Approved syllabus of Bachelor of Science with Physics in Board of Studies (UG) meeting held on 23.3.2021

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Scheme for UG Syllabus

Annual System

(Effective from 2018-19)

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

In

Bachelor of Science Physical Science
(Physics, Computer Science and Mathematics)
And
Bachelor of Science with Physics

Department of Physics
Himachal Pradesh University
Shimla-5

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL (Modern Indian Language) Communication are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 **AE Compulsory Course (AECC**): Environmental Science, English Communication/MIL Communication.

3.2 **AE Elective Course (AEEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of Courses Under Undergraduate Program (B.Sc.)

Course	*Credits	
	Theory+ Practical	Theory +Tutorials
I. Core Course	12×4= 48	12×5=60
(12 Papers)		
04 Courses from each of the 03 disciplines of choice		
Core Course Practical / Tutorial*	12×2=24	12×1=12
(12 Practical/ Tutorials*)		
04 Courses from each of the 03 Disciplines of choice		
II. Discipline Specific Course Elective Course	6×4=24	6×5=30
(6 Papers)		
Two papers from each discipline of choice including paper of interdisciplinary nature.		
Discipline Specific Course Practical / Tutorials*	6 × 2=12	6×1=6
(6 Practical / Tutorials*)		
Two Papers from each discipline of choice including paper of interdisciplinary nature		

- **Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 3rd year**

III. Ability Enhancement Courses

1. **Ability Enhancement Compulsory**	2 × 4=8	2×4=8

(2 Papers of 4 credits each)
Environmental Science English/MIL Communication

2. **Skill Enhancement Course**	4 × 4=16	4 × 4=16

(Skill Based)

(4 Papers of 4 credits each)

Total credit= 132	**Total credit= 132**

College should evolve a system/policy about ECA/ General Interest/ Hobby/ Sports/ NCC/ NSS/ related courses on its own.

***wherever there is practical there will be no tutorials and vice –versa.**

- **In case of theory and tutorial 1 credit will be of 1 hour class room teaching, while in case of Practical/Practical Skill Exam 1 credit will be of 2 hours Laboratory class/project work.**

Scheme for Choice Based Credit System (CBCS) in Bachelor of Science with Physics
Annual Pattern

Year	Core Course (12)	Ability Enhancement Compulsory Course AECC (2)	Skill Enhancement Courses SEC (4)	Elective Course Discipline Specific Elective DSE (6)	Total Credits
I	DSC-1A = 6 Credit DSC-1B = 6 Credit DSC-2A = 6 Credit DSC-2B = 6 Credit DSC-3A = 6 Credit DSC-3B = 6 Credit **Credits = 36**	Eng/MIL Communi/EVS = 4 Credit Eng/MIL Communi/EVS = 4 Credit **Credits = 08**	NIL	NIL	**44**
II	DSC-1C = 6 Credit DSC-1D = 6 Credit DSC-2C = 6 Credit DSC-2D = 6 Credit DSC-3C = 6 Credit DSC-3D = 6 Credit **Credits = 36**	NIL	SEC-1 = 4 Credit SEC-2 = 4 Credit **Credits = 08**	NIL	**44**
III	NIL	NIL	SEC-3 = 4 Credit SEC-4 = 4 Credit **Credits = 08**	DSE-1A = 6 Credit DSE-1B = 6 Credit DSE-2A = 6 Credit DSE-2B = 6 Credit DSE-3A = 6 Credit DSE-3B = 6 Credit **Credits = 36**	**44**
Total Credits in B.Sc. Physical Science and B.Sc. with Physics Degree Courses = 44 × 3					**132**

Credits (hours) Split:

Theory = 04 (4 hours)
Practical = 02 (4 hours)
For SEC:
Theory = 03 (3 hours)
Skill Exam (SE) = 01 (2 hours)

Theory = 05 (5 hours)
Tutorial = 01(1 hour)

Details of CBCS Scheme for Undergraduate Three Year Degree Course: Bachelor of Science with Physics: Teaching Hours and Credits Plan in Annual System for Three years

S. No.	Name of Course (6 Credits)	*Teaching Hrs.		Credits as per annual Plan				
				Non Practical Course (2Weeks Teaching Hours)		Practical Course (2Weeks Teaching Hours)		Total Credits in a Year
1	Core Courses (12)	1st Week	2nd Week	Theory	Tutorial	Theory	Practical	
a	Discipline Specific Courses (4+4+4 =12)							
i	DSC-1A	03	06	05	01	04	02	06
	DSC-1B	03	06	05	01	04	02	06
	DSC-1C	03	06	05	01	04	02	06
	DCS-1D	03	06	05	01	04	02	06
ii	DSC-2A	03	06	05	01	04	02	06
	DSC-2B	03	06	05	01	04	02	06
	DSC-2C	03	06	05	01	04	02	06
	DCS-2D	03	06	05	01	04	02	06
iii	DSC-3A	03	06	05	01	04	02	06
	DSC-3B	03	06	05	01	04	02	06
	DSC-3C	03	06	05	01	04	02	06
	DCS-3D	03	06	05	01	04	02	06
Total Credits of Core Courses								72
2	Ability Enhancement Courses (6)							
a	Ability Enhancement Compulsory Courses (2)							
i	Eng/MIL Communication/EVS	02	04	03	01	--	--	04
	Eng/MIL Communication/EVS	02	04	03	01	--	--	04
Total Credits of Ability Enhancement Compulsory Courses (AECC)								08
b	Skill Enhancement Courses (4)					Theory	Practical Skill Exam	
	SEC-1	02	04	04	--	03	01	04
	SEC-2	02	04	04	--	03	01	04
	SEC-3	02	04	04	--	03	01	04
	SEC-4	02	04	04	--	03	01	04
Total Credits of Skill Enhancement Courses (SEC)								16
Total Credits of Ability Enhancement Courses (AEC) = 08 + 16								24

3	**Elective Courses (6)**							
a	**Discipline Specific Elective Courses**					**Theory**	**Practical**	
i	DSE-1A	03	06	05	01	04	02	06
	DSE-1B	03	06	05	01	04	02	06
	DSE-2A	03	06	05	01	04	02	06
	DSE-2B	03	06	05	01	04	02	06
	DSE-3A	03	06	05	01	04	02	06
	DSE-3B	03	06	05	01	04	02	06
Total Credits of Discipline Specific Elective (DSE) Courses								**36**
Grand Total Credits in Three Year Degree Course: B.Sc. Physical Science and B.Sc. with Physics: 72 + 24 +36								**132**

***** *As per teaching hours given in column three above table, each course of 6 credits* **[{4 credits Theory (4 hours) + 2 credits Practical (4 hours)} or {5 credits Theory (5 hours) + 1 credits Tutorial (1 hours)}]** *and of 4 credits* **{3 credits SEC Theory (3hours) + 1 Credit Practical Skill based on Project work (2 hours)}** should be completed within every two weeks of the annual system.

HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION FOR BACHELOR OF SCIENCE WITH PHYSICS

Year	Course Type	Course Code	Title of paper	*Credits
I	CORE COURSE-I	PHYS101TH PHYS101IA	MECHANICS Theory	4
		PHYS101PR	MECHANICS Lab	2
	CORE COURSE-II	COMP101TH	PROBLEM SOLVING USING COMPTER	4
		COMP101PR	SOFTWARE LAB USING PYTHON	2
	CORE COURSE-III	MATH101TH MATH101IA	DIFFERENTIAL CALCULUS	6
	A.E.C. COURSE-I		ENVIRONMENTAL SCIENCE	4
	CORE COURSE-IV	PHYS102TH PHYS102IA	ELECTRICITY, MAGNETISIM AND EMT Theory	4
		PHYS102PR	ELECTRICITY, MAGNETISIM AND EMT Lab	2
	CORE COURSE-V	COMP102TH	OFFICE AUTOMATION TOOLS	4
		COMP102PR	OFFICE ATOMATION TOOLS LAB	2
	CORE COURSE-VI	MATH102TH MATH102IA	DIFFERENTIAL EQUATIONS	6
	A.E.C.COURSE-II		ENGLISH/MIL COMMUNICATION	4
II	CORE COURSE-VII	PHYS201TH PHYS201IA	STATISTICAL AND THERMAL PHYSICS Theory	4
		PHYS201PR	STATISTICAL AND THERMAL PHYSICS Lab	2
	CORE COURSE-VIII	COMP201TH	COMPUTER SYSTEM ARCHITECTRE	6
	CORE COURSE-IX	MATH201TH MATH201IA	REAL ANALYSIS	6
	CORE COURSE-X	PHYS202TH PHYS202IA	WAVES AND OPTICS Theory	4
		PHYS202PR	WAVES AND OPTICS Lab	2
	CORE COURSE-XI	COMP202TH	DATEBASE MANAGEMENT SYSTEM	4
		COMP202PR	DATEBASE MANAGEMENT SYSTEM LAB	2

	CORE COURSE-XII	MATH202TH MATH202IA	ALGEBRA	**6**
	SEC 1 (CHOOSE ANY ONE FROM GIVEN TWO)	PHYS203TH PHYS203IA	PHYSICS WORKSHOP SKILLS Theory	**3+1** **(TH+IA = 3** **SE = 1)**
		PHYS203SE	PHYSICS WORKSHOP SKILLS Skill Exam	
		PHYS204TH PHYS204IA	COMPUTATIONAL PHYSICS Theory	
		PHYS204SE	COMPUTATIONAL PHYSICS Lab	
	SEC 2 (CHOOSE ANY ONE FROM GIVEN TWO)	PHYS205TH PHYS205IA	ELECTRICAL CIRCUITS AND NETWORK SKILLS Theory	**3+1** **(TH+IA = 3** **SE = 1)**
		PHYS205SE	ELECTRICAL CIRCUITS AND NETWORK SKILLS Skill Exam	
		PHYS206TH PHYS206IA	BASIC INSTRUMENTATION SKILLS Theory	
		PHYS206SE	BASIC INSTRUMENTATION SKILLS Skill Exam	
III	DISCIPLINE SPECIFIC ELECTIVES DSE:1A (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS301TH PHYS301IA	ELEMENTS OF MODERN PHYSICS Theory	**4+2** **(TH+IA = 4** **PR = 2)** **OR** **5+1** **(TH+IA = 5** **TU = 1)**
		PHYS301PR	ELEMENTS OF MODERN PHYSICS Lab	
		PHYS302TH PHYS302IA	SOLID STATE PHYSICS AND ELECTRONICS Theory	
		PHYS302PR	SOLID STATE PHYSICS AND ELECTRONICS Lab	
		PHYS303TH PHYS303IA	ASTRONOMY AND ASTROPHYSICS Theory	
		PHYS303TU	ASTRONOMY AND ASTROPHYSICS Tutorials	
	DISCIPLINE SPECIFIC ELECTIVES (DSE:2A)	COMP301PH	OPERATING SYSTEM	**6**
	DISCIPLINE SPECIFIC ELECTIVES DSE:3A (CHOOSE ANY ONE FROM GIVEN THREE)	MATH301TH MATH301IA	MATRICES	**6**
		MATH302TH MATH302IA	MECHANICS	
		MATH303TH MATH303IA	LINEAR ALGEBRA	
		PHYS304TH PHYS304IA	NUCLEAR AND PARTICLE PHYSICS Theory	

	DISCIPLINE SPECIFIC ELECTIVES DSE:1B (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS304TU	NUCLEAR AND PARTICLE PHYSICS Tutorials	**5+1 (TH+IA = 5 TU = 1) OR 4+2 (TH+IA = 4 PR = 2)**
		PHYS305TH PHYS305IA	QUANTUM MECHANICS Theory	
		PHYS305PR	QUANTUM MECHANICS Lab	
		PHYS306TH PHYS306IA	PHYSICS OF DEVICES AND INSTRUMENTS Theory	
		PHYS306PR	PHYSICS OF DEVICES AND INSTRUMENTS Lab	
	DISCIPLINE SPECIFIC ELECTIVES DSE:2B	COMP302TH	DATA STRUCTURE AND FILE PROCESSING	**4**
		COMP302PR	DATA STRUCTURE AND FILE PROCESSING LAB	**2**
	DISCIPLINE SPECIFIC ELECTIVES DSE:3B (CHOOSE ANY ONE FROM GIVEN THREE)	MATH304TH MATH304IA	NUMERICAL METHOD	**6**
		MATH305TH MATH305IA	COMPLEX ANALYSIS	
		MATH306TH MATH306IA	LINEAR PROGRAMMING	
	SEC 3 (CHOOSE ANY ONE FROM GIVEN TWO)	PHYS307TH PHYS307IA	RADIATION SAFETY Theory	**3+1 (TH+IA = 3 SE = 1)**
		PHYS307SE	RADIATION SAFETY Skill Exam	
		PHYS308TH PHYS308IA	APPLIED OPTICS Theory	
		PHYS308SE	APPLIED OPTICS Skill Exam	
	SEC 4 (CHOOSE ANY ONE FROM GIVEN TWO)	PHYS309TH PHYS309IA	WEATHER FORECASTING Theory	**3+1 (TH+IA = 3 SE = 1)**
		PHYS309SE	WEATHER FORECASTING Skill Exam	
		PHYS310TH PHYS310IA	RENEWABLE ENERGY AND ENERGY HARVESTING Theory	
		PHYS310SE	RENEWABLE ENERGY AND ENERGY HARVESTING Skill Exam	

***TH = Theory, IA = Internal Assessment, PR = Practical, TU = Tutorials and SE = Skill Exam**

Years	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	Environmental Science	4
	Core course-I	Mechanics	4
	Core Course-I Practical/Tutorial	Mechanics Lab	2
	Core Course II	DSC 2A	6
	Core Course III	DSC 3A	6
	Ability Enhancement Compulsory Course-II	English/MIL communications/	4
	Core course-IV	Electricity, Magnetism and EMT	4
	Core Course-IV Practical/Tutorial	Electricity, Magnetism and EMT Lab	2
	Core Course V	DSC 2B	6
	Core Course VI	DSC 3B	6
II	Core course-VII	Statistical and Thermal Physics	4
	Core Course-VII Practical/Tutorial	Statistical and Thermal Physics	2
	Core Course VIII	DSC 2C	6
	Core Course IX	DSC 3C	6
	Skill Enhancement Course -1	SEC-1	4
	Core Course-X	Waves and Optics	4
	Core Course-X Practical/Tutorial	Waves and Optics Lab	2
	Core Course XI	DSC 2D	6
	Core Course XII	DSC 3D	6
	Skill Enhancement Course -2	SEC -2	4
III	Skill Enhancement Course -3	SEC -3	4
	Discipline Specific Elective -1	DSE-1A: Physics	6
	Discipline Specific Elective -2	DSE-2A: Computer Science	6
	Discipline Specific Elective -3	DSE-3A: Mathematics	6
	Skill Enhancement Course -4	SEC -4	4
	Discipline Specific Elective -4	DSE-1B: Physics	6
	Discipline Specific Elective -5	DSE-2B: Computer Science	6
	Discipline Specific Elective -6	DSE-3B: Mathematics	6
	Total Credits		**132**

***Wherever there is a practical there will be no tutorial and vice versa. The size of group for practical papers is recommended to be maximum of 12 to 15 students.**

B.Sc. Program with Physics as one subject

Core papers Physics (Credit: 06 each) (CP 1-4):

PHYS101 Mechanics (4) + Lab (2)
PHYS102 Electricity, Magnetism and EMT (4) + Lab (2)
PHYS201 Statistical and Thermal Physics (4) + Lab (2)
PHYS202 Waves and Optics (4) + Lab (2)

Discipline Specific Elective papers (Credit: 06 each) (DSE 1A, DSE 1B):
Choose two courses in 3rd year, any one from each DSE-1A and DSE-1B

DSE -1 A (Choose one course only):
PHYS301 Elements of Modern Physics (4) + Lab (2)
PHYS302 Solid State Physics and Electronics (4) + Lab (2)
PHYS303 Astronomy and Astrophysics (5) + Tutorials (1)

DSE -1 B (Choose one course only):
PHYS304 Nuclear and particle Physics (5) + Tutorials (1)
PHYS305 Quantum Mechanics (4) + Lab (2)
PHYS306 Physics of Devices and Instruments (4) + Lab (2)

Skill Enhancement Course (any four) (Credit: 04 each) - SEC 1 to SEC 4
SEC- 1 B.Sc. With Physics
PHYS203 Physics Workshop Skills (For B.Sc. Physical Science/ B.Sc. With Physics)
or
PHYS204 Computational Physics (For B.Sc. Physical Science/ B.Sc. With Physics)
or
PHYS205 Electrical Circuits and Network Skills (For B.Sc. Physical Science only)
SEC- 2 B.Sc. With Physics
PHYS205 Electrical Circuits and Network Skills
or
PHYS206 Basic Instrumentation Skills
SEC- 3 B.Sc. With Physics
PHYS307 Radiation Safety
or
PHYS308 Applied Optics
SEC- 4 B.Sc. With Physics
PHYS309 Weather Forecasting
or
PHYS310 Renewable Energy and Energy Harvesting

Yearly Based Examination (YBE) and Comprehensive Continuance Assessment (CCA) Scheme of Three Years Degree of B.Sc. with Physics (Annual Pattern)

➢ Scheme for Examination for each course:

- **The medium of instructions and Examinations shall be English only**
- **YBE, Practical and Skill Examinations shall be conducted at the end of each yearly session as per the Academic Calendar notified by H.P. University, Shimla-5, time to time.**
- **Practical (2 Credits) and Skill Test Examinations (1 Credit) shall be conducted in Laboratory.**
- **Each course of 6 credits (Theory + Practical/Tutorials)/4 credits (SEC Theory + Skill Exam) will carry 100 marks and distribution of marks is given under each courses.**
- **The minimum passing marks will be 40% in aggregate. However, 35% each in Internal Assessment (CCA) and Final Examinations will be compulsory. For Practical/Tutorial/Skill Test Exam 40% passing marks will be compulsory and if candidate fails to obtain 40% marks in Practical/Tutorial/Skill Test Exam will be treated as fail in that subject.**
- **Compartment in at most 2 subjects i.e. (25%) of the total subjects.**
- **Criteria for Class-room and Laboratory/Tutorials Attendance (05 marks):**
  75% attendance is compulsory both in theory and practical. Each seminars and submission of Projects/Dissertation/Assignments are mandatory.

(a) Attendance 75% to 80%	**1 marks**
(b) Attendance 81% to 85%	**2 marks**
(c) Attendance 86% to 90%	**3 marks**
(d) Attendance 91% to 95%	**4 marks**
(e) Attendance 96% to 100%	**5 marks**

Note: B.Sc. with Physics qualifications are eligible to apply for master degree courses in Physics/Computer Science/Mathematics.

Ist Year

MECHANICS

Name of the Course	PHYSICS-DSC 1A: MECHANICS (Credits: Theory-04) Theory: 60 Lectures
Code	PHYS101TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.

Coordinate systems and motion of a particle: Volume, velocity and acceleration in Cartesian and Spherical co-ordinate systems, Solid angle. **(6 Lectures)**

Space Time Symmetry and Conservation Laws: Relationship of conservation laws and symmetries of space and time. **(4 Lectures)**

Frames of Reference: Inertial frames of reference, Galilean transformation and Galilean invariance. Non-inertial frames, Coriolis force and its applications; Foucault's pendulum.

(5 Lectures)

Unit-II

Gravitation and Inverse Square Force Law: Newton's Law of Gravitation, Various forces in nature (qualitative). Central and non-central forces, Inverse square force, Centre of mass. Equivalent one body problem. Reduced mass, angular momentum in central force field.Equation of motion under a force law**.** Equation of orbit and turning points. relationship between eccentricity and energy, Kepler's laws., Basic idea of global positioning system (GPS).

(15 Lectures)

Unit-III

Rotational Motion and Kinematics of Elastic and Inelastic Collisions : Angular velocity, angular momentum, Torque, Conservation of angular momentum,: Elastic and inelastic collisions, coefficient of restitution, Elastic collisions in laboratory and C.M. systems, Velocities, angle and energies in elastic collisions in C.M. and lab. Systems, Classical Scattering: Cross- section for elastic scattering, Rutherford scattering (with derivation).

(15 Lectures)

Unit IV

Special Theory of Relativity: Concept of stationary universal frame of reference and search for ether. Michelson- Morley experiment, postulates of special theory of relativity. Lorentz transformations. Observer in relativity. Relativity of simultaneity. **(8 Lectures)**

Effects of Relativity: Length contraction. Time dilation. Relativistic addition of velocities. Relativistic Doppler effect. Variation of mass with velocity and mass energy equivalence. Increase of mass in an inelastic collision, Relativistic momentum and energies. Transformation of momentum, energy. Minkowsky space. **(7 Lectures)**

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
- Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Mechanics, D.S. Mathur, S. Chand and Company Ltd.
- An Introduction to Mechanics, Kleppner, Tata Macgraw Hill.

MECHANICS LAB

Name of the Course	**PHYSICS-DSC 1A LAB: MECHANICS (Credits: -02)**
Code	PHYS 101PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PHYSICS LAB: DSC 1A LAB: MECHANICS

60 Lectures

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.

5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
11. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
12. To compare the moment of inertia of a solid sphere and hollow sphere or solid disc of same mass with the torsional pendulum.
13. To verify (a) the law of conservation of linear momentum and (b) law conservation of kinetic energy on case of elastic collision.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, Indu Pra..kash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- B.Sc Practical Physics C.L. Arora, S. Chand and company Ltd.

Ist Year

ELECTRICITY, MAGNETISM AND EMT

Name of the Course	**PHYSICS-DSC 1B: ELECTRICITY, MAGNETISM AND EMT** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS102TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of*

seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem, Stokes's theorem, Green's theorem. **(5 Lectures)**

Electrostatics: Significance of electrostatic force, Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor, electrostatic potential, electrostatic potential energy. Electric potential due to a dipole and quadrupole, long uniformly changed wire, charged disc. Electric potential energy. Electric field as a gradient of a scalar potential. Calculation of electric field due to a point charge and a dipole from potential. Method of Electrical Images. Poisson and Laplace equations. **(7 Lectures)**

Electric Current and Fields of Moving charges: Current and current density. Continuity equation; $\nabla J + \partial\rho/\partial t = 0$. Microscopic form of Ohm's law ($J \alpha E$) and conductivity. Failure of Ohms law and its explanation. Invariance of charge. **(3 Lectures)**

Unit-II

Magnetism: Ampere circuital law and its applications. Hall Effect, Expression for Hall constant and its significance. Divergence and curl of magnetic field **B**. Vector potential: Definition of vector potential **A** and derivation. **(5 Lectures)**

Field of Moving Charges: E in different frames of reference. Field of a point charge moving with constant velocity. Field of charge that starts or stops (qualitative). Interaction between moving charge and force between parallel currents. **(4 Lectures)**

Surface current density: Definition. and its use in calculation of change in magnetic field at a current sheet. Transformation equations of E and B from one frame of reference to another. Dielectrics, parallel plate capacitor with a dielectric, dielectric constant, polarization and polarization vector, displacement vector **D**, molecular interpretation of Claussius - Mossotti equation, boundary conditions satisfied by **E** and **D** at the interface between two homogenous dielectrics, illustration through a simple example**.** **(6 Lectures)**

Unit-III

Electrostatic Fields in Dielectrics: Polarization of matter. Atomic and molecular dipoles, induced. Dipole moment and atomic polarizability. Electric susceptibility and polarization vector

Capacity of a capacitor filled with Dielectrics. Dielectrics and Gauss's law Displacement vector- Establishment of relation $\nabla . D = \rho_{free}$. Energy stored in a dielectric medium. **(7 Lectures)**

Magnetic Fields in Matter: Behavior of various substances in magnetic fields. Definition of M and H and their relation to free and bound currents. Magnetic permeability and susceptibility and their interrelation. Orbital motion of electrons and diamagnetism. Electron spin and paramagnetic. Ferromagnetism. Domain theory of ferromagnetism, magnetization curve, hysterics loss, ferrites. **(8 Lectures)**

Unit-IV

Maxwell`s equations and Electromagnetic wave propagation: Displacement current, Maxwell's equations and its physical interpretation, EM waves and wave equation in a medium having finite permeability and permittivity but with conductivity $\sigma = 0$. Poynting vector, Poynting theorem, Impedence of a dielectric to EM waves, EM waves in conducting medium and skin depth. EM waves velocity in a conductor and anomalous dispersion. Reflection and Transmission of EM waves at a boundary of two dielectric media for normal and oblique incidence of reflection of EM waves from the surface of a conductor at normal incidence.

(15 Lectures)

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Introduction to Electrodynamics, D.J. Griffth, 3rd Edition, Prentice Hall of India.
- Electricity and Magnetism, Brij Lal and Subramanium, S. Chand & Co. Ltd.
- Electricity and Magnetism, A S Mahajan and A A Rangwala, Tata McGraw Hill Company.

ELECTRICITY, MAGNETISM AND EMT LAB

Name of the Course	**PHYSICS-DSC 1B LAB: ELECTRICITY, MAGNETISM AND EMT (Credits: -02)**
Code	PHYS 102PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PHYSICS LAB- DSC 1B LAB: ELECTRICITY, MAGNETISM AND EMT

60 Lectures

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:

(i) Measurement of charge and current sensitivity
(ii) Measurement of CDR
(iii) Determine a high resistance by Leakage Method
(iv) To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem
11. To determine unknown capacitance by flashing and quenching method
12. To find frequency of ac supply using an electrical viberator.
13. To study the induced emf as a function of the velocity of the magnet (simple method).

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- B.Sc. Practical Physics C.L. Arora, S. Chand and company Ltd.

2nd Year

STATISTICAL AND THERMAL PHYSICS

Name of the Course	**PHYSICS-DSC 1C: STATISTICAL AND THERMAL PHYSICS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS201TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Basic Ideas of Statistical Physics: Scope of statistical physics, basic ideas about probability, distribution of four distinguishable particles in two compartments of equal sizes. Concept of macro-states, micro-states, thermodynamic probability, effect of constraints on the system. **(8 Lectures)**

Distribution of Particles in Compartments: Distribution of n particles in two compartments, Deviation from the state of maximum probability. Equilibrium state of a dynamic system, distribution of n distinguishable particles in k compartments of unequal sizes.

(7 Lectures)

Unit-II

Types of Statistics in Physics: Phase space and division into elementary cells. Three kinds of statistics. The basic approach in the three statistics. M-B. Statistics applied to an ideal gas in equilibrium, experimental verification of the Maxwell Boltzmann‘s law of distribution of molecular speeds. Need for quantum statistics, h as a natural constant and its implications, indistinguishability of particles and its implications. B-E statistics, **(8 Lectures)**

Bose Einstein and Fermi Dirac Statistics: Derivation of Planck’s law of radiation, deduction of Wien’s distribution law and Stefan’s law from plank’s law. Fermi-Dirac statistics. Applications to liquid helium, free electrons gas (Fermi level and Fermi Energy), Comparison of M-B, B-E, F-D statistics. **(7 Lectures)**

Unit-III

Entropy and Laws of Thermodynamics: Application of thermodynamics to the thermoelectric effect, change of entropy along a reversible path in a p-v diagram, entropy of a perfect gas, equation of state of ideal gas from simple statistical considerations, heat death of the universe. **(7 Lectures)**

Statistical Interpretation of entropy: Statistical definition of entropy, change of entropy of system, additive nature of entropy, law of increase of entropy. Reversible and irreversible processes, example of reversible and irreversible processes. Work done in a reversible process, example of entropy in natural process, entropy and disorder.

(8 Lectures)

Unit-IV

Maxwell's Thermodynamic Relations and Their Applications: Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Derivation of Maxwell's thermodynamic relations. **(7 Lectures)**

Applications of thermodynamics relations. Cooling produced by adiabatic stretching, adiabatic compression, adiabatic Stretching of a wire, stretching of thin films, change of internal energy with volume. Clausius-Clapeyron Equation, Thermo dynamical treatment of Joule-Thomson effect for liquification of Helium. Production of very low temperatures by adiabatic demagnetization, TdS equations. **(8 Lectures)**

Reference Books:

- Statistical Physics and Thermodynamics, V.S. Bhatia, Sohan Lal Nagin Chand & Co, 1986, Jalandhar.
- Statistical Mechanics, R.K. Patharia, 2nd Edition, Butterworth-Heinemann.
- Introduction to Statistical Mechanics, B. B. Laud,(1988), Macmillan India Limited
- Statistical Physics, Berkley Physics Course, Vol. 5, F. Rief, Mc-Graw Hill Book Company.
- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal and Statstical Physics, Brij Lal and Subrahmanyam, S. Chand & Co. Ltd.
- Introduction to Statistical Mechanics, B. B. Laud,(1988), Macmillan India Limited
- Statistical Physics, Berkley Physics Course, Vol. 5, F. Rief, Mc-Graw Hill Book Company.

STATISTICAL AND THERMAL PHYSICS LAB

Name of the Course	**PHYSICS-DSC 1C LAB: STATISTICAL AND THERMAL PHYSICS (Credits: -02)**
Code	PHYS 201PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PHYSICS LAB-DSC 1C LAB: STATISTICAL AND THERMAL PHYSICS
60 Lectures

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.

6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge
11. To prove the law of probability by using one coin, two coins and 10 or more coins.
12. To determine the coefficient of increase of volume of air at constant pressure.
13. To determine the coefficient of increase of pressure of air at constant volume.
14. To study the spectral characteristics of a photo-voltaic cell.
15. To study the current voltage, power load, areal, azimuthal and spectral characteristics of a photo voltaic cell.
16. To verify inverse square law of radiation using a photoelectric cell.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
- B.Sc. Practical Physics C.L. Arora, S. Chand and company Ltd.

2nd Year

WAVES AND OPTICS

Name of the Course	**PHYSICS-DSC 1D: WAVES AND OPTICS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS202TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit*

IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Simple harmonic motion: characteristics, graphical representation of SHM, phase relation between displacement, velocity and acceleration of a particle, executing SHM, SHM oscillator (mass attached to a spring placed on horizontal frictionless surface). energy of a simple harmonic oscillator. solution of the differential equation of SHM. Average kinetic energy, average potential energy and total energy. **(7 Lectures)**

Damped SHM: Damped oscillations. differential equation of motion of one dimensional damped harmonic mechanical oscillator. Types of damping. damped harmonic electric oscillator (differential equation and its solutions). Determination of the damping constants. Logarithmic decrement. Relaxation time. The quality factor, power dissipation in a damped harmonic oscillator when damping is weak. Relation between power dissipation energy and relaxation time of damped harmonic oscillator. **(8 Lectures)**

Unit-II

The Forced Oscillator: Transient and steady behaviour of forced oscillator. Displacement and velocity variation with driving force frequency. Variation of phase with frequency. Power supplied to an oscillator and its variation with frequency. Q- value and band width. Q-value as an amplification factor (Phasor treatment to be followed). **(4 Lectures)**

Coupled Oscillators: Stiffness coupled pendulums. Normal co-ordinates and normal modes of vibration. Inductance coupling of electrical oscillators. **(3 Lectures)**

Wave Motion: The type of waves. The wave equation and its solution. Characteristic impedance of a string. Impedance matching. Reflection and transmission of energy. Reflected and transmitted energy coefficients. Standing waves on a string of fixed length. Energy of a vibrating string. Wave velocity and group velocity. **(8 Lectures)**

Unit-III

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **(3 Lectures)**

Interference: Division of wavefront and division of amplitude. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer.

(12 Lectures)

Unit-IV

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating, Dispersive power of diffraction grating, Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

(8 Lectures)

Polarization: Transverse nature of light waves. Unpolarized and plane polarized light, production of polarized light, Wire grid polarizer, Polaroid, Effect of intensity of light passing through Polaroid, Malus' law, double refraction; ordinary ray and extraordinary ray, positive and negative crystals, birefringence, Nicol Prism, quarter wave plate and half wave plate, Polarization by reflection (Brewster law), polarization by scattering,. Circular and elliptical polarization, production of elliptically polarized and circularly polarized light.

(7 Lectures)

Reference Books:

- A text book of Optics, N. Subrahmanyam, B. Lal, M.N. Avadhanulu, S. Chand & Company Ltd.
- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill.
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
- Fundamentals of Optics: Geometrical Physical and Quantum, D. R. Khanna, H. R. Gulati R. Chand Publication.
- Optics, Eugene Hecht, Addison-Wesley 2002.

WAVES AND OPTICS LAB

Name of the Course	**PHYSICS-DSC 1D LAB: WAVES AND OPTICS (Credits: -02)**
Code	PHYS 202PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PHYSICS LAB-DSC 1D LAB: WAVES AND OPTICS

60 Lectures

1. To investigate the motion of coupled oscillators
2. Familiarization with Schuster`s focussing; determination of angle of prism.
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power and Resolving power of the Material of a given Prism using Mercury Light
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Bi prism.
8. To determine wavelength of sodium light using Newton's Rings.

9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.
13. To find the refractive index of glass slab using travelling microscope
14. To find the refractive index of water using travelling microscope
15. To determine the magnifying power of a telescope.
16. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
17. Plot a graph between the concentration and rotation for various strengths of sugar solution and hence find (a) the specific rotation and (b) the concentration of the given sugar solution.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

DISCIPLINE SPECIFIC ELECTIVE:
SELECT TWO PAPERS

3rd Year

ELEMENTS OF MODERN PHYSICS

Name of the Course	**PHYSICS-DSE 1A: ELEMENTS OF MODERN PHYSICS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS301TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from*

section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. **(10 Lectures)**

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. **(5 Lectures)**

Unit-II

Heisenberg uncertainty principle- impossibility trajectory; estimating minimum energy of a confined principle; Energy-time uncertainty principle. Wave-particle duality.

(4 Lectures)

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension.

(**11 Lectures)**

Unit-III

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. **(10 Lectures)**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

(5 Lectures)

Unit-IV

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

(11 Lectures)

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions. **(4 Lectures)**

Reference Books:

- Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003,

McGraw Hill
- Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
- Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
- Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

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ELEMENTS OF MODERN PHYSICS LAB

Name of the Course	**PHYSICS-DSE 1A LAB: ELEMENTS OF MODERN PHYSICS (Credits: -02)**
Code	PHYS301PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PRACTICALS – DSE 1A LAB: ELEMENTS OF MODERN PHYSICS
60 Lectures

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.
11. To verify the inverse square law by using photovoltaic cell.
12. To measure the DC voltage by using CRO
13. To display the action of junction Diode as (a) Half wave rectifier and (b) Full wave rectifier using CRO
14. To determine e/m by magnetron method or small solenoid method.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

3rd Year

SOLID STATE PHYSICS AND ELECTRONICS

Name of the Course	**PHYSICS-DSE 1A: SOLID STATE PHYSICS AND ELECTRONICS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS302TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Crystal Structure and Crystal Bonding: Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Laue pattern, Laue equation, Atomic and Geometrical Factor. Potential between a pair of atoms, Lennard-Jones potential, Ionic, Covalent, Vander - Waal's. Calculation of cohesive energy for ionic and inert gas system. **(10 Lectures)**

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law **(5 Lectures)**

Unit-II

Free electron theory of metals: Classical picture, Fermi gas, density of states, Fermi energy and fermi velocity, electronic contribution to specific heat of metals. **(3 Lectures)**

Band Theory of Metals: Kronig Penny model, Brillouin zones, electrons in periodic structure, energy bands, energy gaps, effective mass of electrons and holes, metals, insulators, p and n type Semiconductors effective mass of electron, mobility. **(4 Lectures)**

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. cooper pairs, BCS theory. **(8 Lectures)**

Unit-III

Junction diodes: pn junctions, V-I characteristics, Zener diode, voltage regulation, tunnel diode, LED and LCD, Solar cell, diode as circuit element, load line concept, Rectifiers: Half Wave, full wave and bridge rectifier, efficiency and ripple factor, filter circuits. **(7 Lectures)**

Transistors: Characteristics of a transistor in CB, CE and CC mode, idea of equivalent circuits, α and β of BJT, common emitter amplifier. Field Effect Transistor: working of JFET, voltage ampere curves, biasing JFET, ac operation of JFET, depletion and enhancement mode, MOSFET, FET amplifier. **(8 Lectures)**

Unit-IV

Amplifiers: Small signal amplifiers: General principles of operation, classification, distortion, RC coupled amplifier, gain frequency response, input and output impedance. Multistage amplifiers, transformed coupled amplifiers, Equivalent circuits at low, medium and high frequencies, emitter follower, low frequency common source and common drain amplifier, Noise in electronic circuits. Feedback in amplifiers; negative feedback and stability.

(9 Lectures)

Oscillators: Braukhausen criteria for oscillations, Tuned collector, Hartley and colpitts oscillators, phase shift oscillators, operational amplifiers, inverting and non-inverting amplifiers, operational amplifier as adder, subtractor, comparator, integrator and differentiator.

(6 Lectures)

Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
- Basic Electronics, D.C. Tayal, Himalya Publishing House.
- Physics of Semiconductor Devices, Dilip K. Roy (1992), Universites Press, Distributed by Orient Longman Limited.
- Solid State Electronic Devices, Ben G. Streetman, 2nd Edtion(1986), Prentice Hall Of India New Delhi-110001.
- Electronic Principles, A.P. Malvino, 3rd Edition(1984), Tata Mcgraw Hill Edition, New Delhi.
- Principle of Electronics, VK Mehta, S Chand and Company

SOLID STATE PHYSICS AND ELECTRONICS LAB

Name of the Course	**PRACTICALS –DSE 1A LAB: SOLID STATE PHYSICS AND ELECTRONICS (Credits: -02)**
Code	PHYS302PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PRACTICALS –DSE 1A LAB: SOLID STATE PHYSICS AND ELECTRONICS

60 Lectures

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (from room temperature to 150 ^{o}C) and to determine its band gap.
10. To study the characteristics of FET
11. To find energy gap of a semiconductor.
12. To study the characteristics of Zener diode.
13. To study the voltage regulation using Zener diode
14. To study the characteristics of NPN transistor
15. To study the characteristics of PNP transistor
16. To measure the efficiency and ripple factors for: a) Half wave b) full wave and c) bridge rectifier circuits.
17. To study the gain of an amplifier at different frequencies and to find band width and gain band width product.
18. (a) To draw forward and reverse bias characteristics for a PN-junction diode and draw a load line.
    (b) Study of a diode as a clipping element.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

3rd Year

ASTRONOMY AND ASTROPHYSICS

Name of the Course	**PHYSICS-DSE 1A: ASTRONOMY AND ASTROPHYSICS** **(Credits: Theory-05, Tutorial-01)** **Theory: 72 Lectures**
Code	PHYS303TH
Yearly Based Examination	**70 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Tutorials**: Tutorials + Tutorial Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 12 marks. Question Number 1. (Section A), will consist of eleven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and eleven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. **Basic concepts of positional astronomy:** Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram. **(18 Lectures)**

Unit-II

Astronomical techniques: Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical

Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes).

Physical principles: Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium. **(18 Lectures)**

Unit-III

The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology).
The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.
Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification) **(18 Lectures)**

Unit-IV

The milky way: Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus.

Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms.
Large scale structure & expanding universe: Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance-Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter). **(18 Lectures)**

Reference Books:

- Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4thEdition, Saunders College Publishing.
- The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
- Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
- K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
- Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice - Hall of India Private limited, New Delhi,2001.
- Textbook of Astronomy and Astrophysics with elements of cosmology, V.B.Bhatia, Narosa Publication.

3rd Year

NUCLEAR AND PARTICLE PHYSICS

Name of the Course	**PHYSICS-DSE 1B: NUCLEAR AND PARTICLE PHYSICS** **(Credits: Theory-05, Tutorials-01)** **Theory: 72 Lectures**
Code	PHYS304TH
Yearly Based Examination	**70 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Tutorial**: Tutorial + Tutorial Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 12 marks. Question Number 1. (Section A), will consist of eleven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and eleven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **(20 Lectures)**

Unit-II

Radioactivity decay:(a) Alphaα decay: basics of -decay processes, theory of α-emission, Gamowα factor, Geiger Nuttall law, -decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays

emission & kinematics, internal conversion.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering). **(18 Lectures)**

Unit-III

Nuclear Detectors and Accelerators: Interaction of nuclear radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation, Detector for Nuclear Radiations: Gas detectors, estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility). Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. **(18 Lectures)**

Unit-IV

Particle Physics: Particle interactions; basic features. Classification of elementary particles and its families. Conservation Laws: energy and momentum, angular momentum, parity, Baryon number, Lepton number, Isospin, Strangeness, Gell-Mann-Nishijima Scheme, CPT theorem, parity violation in weak interactions. Particle Symmetries. Quarks Model, quantum number of quarks and gluons. Quark Model of Hadrons: Quark structure of non strange and strange hadrons, Mesons and baryons containing charm and bottom quarks, explanation of their quantum numbers in terms of their constituents quarks, Quark wave function of Mesons and nucleons, need of color quantum number. Cosmic Rays; origin of cosmic rays. primary and secondary cosmic rays, hard component and soft component, the altitude effect, the latitude effect, East–west asymmetry, cosmic rays showers. **(18 Lectures)**

Reference Books:

- Introductory Nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of Nuclear Physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons.
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub.Inc., 1991)
- Nuclear Physics, D.C. Tayal, Himalaya Publishing House.
- Introduction to Nuclear and Particle Physics, V.K. Mittal, R.C. Verma, S.C.Gupta, Prentice Hall of India (N.Delhi)
- Introduction to Particle Physics, M.P. Khanna, Prentice Hall of India (N.Delhi)
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons.

3rd Year

QUANTUM MECHANICS

Name of the Course	**PHYSICS-DSE 1B: QUANTUM MECHANICS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS305TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit-I

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **(6 Lectures)**

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wavepacket for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle. **(10 Lectures)**

Unit-II

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method. **(14 Lectures)**

Unit-III

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wave functions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only) **(9 Lectures)**

Atoms in Electric and Magnetic Fields:- Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **(7 Lectures)**

Unit-IV

Atoms in External Magnetic Fields:- Zeeman Effect, Normal and Anomalous Zeeman Effect. **(4 Lectures)**

Many electron atoms:- Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings.

(10 Lectures)

Reference Books:

- A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press

Additional Books for Reference

- Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education
- Quantum Mechanics, Walter Greiner, 4thEdn., 2001, Springer

QUANTUM MECHANICS LAB

Name of the Course	**PRACTICALS –DSE 1B LAB: QUANTUM MECHANICS** **(Credits: -02)**
Code	PHYS305PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PRACTICAL-DSE 1B LAB: QUANTUM MECHANICS

60 Lectures

Use C/C^{++}/Scilab/FORTRAN for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom

$$\frac{d^2y}{dt^2} = A(r)u(r),\ \ A(r) = \frac{2m}{\hbar^2}[V(r) - E] = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ)$^{1/2}$,ħc = 1973 (eV Å) and m = 0.511x10^{6}eV/c^2.

2. Solve the s-wave radial Schrodinger equation for an atom

$$\frac{d^2y}{dr^2} = -A(r)u(r), A(r) = \frac{2m}{h^2}[V(r) - E]$$

Here m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{-r/a}$$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits, Also, plot the corresponding wave function. Take e = 3.795 (eVÅ)$^{1/2}$,m=0.511x10^{6}eV/c^2, and a = 3 Å. In these Units hc =1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2y}{dr^2} = A(r)u(r), \bar{A}(r) = \frac{2m}{h^2}[\bar{V}(r) - E]$$

for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In theseħ=197units,30MeV fm^{-3}. The ground state energy I expected to lie

between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule

$$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{h^2}[V(r) - E]$$

Where is the reduced mass of the two atom system for the Morse potential

$$V(r) = D\left(e^{-2\alpha r'} e^{-\alpha r'}\right), \qquad r' = \frac{r - r_0}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant edigits. Also plot the corresponding wave function.

Take: m = 940 x10^6e V/C^2, D= 0.755501 eV, α= 1.44, r_0= 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Reference Books:

- Schaum's Outline of Programming with C++. J.Hubbard, 2000 , McGraw-Hill Publications.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al. 3rd Edn, 2007, Cambridge University Press
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn, 2007, Wiley India Edition.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press

  Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
- Scilab by example: M. Affouf2012ISBN: 978-1479203444

  Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706

  Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
- Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
- Quantum Mechanics, Bruce Cameron Reed, 008, Jones and Bartlett Learning.

3rd Year

PHYSICS OF DEVICES AND INSTRUMENTS

Name of the Course	**PHYSICS-DSE 1B: PHYSICS OF DEVICES AND INSTRUMENTS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	PHYS306TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hour.*

Unit-I

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metalsemiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode.

(14 Lectures)

Unit-II

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection. Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters.

Multivibrators: Astable, Monostable and Bistable Multivibrators using transistors.

(9 Lectures)

Phase Locked Loop (PLL): Basic Principles, Phase detector (XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient

response, lock and capture. Basic idea of PLL IC (565 or 4046).

(5 Lectures)

Unit-III

Processing of Devices: Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion and implantation

(12 Lectures)

Unit-IV

Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK. **(15 lectures)**

Digital Data Communication Standards: Serial Communications: RS232, Handshaking, Implementation of RS232 on PC. Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART). Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

(5 Lectures)

Reference Books:

- Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons
- Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd.
- Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd
- Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd.
- Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

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PHYSICS OF DEVICES AND INSTRUMENTS LAB

Name of the Course	**PRACTICALS –DSE 1B LAB: PHYSICS OF DEVICES AND INSTRUMENTS (Credits: -02)**
Code	PHYS306PR
Yearly Based Examination	**20 marks (3 Hrs)**
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PRACTICALS –DSE 1B LAB: PHYSICS OF DEVICES AND INSTRUMENTS
60 Lectures

Experiments from both Section A and Section B:

Section-A:

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design the active filter (wide band pass and band reject) of given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.
9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astable multivibrator of given specifications using transistor.
11. To study a PLL IC (Lock and capture range).
12. To study envelope detector for demodulation of AM signal.
13. Study of ASK and FSK modulator.
14. Glow an LED via USB port of PC.
15. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.

Section-B:

SPICE/MULTISIM simulations for electrical networks and electronic circuits:

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits.
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain.
4. Design and Verification of op-amp as integrator and differentiator.
5. Design the 1st order active low pass and high pass filters of given cutoff frequency.
6. Design a Wein`s Bridge oscillator of given frequency.
7. Design clocked SR and JK Flip-Flop`s using NAND Gates.
8. Design 4-bit asynchronous counter using Flip-Flop ICs.
9. Design the CE amplifier of a given gain and its frequency response.
10. Design an Astable multivibrator using IC555 of given duty cycle.

Reference Books:

- Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill.
- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.

- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall.
- Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning.
- PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India -

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SKILL ENHANCEMENT COURSE (Any four) (Credit: 04 each)- SEC1 to SEC4

2nd Year

Part A - PHYSICS WORKSHOP SKILL - SEC1

Name of the Course	**PHYSICS – SEC1: PHYSICS WORKSHOP SKILL** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS203TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - PHYSICS WORKSHOP SKILL EXAM - SEC1

Name of the Course	**PHYSICS – SEC1: PHYSICS WORKSHOP SKILL EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic Skill/Problem solving in skill exam.	
Code	PHYS203SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS – SEC1: PHYSICS WORKSHOP SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under Physics Work Shop Skill (PHYS203TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,

2. *The candidate will be required to attempt five questions in all . The duration of the examination will be 3 hours.*

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode

Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **(4 Lectures)**

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet. **(10 Lectures)**

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

(10 Lectures)

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment. **(6 Lectures)**

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

2nd Year

Part A - COMPUTATIONAL PHYSICS - SEC1

Name of the Course	**PHYSICS –SEC1: COMPUTATIONAL PHYSICS** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS204TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - COMPUTATIONAL PHYSICS SKILL EXAM - SEC1

Name of the Course	**PHYSICS-SEC1: COMPUTATIONAL PHYSICS SKILL EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS204SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC1: COMPUTATIONAL PHYSICS SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under Computational Physics (PHYS204TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all . The duration of the examination will be 3 hours.*

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- *Highlights the use of computational methods to solve physical problems*
- *Use of computer language as a tool in solving physics problems (applications)*
- *Course will consist of hands on training on the Problem solving on Computers.*

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for

plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal. **(4 Lectures)**

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

(4 Lectures)

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of Object oriented C++/FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.

3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1 **(4 Lectures)**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

(4 Lectures)

Introduction to electronic spreadsheet: Brief history and applications, Features of MS Excel, Organization of spreadsheet, Building a spreadsheet, Entering data: Text data, numeric data, formulae, entering different functions (Mathematical, Statistical, Trigonometric, Logical, Text and Financial); Types of operators (Arithmetic, Comparison, Text Concatenation and Reference), Syntax and nesting of functions, Cell Addressing/Referencing (Absolute, Relative and Mixed). Charting using spreadsheets

(4 Lectures)

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot. **(4 Lectures)**

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

(6 Lectures)

Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

2nd Year

Part A - ELECTRICAL CIRCUITS AND NETWORK SKILLS – SEC1/SEC2

Name of the Course	**PHYSICS-SEC1/ SEC2: ELECTRICAL CIRCUITS AND NETWORK SKILLS** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS205TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - ELECTRICAL CIRCUITS AND NETWORK SKILLS EXAM – SEC1/SEC2

Name of the Course	**PHYSICS-SEC1/SEC2: ELECTRICAL CIRCUITS AND NETWORK SKILLS EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS205SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC1/SEC2: ELECTRICAL CIRCUITS AND NETWORK SKILLS EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under Electrical Circuits and Network Skills (PHYS205TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all . The duration of the examination will be 3 hours.*

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

(3 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. **(4 Lectures)**

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

(4 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

(3 Lectures)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

(4 Lectures)

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources

(3 Lectures)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

(4 Lectures)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

(5 Lectures)

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

2nd Year

Part A - BASIC INSTRUMENTATION SKILLS - SEC2

Name of the Course	**PHYSICS-SEC2: BASIC INSTRUMENTATION SKILLS** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS206TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - BASIC INSTRUMENTATION SKILLS EXAM - SEC2

Name of the Course	**PHYSICS-SEC2: BASIC INSTRUMENTATION SKILLS EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS206SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC2: BASIC INSTRUMENTATION SKILLS EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned above under Basic Instrumentation Skills (PHYS206TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all . The duration of the examination will be 3 hours.*

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **(4 Lectures)**

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance. **(4 Lectures)**

Cathode Ray **Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. **(6 Lectures)**

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. **(3 Lectures)**

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. **(4 Lectures)**

Impedance Bridges & Q-Meters: Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges. **(3 Lectures)**

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. **(3 Lectures)**

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. **(3 Lectures)**

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.

8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

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3rd Year

Part A - RADIATION SAFETY – SEC3

Name of the Course	**PHYSICS-SEC3: RADIATION SAFETY** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS307TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - RADIATION SAFETY SKILL EXAM – SEC3

Name of the Course	**PHYSICS-SEC3: RADIATION SAFETY SKILL EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS307SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC3: RADIATION SAFETY SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under**

Radiation Safety (PHYS307TH) for Analytical skill/ Problem solving.

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all. The duration of the examination will be 3 hours.*

The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission. **(6 Lectures)**

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** - Photo-electric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, **Interaction of Charged Particles:** Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), **Interaction of Neutrons**- Collision, slowing down and Moderation. **(7 Lectures)**

Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). **Radiation detection:** Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), Scintillation Detectors **(**Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry.

(7 Lectures)

Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management. **(5 Lectures)**

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses*:* Tracing, Gauging, Material Modification, Sterization, Food preservation. **(5 Lectures)**

Experiments:

1. Study the background radiation levels using Radiation meter

Characteristics of Geiger Muller (GM) Counter:

2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
3. Study of counting statistics using background radiation using GM counter.
4. Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
5. Study of absorption of beta particles in Aluminum using GM counter.
6. Detection of α-particles using reference source & determining its half life using spark counter
7. Gamma spectrum of Gas Light mantle (Source of Thorium)

Reference Books:

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
7. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.
9. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981

3rd Year

Part A - APPLIED OPTICS - SEC3

Name of the Course	**PHYSICS-SEC3: APPLIED OPTICS** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS308TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - APPLIED OPTICS SKILL EXAM – SEC3

Name of the Course	**PHYSICS-SEC3: APPLIED OPTICS SKILL EXAM (Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS308SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC3: APPLIED OPTICS SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned above under Applied Optics (PHYS308TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all. The duration of the examination will be 3 hours.*

Theory includes only qualitative explanation. Minimum five experiments should be performed covering minimum three sections.

(i) Sources and Detectors **(9 Lectures)**

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Experiments on Lasers:

a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
c. To find the polarization angle of laser light using polarizer and analyzer
d. Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

a. V-I characteristics of LED
b. Study the characteristics of solid state laser
c. Study the characteristics of LDR
d. Photovoltaic Cell
e. Characteristics of IR sensor

(ii) Fourier Optics: **(6 Lectures)**

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens

Experiments on Fourier Optics:

a. Fourier optic and image processing

1. Optical image addition/subtraction
2. Optical image differentiation

3. Fourier optical filtering
4. Construction of an optical 4f system

b. Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science.

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.

(iii) Holography: (6 Lectures)

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

Experiments on Holography and interferometry:

1. Recording and reconstructing holograms
2. Constructing a Michelson interferometer or a Fabry Perot interferometer
3. Measuring the refractive index of air
4. Constructing a Sagnac interferometer
5. Constructing a Mach-Zehnder interferometer
6. White light Hologram

(iv) Photonics: Fibre Optics (9 Lectures)

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating

Experiments on Photonics: Fibre Optics

a. To measure the numerical aperture of an optical fibre
b. To study the variation of the bending loss in a multimode fibre
c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern
d. To measure the near field intensity profile of a fibre and study its refractive index profile
e. To determine the power loss at a splice between two multimode fibre

Reference Books:

- Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill.
- LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
- Fibre optics through experiments,M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
- Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
- Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press

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3rd Year

Part A - WEATHER FORECASTING - SEC4

Name of the Course	**PHYSICS-SEC4: WEATHER FORECASTING (Credits: Theory-03) Theory: 30 Lectures**
Code	PHYS309TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - WEATHER FORECASTING SKILL EXAM – SEC4

Name of the Course	**PHYSICS-SEC4: WEATHER FORECASTING SKILL EXAM (Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS309SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC4: WEATHER FORECASTING SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under Weather Forecasting (PHYS309TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all . The duration of the examination will be 3 hours.*

The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques

Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics.

(9 Lectures)

Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws.

(4 Lectures)

Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.

(3 Lectures)

Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **(6 Lectures)**

Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.

(8 Lectures)

Demonstrations and Experiments:

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:

(a) To calculate the sunniest time of the year.
(b) To study the variation of rainfall amount and intensity by wind direction.
(c) To observe the sunniest/driest day of the week.
(d) To examine the maximum and minimum temperature throughout the year.
(e) To evaluate the relative humidity of the day.
(f) To examine the rainfall amount month wise.

3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis.
4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)

Reference books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

3rd Year

Part A - RENEWABLE ENERGY AND ENERGY HARVESTING - SEC4

Name of the Course	**PHYSICS-SEC4: RENEWABLE ENERGY AND ENERGY HARVESTING** **(Credits: Theory-03)** **Theory: 30 Lectures**
Code	PHYS310TH
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory **= 05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5+5 marks.**	

Part B - RENEWABLE ENERGY AND ENERGY HARVESTING SKILL EXAM – SEC4

Name of the Course	**PHYSICS-SEC4: RENEWABLE ENERGY AND ENERGY HARVESTING SKILL EXAM** **(Credits: -01)**
Maintain Project file or Dissertation to check Analytic skill/Problem solving in skill exam.	
Code	PHYS310SE
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

PHYSICS-SEC4: RENEWABLE ENERGY AND ENERGY HARVESTING SKILL EXAM

- **Skill based Project or Dissertation work on any topic of syllabus mentioned under Renewable Energy and Energy Harvesting (PHYS310TH) for Analytical skill/ Problem solving.**

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks ,*
2. *The candidate will be required to attempt five questions in all. The duration of the examination will be 3 hours.*

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in

Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

(3 Lectures)

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

(6 Lectures)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

(3 Lectures)

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.
Geothermal Energy: Geothermal Resources, Geothermal Technologies.

(7 Lectures)

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

(2 Lectures)

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power

(4 Lectures)

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications, Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

(5 Lectures)

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

- Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
- Solar energy - M P Agarwal - S Chand and Co. Ltd.
- Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
- Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University.
- Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- http://en.wikipedia.org/wiki/Renewable_energy
