to an expt which is neatly recorded.** 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 EIGHT (8) PAPER- II &III SIX (6)

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

PH4B05 Practical-I (Credit 5)

1^{st}, 2^{nd}, 3^{rd} & 4^{th} SEMESTER EXPTS

(Any Ten from Each Part)

Part A

1. Young's modulus-non uniform bending-using pin and microscope-(load-extension graph).
2. Young's modulus-Uniform bending-using optic lever
3. Young's modulus-Angle between the tangents
4. Surface Tension-capillary rise method-radius by vernier microscope
5. Viscosity-Poiseuille's method –(Variable Pressure head, radius by mercury pellet method, sensibility method to find mass)
6. Moment of inertia-Flywheel

7. Moment of Inertia-Torsion Pendulum
8. Rigidity modulus-static torsion
9. Compound pendulum-acceleration due to gravity, Radius of gyration
10. Liquid lens-Refractive index of liquid and glass
11. Spectrometer-solid prism-Refractive index of glass measuring angle of minimum deviation.
12. Spectrometer-solid prism- Dispersive power

Part B

13. Deflection magnetometer-Tan A, Tan B positions
14. Deflection magnetometer -Tan C Position-moment of moments
15. Searle's vibration magnetometer-moment & ratio of moments
16. Box type vibration magnetometer-m & B_h
17. Melde's string arrangement-Frequency, relative density of liquid and solid (both modes)
18. Ballistic galvanometer-figure of merit
19. Potentiometer-measurement of resistance
20. Potentiometer-calibration of ammeter
21. Ballistic Galvanometer- BG constant using HMS-then find B_h.
22. B.G.-Comparison of capacities Desauty's method.
23. Spectrometer- i-d curve
24. Verification of Thevenin's theorem.

PH6B14 - Practical II (Credit – 5)

5^{th} & 6^{th} SEM EXPTS. (Any 20)

1. Spectrometer- i_1-i_2 curve
2. Spectrometer-Cauchy's constants
3. Spectrometer-Diffraction Grating-Normal incidence
4. Laser-wavelength using transmission grating
5. Diffraction Grating-minimum deviation
6. Spectrometer-Quartz prism-Refractive indices of quartz for the ordinary and extra-ordinary rays
7. Newton's rings-wavelength of sodium light
8. Air wedge-angle of the wedge, radius of a thin wire
9. Lee's Disc –thermal conductivity

10. Potentiometer-calibration low range and high range voltmeters
11. Potentiometer- Reduction factor of TG
12. Variation of field with distance-Circular coil-moment of magnet & B_h
13. Carey Foster's bridge-resistance & resistivity
14. Carey Foster's bridge-Temperature coefficient of Resistance
15. Conversion of Galvanometer to voltmeter and calibrating using Potentiometer.
16. Conversion of Galvanometer to ammeter and calibrating using Potentiometer.
17. BG Absolute Capacity
18. BG-High resistance by leakage method
19. BG Mutual inductance
20. Planck's constant using LED's (3no.s)
21. Polarimeter-Specific rotation of sugar solution.
22. Searls and Box vibration magnetometers- m &Bh.
23. Numerical aperture of an optical fibre by semiconductor laser
24. Frequency of AC using sonometer

PH6B15 Practical III (Credit – 5)

5^{th} & 6^{th} SEM EXPTS (Minimum Fifteen from Unit : I and Five from Unit : II)

Unit : I

1. Construction of full wave, Centre tapped and Bridge rectifiers
2. Characteristics of Zener diode and construction of Voltage regulator.
3. Transistor characteristics and transfer characteristics in Common Base

Configuration- current again

4. Transistor characteristics and transfer characteristics in Common Emitter

Configuration- current again

5. CE Transistor Amplifier-Frequency response.
6. Full adder using NAND gates-construction & varification
7. Negative feed back amplifier
8. LC Oscillator (Hartley or Colpitt's)
9. Phase shift oscillator
10. Operational Amplifier –inverting, non inverting, Voltage follower
11. LCR circuits-Resonance using CRO

12. Construction of basic gates using diodes(AND, OR) & transistors (NOT), verification by measuring voltages
13. Voltage multiplier (doubler, tripler)
14. Multivibrator using transistors.
15. Flip-Flop circuits –RS and JK using IC's
16. Verification of De-Morgan's Theorem using basic gates.
17. Half adder using NAND gates

Unit : II Numerical Methods Using Python :All programmes to be done.

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

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

PH1C01: 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 48**

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

PH2 C02: Mechanics, Relativity, Waves & Oscillations

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

1. **Frames of reference . 4 Hours Max marks 15**

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 27**

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 22**

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 22**

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 14**

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

PH3 C03: Optics , Laser , Electronics & communication

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

1.**Fermat's Principle-** **2Hrs** **Max marks 8**

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

2.Interference **12 Hrs** **Max Marks 20**

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 8**Hrs Max marks 16**

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 16**

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 24**

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 **6 Hrs Max marks 8**

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 8

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

PH4 C04: Electricity, Magnetism and Nuclear physics

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

1. Electrostatics 12 Hrs Max marks 22

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 16

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

3. Magnetism 10 Hrs Max marks 20

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 14 Hrs Max marks 24

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 18

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 COMPLIMENTARY COURSES

Lab examination will be conducted at the end of 4 th 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 at the centre.

Complimentary Course- (Practical)

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

(Any FIVE)

1. Characteristics of Diode and Zener diode
2. Liquid lens- Refractive index of liquid and glass
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

Complimentary Course- (Practical)

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

(Any five)

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 and Full wave rectifier
6. Field along the axis of a circular coil

Complimentary Course- (Practical)

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

(Any five)

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

2.Potentiometer- Conversion of Galvanometer in to voltmeter –calibration by standard 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.

Semester-4

Complimentary Course- (Practical)

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

(Any five)

1. Young's modulus of a cantilever- Pin and microscope method
2. Potentiometer-Calibration of low range 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

MODEL QUESTION PAPERS

Reg. No……

(A) CORE COURSE (1)

Name……....

FOURTH SEMESTER B.Sc.DEGREE EXAMINATION MAY 2016

(CCSS)

PHYSICS CORE

PH4B07- ELECTRODYNAMICS - I

Time: 3 hours Total Marks : 80

Symbols used in this question paper have their usual meanings

SECTION A

(Answer in a word or phrase)

Answer all questions; each question carries 1 mark

1. Write down the expression of volume current density J?
2. What will happen to the domains in a ferromagnetic substance in a external magnetic field?
3. What is the relationship between electric potential and electric field?
4. A charge q is placed at the centre of a cube of side L. What is the electric flux linked with the cubical surface?
5. Write down the divergence and curl of Magnetic fields?

Questions 6 to 10 : Write True or False.

6. The Electric field developed between two oppositely charged parallel plates is uniform.
7. In magneto statics boundary conditions, normal components of fields are discontinuous.
8. The concept of magnetic vector potential A is introduced on the basis of Lenz's law.
9. No work is done in moving a charge from one point to another on equi potential surface.
10. When an dielectric is placed in a parallel plate capacitor its capacitance decreases.

10x1= 10

SECTION B

(Answer in Two or three sentences)

Answer all questions. Each question carries 2 marks.

11. State and explain Coulomb's law
12. Define electric field at a point. Give its two units..
13. What are Polar molecules ?
14. State the first Uniqueness theorem?
15. Show that surface current density is the product of charge density and velocity of charges?
16. Write down the differential form of Ampere's circuital theorem from the integral form.
17. How magnetic dipoles are generated in specimen placed in a magnetic field?

7x2= 14

SECTION C

(Answer in a paragraph of about half a page to one page)

Answer any three questions. Each question carries 4 marks

18. What are paramagnetic and diamagnetic substances?

19. Derive an expression for the electric field intensity at a point in between two infinite plane sheet of charge?
20. What are bound currents? Explain them?
21. Explain cyclotron motion?
22 Derive Amper's law in magnetized materials

23 Discuss about the comparison of magnetostatics and electrostatics.
24. Derive Poissons equation and obtain Laplace equation.

5x4= 20

SECTION D

(Problems- write all relevant formulas. All important steps carry separate marks)

Answer any four questions. Each question carries 4 marks

25. Find the electric field at a distance z above the centre of a flat circular disc of radius R, which carries uniform surface charge σ.
26. E = xy i + 2yz j + 3xz k. Check whether it is an admissible electric field or not.
27. An electron travels with a velocity of $2x10^8$ m/s perpendicular to a uniform magnetic field 0.15 T. Determine the force on the electron.
28. A potential difference 100 V is applied to a 1 microfarad and 2 microfarad capacitors are connected parallel. Find charge and potential across each other.
29 A point charge 10^{-7} is situated at the centre of a cube of side1m. Calculate the electric flux through the surface.
30 A power line carries a current of 90 Ampere in East – West direction. What is the magnitude and direction of the magnetic field due to the current 1.5 m below the line?
31Find out he magnetic flux density B of a square wire loop of side 10 cm carrying a current 1 A in the clockwise direction

4x4= 16

SECTION E

(Essays - Answer in about two pages)

Answer any two questions. Each question carries 10 marks.

32 Derive equations for div and curl of B due to a volume distribution of current..
33.Applying Gauss's law find the electric field due to a uniformly charged spherical Insulator at a point (a) outside (b) on the surface and (c) inside. Plot the variation graphically.
34. What is the effect of magnetic field on atoms?
35 Derive an expression for the magnetic field due to a straight conductor carrying steady current using Biot – Savart law?

2x10 = 20

k

CORE COURSE (2)

PH5 B08 - PHYSICAL OPTICS AND MODERN OPTICS

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION (CCSS)

PH5 B08 - PHYSICAL OPTICS AND MODERN OPTICS

Time: 3 hours Total Marks: 80

Symbols used in this question paper have their usual meanings

SECTION A

(Answer all questions in a word or phrase) Each question carries 1 mark

1. When white light is used in biprism experiment, centre of fringe system is…….

2. What is the ratio of the amplitudes if the ratio of the intensities is 4:1?
3. What will happen to the fringe width if the biprism experiment is conducted in water instead of air?
4. Colours of thin film is due to …… .
5. The central point in Newton's ring seen in reflected light appears …….. .

Questions 6 to 10 : Write True or False.

6. The optical path length can never be less than geometrical path
7. For negative crystal μ_e is less than μ_o.
8. Refractive index of core is less than that of cladding.
9. Total internal reflection occurs when light ray travels from rarer to denser medium.
10. Optical fibres are immune to external interferences.

(10x1= 10)

SECTION B

(Answer all questions in two or three sentences) Each question carries 2 marks.

11. What are the necessary conditions for producing sustained interference?
12. Draw the diagram of Fresnel's two mirror arrangement
13. What is Rayleigh's criterion for resolution?
14. Compare zone plate with convex lens.
15. Give two applications of Holography.
16. What is the difference between step index fibre and graded index fibre.
17. What is acceptance angle? Write down the expression for it.

(7x2= 14)

SECTION C

(Answer any five questions in a paragraph of about half a page to one page)
Each question carries 4 marks

18. Using Fermat's principle prove the second law of reflection.
19. Explain how the distance between the two virtual slits in the biprism experiment is determined?
20. Deduce an equation for the resolving power of a grating
21. Explain with necessary graph the intensity distribution due to diffraction at a straight edge.
22. Distinguish between holography and photography.
23. Briefly explain how hologram is constructed.
24. Explain three types of pulse dispersions in optical fibres.

(5x4= 20)

SECTION D

(Problems- write all relevant formulas. All important steps carry separate marks)
Answer any four questions. Each question carries 4 marks

25. Fresnel's biprism of refractive index 1.5 has an angle of 1^0.If the biprism is kept at a distance of 0.3 m from the slit illuminated by a light of wave length 600nm.,Find the band width. Given the distance between biprism and screen is 0.7m.
26. A beam of monochromatic light of wavelength582nm falls normally on a glass wedge with the wedge angle of 20 seconds of an arc. If the refractive index of glass is 1.5, find the number of dark fringes per cm of the wedge length.
27. In a Newton's rings experiment the diameter of the 15^{th} ring was found to be 0.59cm and that of the 5^{th} ring was 0.336 cm. If the radius of the Plano-convex lens is 100 cm, calculate the wave length of the light used.
28. A parallel beam of light of wave length 546 nm is incident at an angle of 30^0 on a plane transmission grating which has 6000 lines per cm. Find the highest order spectrum that can be observed.
29. What is the radius of the first half-period zone in a zone plate behaving like a convex lens of focal length 60 cm for light of wavelength 600 nm.

30. Calculate least thickness of a calcite plate which would convert plane polarized light into circularily polarized light. Given μ_o=1.65, μ_e = 1.48 and wavelength of light is 589 nm.

31. The numerical aperture of an optical fibre is 0.5 and the core refractive index is 1.54. Find The refractive index of the cladding.

(4x4= 16)

SECTION E

(Essays - Answer any two questions in about two pages)

. Each question carries 10 marks.

32. Derive the system matrix for a thick lens and hence arrive at lens maker's formula.

33.Describe Michelson's interferometer .How will you determine the wave length of monochromatic light with the help of Michelson's interferometer?

34. Discuss Fraunhofer diffraction due to a double slit. Derive an expression for the intensity distribution and explain maxima and minima?

35. What is specific rotation? Deduce an equation for specific rotation. Describe Laurent's half shade polarimeter to find the specific rotation of sugar solution.

(2x10 = 20)

(B) OPEN COURSE

Vth SEM . NON CONVENTINAL ENERGY SOURCES

Marks 40 **Time 2hours**

Section A -One word answer- Answer all 6x1=6

1 .----------radiations are absorbed by Ozone

2. What type of energy is derived from heated ground water?

3. The temperature difference between upper and deeper layers of the ocean should be at least ----------degree to install an OTEC plant

4. The primary source behind the wind energy is --------energy

5.Molten Rock at a temperature 650 degree is called--------

6……type of rotor mill is used for high velocity wind.

Section B -Short answer - (In one or two sentences) Answer all 5 5x2=10

7. Define Solar constant

8. What are the factors that determine the output from wind energy converter?

9. What are the two types of battery? Give examples

10. What are the different categories of geomass resources?

11.What are the sources of geothermal energy?

Section C -Paragraph Answer -Answer any 4 4x4=16

12. What do you mean by solar green house? Explain.

13. Describe with neat diagram the working of open cycle OTEC

14. List the advantages and disadvantages of geothermal energy.

15. Discuss the advantages and disadvantages of wind energy converters

16. Explain any one of the solar collectors with the help of a neat diagram.

17.Explain the working of a wind mill with the help of a diagram

Section D - Essay -Answer any one 1x8=8

18. Describe the principle of working of solar furnace? What are the main applications? What are the advantages and limitations of solar furnace?

19. Explain how tidal power is used to generate electricity with one tidal energy conversion plant? Give its limits.

20. Discuss the methods to get energy from Bio mass .

(C) COMPLIMENTARY COURSE

PH3C07- Optics, Laser, Electronics and communication

Time: 3 hours Maximum marks: 64

Section A (one word)

Answer all questions. Each question carries 1 mark

1 Colour of thin films is due to ……

2 When a ray of light is reflected at the boundary of a rarer to denser medium, the reflected ray undergoes a phase change of ……..

3 What is the phenomenon of light that illustrates its transverse nature?

4 In double refraction the ray which obeys Snell's law is known as ……

5 Zener diode is always ……biased.

6 If the inputs of a NAND gate are connected together, the resulting circuit is a ……gate.

7 The energy level having greater lifetime is known as …….

8 In Ruby laser the active medium is……..

9 ……converts nonelectrical signal into electrical signal.

10 In amplitude modulation the band width is twice the ……..

(10X1=10)

Section B (Short answer questions)

Answer all questions. Each question carries 2 marks

11 What is Fermat's principle?
12 Define optical path.
13 What is constructive interference?
14 What is meant by resolving power of a grating?
15 State and explain Brewster's law.
16 What is stimulated emission?
17 What are the necessities of modulation?

(7X2=14)

Section C (Paragraph questions)

Answer any 2 questions. Each question carries 4 marks

18 Obtain the laws of refraction from Fermat's principle.
19 Explain the production and detection of circularly polarized light.
20 With a neat diagram explain briefly the working of a Common Emitter Transistor amplifier.
21 Explain the principle and working of a He-Ne Laser.
22 What is modulation? What are different types of modulation?

(2X4=8)

Section D (Problems)

Answer any 3 questions. Each question carries 4 marks

23 A soap film of refractive index 1.33 and thickness $1.5X10^{-4}$ cm is illuminated by white light incident at an angle of 60°. The light reflected is examined through a spectroscope in which a dark band corresponding to a wavelength of $5X10^{-5}$ is found. Calculate order of the dark band.
24 A parallel beam of sodium light is incident normally on a plane transmission grating having $6X10^{5}$ lines per meter length. The first order spectrum is found to be deviated through an angle of 20.7° from the normal. Calculate the wavelength of light used.
25 Plane polarized light is incident on a Calcite plate cut with faces parallel to optic axis. If the emergent light is circularly polarized, calculate the least thickness of the plate. μ_o= 1.658, μ_e=1.486 and wavelength of light used is 5890A°.
26 A tube 30cm long filled with a solution containing 15gm of cane sugar per 100cc is placed In the path of a polarized light. Find the angle of rotation of the plane of polarization. The
Specific rotation of sugar is 66.5°.
27 Find the operating frequency of Colpitt's oscillator if C_1=0 .01μF, C_2=0.1μF and L=10μF.

(3X4=12)

Section E (Essays)

Answer any 2 questions. Each question carries10 marks

28 Draw and explain the fringe formation by Fresnel's biprism. Explain how can it be used to determine the wave length of a monochromatic light.
29 Discuss the Fraunhofer diffraction due to a single slit. Also find the width of central maximum.
30 Describe the principle and working of half wave and full wave rectifier. Show that the rectification efficiency of full wave rectifier is twice that of half wave rectifier.

(2X10=20)

(D) CORE COURSE -1

MODEL QUESTION PAPER

PH1B01-METHEDOLOGY OF SCIENCE AND PHYSICS

Max marks 100 **Time 3 Hours**

Section A(Answer all questions) **1x10=10**

1. Knowledge obtained by deductive reasoning is called ----------
2. Author of Principia Mathematica is----------
3. Who introduced the word Physics to science first?
4. ----------is referred to as language of science .
5. A vector divided by its magnitude is ----------vector.
6. Vectors A and B are such that [A+B]= [A-B] then the angle between the vectors is---------
7. Two forces 6N and 2N are acting at an angle 60 degrees. Angle made by the resultant with the greater force is----------

State whether the statement is true or false (8-10)

8. Finding the speed of a car is science.
9. A Scientific Theory is extensible.
10. If Curl F =0, then F is rotational.

Section B Answer all (Write in two or three sentences.) Two marks each. 7x2=14

11. What are auxiliary hypothesis and adhoc hypothesis?
12. What is meant by pseudo science?
13. What is a black body?
14. Give three properties of null vector.
15. What is the geometrical meaning of gradient?
16. Define transpose of a matrix
17. State and explain Stokes theorem

Section C . Write in one paragraph (Write any five) 5x4=20

18 What are the assumptions made by Newton to develop Mechanics?
19. What is DeBroglies hypothesis?
20. Discuss the importance of peer review.
21. Give the elemental displacement in cylindrical coordinates
22. What is Hermitian matrix. Show that A is Hermitian, $=\begin{bmatrix} 1 & i & 0 \\ -i & 0-2i & \\ 0 & 2i & 0 \end{bmatrix}$
23. Using spherical polar coordinates find the volume of a sphere of radius R.
24. Prove that the given vectors A=1+4j+3k and B =4i=2j-4k are perpendicular to each other.

Section D.(Solve any four problems.) **4x4=16**

25. The threshold wavelength for photo electric emission in tungsten is 230nm.What is the wavelength of light that must be used in order to eject electron with energy of 1.5 eV.
26. Find the area of a parallelogram whose sides A and B are in metres. A=i+j+k and B+=3i+2k
27 If F= $2xz^2$i-yzj+$3xz^3$k, find the Curl of Curl of F at the point (1,1,1)
28. If A=4i-3j+2k and B=2i-4j+3k and C=4i-8j-2k find (AXB)XC
29. A particle acted upon by a force F=6i+j-3k is displaced from a point i+2j+3k to a point 5i+4j+k.Find the work done by the force.
30. Calculate the Laplacian of the following function Ø= x^2+2xy+3z+4

31. Show that matrix A is orthogonal. A=$\begin{pmatrix} coso & -sino \\ sino & coso \end{pmatrix}$

Section E (Write any two) 2x10=20

32. What is hypothesis? Discuss the various aspects and steps in formulation of hypothesis scientific method.

33.Write an essay on the development of Quantum Mechanics

34. Solve the equations using Cramer's rule.

2x-y+2z=2, x+10y-3z=5, -x+y+z=-3

35. What are Eigen values and Eigenvectors. Find the Eigen values and Eigen vectors of A=$\begin{pmatrix} 2 & 1 \\ -1 & 4 \end{pmatrix}$

FIFTH SEMESTER B.Sc .DEGREE EXAMINATION
(CCSS)
PH5 B09: ELECTRONICS (ANALOG & DIGITAL)

Time: 3 hours Total Marks : 80

Symbols used in this question paper have their usual meanings

SECTION A
(Answer in a word or phrase)
Answer all questions; each question carries 1 mark

1. What is the maximum efficiency of a full wave rectifier?
2. A zener diode is used as a ----------
3. There is a phase difference of ----------between the input and output voltages of a CE amplifier..
4. For highest power gain which transistor configuration is to be used?
5. The binary equivalent of a hexadecimal number EF is ---------

Questions 6 to 10 : Write True or False.

6. If the doping level of a crystal diode is increased, the breakdown voltage decreases.
7. CC configuration is used for getting high voltage gain.
8. The input to an XOR gate are 1 , 0, 1. Then the output will be zero.
9. Two's complement of 10111 is 01000.
10 The decimal equivalent of octal number 110 is 73.

10x1=10 Marks

SECTION B
(Answer in Two or three sentences)
Answer all questions. Each question carries 2 marks.

11. What is positional number system?
12. What is the importance of modulation factor in communication system?
13. Define α of a transistor and show that it is always less than unity.
14. Draw a full adder and its truth table.
15.Why do you prefer to express the gain in db?

16.State and explain De Morgans theorem.
17. Subtract 4 from 8 using two's complement method in 8-bit format.

7x2= 14Marks

SECTION C

(Answer in a paragraph of about half a page to one page)

Answer any three questions. Each question carries 4 marks

18. With a neat labelled diagram describe the working of a full wave bridge rectifier
19.Explain the following terms for a transistor CE amplifier a) Voltage gain b) Power gain
20. Discuss the importance of load line analysis in a transistor amplifier.
21.Draw the connection diagram of two stage RC coupled transistor amplifier and discuss the use of various capacitors in the circuit.
22 What do you understand by frequency modulation? Explain its advantages over amplitude modulation.
23 Explain the working of a basic integrator circuits using opamp.
24. Explain how voltage stabilization is ensured in a zener voltage regulator.

5x4= 20 Marks

SECTION D

(Problems- write all relevant formulas. All important steps carry separate marks)

Answer any four questions. Each question carries 4 marks

25. A full wave bridge rectifier is connected to a 12V step down transformer. If the forward resistance of each diode is 4Ω and load resistance is 400Ω, find the dc load current and efficiency of the rectifier.
26. A transistor amplifier is biased with feedback resistor R_B of 100kΩ. If V_{CC} =20V, R_C =1kΩ. And β=100 determine the operating points.
27. The absolute gain of an amplifier is 20. Find its decibel gain. When it is coupled to another amplifier the overall gain is 400. What is the overall gain in decibel.
28. Calculate the modulation index for an FM wave where the maximum frequency deviation is 50KHz and the modulating frequency is 5kHz.
29 A JFET has drain current of 5mA. If I_{DSS} = 10mA and V_{GS}(off) = -6V, find the value of V_{GS} and V_p
30 A)Illustrate associative law of (i) addition and (ii)multiplication as applied to Boolean algebra.
B)Also simplify the Boolean expression Y = (A+B+C) . (A+B)
31 Convert the the following decimal numbers into binary numbers
a) 133 b) 59.6855

4x4= 16 Marks

SECTION E

(Essays - Answer in about two pages)

Answer any two questions. Each question carries 10 marks.

32 Discuss two biasing circuits used in CE amplifier configuration. Also explain how stabilization of operating point is achieved in each case and discuss the advantages and disadvantages of each circuit.
33. Explain negative feed back. Derive an expression for gain in a negative voltage feedback amplifier.
What are the advantages of negative feed back?

34. Explain the principle, working and V-I characteristic of UJT. Discuss one practical application of UJT in detail.
35 With the help of diagrams explain the working of RS and JK flip-flops.

2x10 = 20Marks

MODEL QUESTION PAPER (CORE)

Reg. No……
**Name……..... **

SIXTH SEMESTER B.Sc.DEGREE EXAMINATION (CCSS) PHYSICS CORE
PH6 B11 : SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

Time: 3 hours Total Marks : 80

Symbols used in this question paper have their usual meanings

SECTION A
(Answer in a word or phrase)
Answer all questions; each question carries 1 mark

1. The atomic packing factor for simple cubic structure is ---------
2. Write down the range of frequency of microwave radiations .
3. A super conductor exhibit complete Meissner effect is called ----------
4. Name the semiconducting material used in Semiconductor laser.
5. The commonly used source in microwave spectrometer is ----------
6. Name two molecules which shows infrared spectrum.
7. The lines on the low frequency side of raman spectra are called ---------
8. The symmetry element in which a rotation followed by a translation is called -----
9. For a non –rigid rotator the spacing between the successive spectral lines decreases. (True or False)
10. Name two linear molecules

(10x1= 10 marks)

SECTION B
(Answer in a short paragraph- three or four sentences)
Answer any all questions. Each question carries 2 marks.

11. What is meant by coordination number. obtain the coordination number for fcc lattice
12. Explain how population of states affect the intensity of spectral lines
13. Distinguish between prolate and oblate type of molecules
14. What is zero point energy
15. Stokes or Antistokes, Which are more intense. Why
16. What is population inversion
17. Sketch the Schematic arrangement of an infrared spectrometer

(7x2= 14 marks)

SECTION C
(Answer in a paragraph of about half a page to one page)
Answer any five questions. Each question carries 4 marks

18. What are miller indices? Explain the significance of miller indices.
19. Sketch the possible orthorhombic crystal systems.
20. Explain the BCS theory.
21. Distinguish between Type I and Type II super conductors.
22. Discuss the factors on which width of spectral lines depends.
23. Explain the breakdown of Born Oppenheimer approximation
24. Discuss the rotational Raman spectrum of symmetric top molecules

(5x4= 20 marks)

SECTION D

(Problems- write all relevant formulas. All important steps carry separate marks)

Answer any four questions. Each question carries 6 marks

25. Shoe that for a simple cubic lattice $d_{100} : d_{110} : d_{111} = 1; 1/\sqrt{2} : 1/\sqrt{3}$
26. The first line in the rotational spectrum of CO has a frequency of 3.8424 cm^{-I}. Calculate B and hence bond length in CO molecule. Given Avogardro No is 6.022×10^{23}.
27. What is the average period of rotation of H Cl molecule if it is in the J=1 state. The inter nuclear distance of H Cl is 0.1274 nm. Given mass of Hydrogen and Chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} kg respectively.
28. The fundamental and first overtone of NO are centred at 1876 cm^{-1} and 3724 cm^{-1} respectively. Evaluate the equilibrium vibration frequency, the anharmonicity constant, zero point energy and force constant of the molecule.
    Mass of Nitrogen atom= 23.25×10^{-27}Kg. Mass of Oxygen atom = 26.56×10^{-27} Kg.
29. A substance shows a Raman line at 4567 A^{θ} when exciting line $4358A^{0}$ is used. Deduce the positions of stokes and anti stokes lines for same substance when exciting line $4047A^{o}$ is used.
30. Critical temperature of mercury with isotopic mass 199.5 is 4.185 K. Calculate the critical temperature when atomic mass changes to 203.4.
31. Determine the coefficient of stimulated emission of radiation whose wavelength is 610 nm and the coefficient of spontaneous emission is 10^{6} per second

(4x4= 16 marks)

SECTION E

(Essays - Answer in about two pages)

Answer any two questions. Each question carries 10 marks.

32 Explain Braggs Law and Braggs X-ray Spectrometer
33. Explain the rotational Spectrum of a linear diatomic molecule
34. Explain the theory and working of Ruby laser
35. Discuss the different Plains of symmetry of a cubic crystal

(2x10 = 20 marks)

MODEL QUESTION PAPER (CORE)

Reg. No.....

Name……..

SIXTH SEMESTER B.Sc.DEGREE EXAMINATION (CCSS) PHYSICS CORE

PH3PO3 - Mechanics

Time: 3 hrs **Max marks = 80**

Section A Ans. All **1x10=10**

1. **The frame in which Newton's ^{lst} and 2^{nd} law hold good is called -----**
2. **Write the expression for coriolis force.**
3. **The hypothetical particle with velocity greater than light is called ------**
4. **For a central force -------- is conserved.**
5. **The Lorentz's equation for length contraction is ----------.**
6. **The work done by a conservative force is ----------.**
7. **A rocket works in ..... principle.**
8. **Write the generalised coordinates for cycloid.**
9. **The min.imum velocity need to escape for any body from the gravitational pull of a planet is ---------.**
10. **The fictitious force acting in rotating body is ----------.**

Section B Ans. All **2x7=14**

11. **What is fictitious force?**
12. **What do you meant by time dilation?**
13. **What are the postulates of special theory of relativity?**
14. **What are constraints?**
15. **Differentiate between conservative and non-conservative forces.**
16. **State Kepler's laws of planetary motion.**
17. **What is centre of mass of a system?**

Section C Ans. any 5 **4x5=20**

18. **What is self energy? Deduce an expression for gravitational self energy of a uniform sphere of radius 'r'.**
19. **What are cyclic coordinates? Show that if time is cycle in Lagrangian Hamiltonian H = Total energy E of the system.**
20. **Show that linear momentum of system of particles about centre m ass is zero.**
21. **Explain potential energy curve.**
22. **Write a note on coliolis force.**
23. **Write a note on four vectors and four momentum.**
24. **Show the C.M of 2 particle lie on line joining them.**

Section D Ans. Any 4. **4x4=16**

25. **If $F = (2xy+z^2)\,\hat{i}+x^2\hat{j}+2xz\,\hat{k}$, 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).**
26. **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.**
27. **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.**

28. **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?**
29. **If the rest mass of proton is 1.67×10^{-27} kg , calculate the velocity and momentum if it moves with 2.7×10^{8} m/s. If it collides with a stationary nucleus of mass 2.5×10^{-26}kg and coalesces, fine the velocity of the combined particle.**
30. **A rod of length 5m is placed in xy plane of system S^1 at an angle of $\sin^{-1}(3/5)$. Calculate its length and orientation in the frame S if the frame S^1 is moving with a speed 0.8c $\hat{i}$ relative to S.**
31. **A particle at rest breaks into two particles of rest mass ratio 1:2. If the heavier particle moves with a velocity 1.8×10^{8}m/s find the velocity of lighter particle. Also find the velocity of lighter particle relative to the heavier one.**

Section E Ans. Any 2. 2x10=20

32. **What is principle of virtual work? Derive Lagrangian from that.**
33. **Derive variation of mass with velocity.**
34. **Derive Keplers laws of planetary motion from Newtons law of gravitation.**
35. **Describe the principle of rocket. Derive the expression for acceleration and final velocity if rocket.**