ANNEXURE-I

Directorate of Research and Innovation

Uttarakhand Open University

Ph. D. Course Work Structure (One Semester)

Total 06 Modules, each of 03 Credits (Total Credit = 18; 18×30 = 360 Hours)

Sl. No.	Module Name	Total Credit	Total Marks Assigned			To be administered by
			Evaluation (Theory)	Evaluation (Assign.)	Evaluation (Project)	
1.	Module I: Introduction of Research	03	70	30	-	Directorate of Research & Innovation
2.	Module II: Tools and techniques for data collection	03	70	30	-	Directorate of Research & Innovation
3.	Module III: Research Writing and Technological Inputs in Research	03	70	30	-	Directorate of Research & Innovation
4.	Module IV: Discipline Specific Research Methodologies	03	70	30	-	Concerned Department
5.	Module V: Emerging Trends and Major Thrust areas in Discipline Specific Research Approaches	03	70	30	-	Concerned Department
6.	Module VI: Formulating a Research Proposal	03	-	-	100(Project Evaluation - 50)Presentation and Viva – 50)	Concerned Department (with the help of Directorate of Research and Innovation)

Module I: Introduction of Research

(03 Credits: 90 Hrs.)

- · Research: Meaning and Characteristics. Why Research? Areas of Research.
- · Objectives of Research: Exploration, Description, Explanation, Prediction, Influence.

· Research Paradigms/Approaches: Quantitative and Qualitative, Logical Positivistic and Phenomenological.

- · Research Method, Methodology & Designs.
- · General Kinds of Research (Brief Introduction):-
- · Basic/Fundamental Research, Applied Research, Action Research; Orientational Research;

• Quantitative Research:

• Experimental Research (True and Quasi): Concept, Types, Internal & External Validity, Experimental Designs.

- · Non Experimental Research/Descriptive Study
- · Assessment Research
- Evaluation Research
- · Descriptive Research
- (a) Interrelationship Study: Ex-Post Facto Research/Causal Comparative Study,
- (b) Co-relational Study
- (c) Developmental Study
- (i) Growth Study- Longitudinal and Cross Sectional Study
- (ii) Trend Developmental Study
- · Qualitative Research: Concept, Characteristics & Types
 - · Historical Research: Concept, Resources, Facts & Evidence, Criticism in Historical Researches
 - · Philosophical Research
 - · Case Study
 - · Grounded Theory
 - · Phenomenological Research
 - · Ethnographical Research
 - · Ethno-methodological Research

· Symbolic Interactionism

· Mixed Research: Concept, Characteristics & Types

 Epistemology, Knowledge and its Sources (Tenacity, Authority/Expert Opinion, Intuition, Empiricism (Experience), Rationalism (Reasoning- Inductive & Deductive), Scientific Approach: Basic Assumptions of Science, Scientific Methods- Exploratory and Confirmatory)

· Epistemology in Indian Tradition: Knowledge $(J\tilde{n}\bar{a}na)$, Cognition (*Buddhi*), Apprehension (*Upalabdhi*) & Consciousness (*Anubhava*); Valid Means (*Pramația*) of Knowledge ($J\tilde{n}\bar{a}na$):-Perception (*Pratyakșa*), Inference (*Anumāna*), Comparison (*Upamāna*), Verbal Testimony (*śabda*), Postulation (*Arthāpatti*), Non-cognition (*Anupalabdi*) & Logic (*Tarka*).

• Forms of Knowledge: Information & Facts; Concepts and Constructs; Hypotheses, Theories & Laws; Rules, Principles and Generalisation; Assumptions.

· Hypothesis: Concept, Characteristics of good Hypothesis, Types of Hypothesis (Research Hypothesis: Directional & Non-directional, Null Hypothesis, Alternative Hypothesis; Simple & Complex Hypothesis; Causal & Descriptive Hypothesis), Hypothesis Testing, Area of Acceptance, Area of Rejection, Level of Significance, Level of Confidence, Confidence Interval, Type I Error, Type II Error.

· Variables: Qualitative Variables (Organismic or Attribute Variables), Quantitative Variables (Continuous and Discrete Variables); Independent/Experimental Variables (Treatment/E-Type Variables, Attribute/S-Type Variables) Dependent Variables, Intervening Variables (Confounding Variables and Extraneous Variables).

 Universe, Population (Homogeneous & Heterogeneous, Finite & Infinite, Existent & Hypothetical), Sample, Sampling Units, Sampling Frame, Sample Units, Sampling Fraction, Response Rate, Sampling Method, Inferential Statistical Methods, Statistical Inferences, Parameters & Statistics, Sampling Distribution, Standard Error, Central Limit Theorem, Types of Sampling: Probability/Random (Unrestricted/Simple Random, Restricted: Systematic, Cluster, Stratified, Multistage), Non Probability/ Non Random (Incidental/Accidental/Convenience, Quota, Purposive/Judgmental, Snowball); Sampling in Qualitative Research; Basis of determining the Sample Size.

· Contemporary issues and Research, Politics of Research, Media and Research

· Paradigm shifts in the field of Research: Structuralism, Modernism, Scientism, Romanticism, Positivism, Post-structuralism, Post-modernism.

· Intra-disciplinary, Interdisciplinary, Multidisciplinary, Trans-disciplinary and Cross- disciplinary approaches in Research.

• Ethical issues in Research.

Module-II: Tools and teaching for datya collection 03 Credits: 90 Hrs

- Concept of Measurement, Evaluation, Assessment & Appraisal; Scales of Measurement: Nominal, Ordinal, Interval and Ratio.
- Data: Concept and its types (Qualitative & Quantitative, Parametric & Nonparametric)
- Connotation of Tools and Techniques.
- Techniques for data collection: Observation Technique, Self Reporting Technique, Testing Technique, Sociometry Technique, Projective Technique.
- Tools for data collection: Objective & Subjective Tools. Continuum of Objectivity in context of tools.
- Different tools and their developmental procedures: Questionnaires, Schedules, Inventories, Interviews, Check Lists, Rating Scales (Numerical, Graphical, Ordering, Position, Forced Choice), Projective Tools (TAT, CAT, Ink Blot Test, Sentence Completion, Word/Picture/Sentence/Free Association Test, Psycho-drama), Sociometry (Sociometric Matrix, Sociogram, Sociometric Index), Observation, Tests, Test Battery, Attitude Scales (Thurston, Likert), Q-Short Method, Semantic Differential Scale, Cumulative Record, Anecdotal Record, Content Analysis.
- Characteristics of good research tools: Objectivity, Reliability, Validity, Norms & Usability.

Module III: Research Writing and Technological Inputs in Research

(03 Credits: 90 Hrs.)

(A) Review, Research Proposal and Research Paper Writing

- Role of library in Research process
- Literature survey & review writing
- Techniques of Research Paper Review
- Techniques of Article Review
- Techniques of Book Review
- Basic Principles of Writing Research Paper
- Basic Principles of Abstract Writing
- Brief introduction about Seminar, Conference, Convention, Symposium, Workshop, Training Programme& Brain Storming Session
- Synopsis: Meaning, Significance, Components and Structure
- Research Proposals of Minor & Major Projects

(B) Writing Research Report

- Research report writing and dissemination of research findings.
- Structure of Doctoral Dissertation (Thesis)

- Basic technicalities of Report Writing
- Documentation, styles of documentation, use of Footnotes or Endnote
- Citation styles; Style guides with examples (APA, MLA & Chicago)
- How to write References and Bibliography

(C) The application of Information and Communication Technologies in Research

- Introduction to computers and Internet
- Role of computer in knowledge management
- Open Education Resources and Research
- Plagiarism and ICT in Research
- Introduction to Windows XP/Vista
- Introduction to operating systems-handling different operating systems PC / Mac etc.
- Role of web media for Literature survey
- Using word processing software MS Word / Latex / others,
- Data analysis and Computer
- Drawing graphs and diagrams through computer
- Microsoft Power point presentation
- Microsoft Excel
- Microsoft Publisher
- SPSS

Module IV: Discipline Specific Research Methodologies (03 Credits: 90 Hrs.)

(Jyotish)

- 1- ज्योतिषशास्त्र : अर्थ, उत्पत्ति, उपयोगिता, अवधारणा
- 2- प्रमुख त्रिस्कन्ध (गणित, फलित एवं संहिता) ज्योतिष के विविध पक्ष एवं बहुस्कन्धात्मक ज्योतिष
- 3- ज्योतिष शास्त्र के प्रवर्त्तक एवं आचार्य तथा उनका प्रमुख सिद्धान्त
- 4- ज्योतिष शास्त्र का इतिहास : काल विभाजन के आधार पर
- 5- ब्रह्माण्ड एवं काल, सृष्टि एवं प्रलय सिद्धान्त
- 6- पंचांग समीक्षा एवं मुहूर्त्त
- 7- प्राच्य पाश्चात्य ज्योतिष का तुलनात्मक अध्ययन
- 8- वेदांग ज्योतिष
- 9- ज्योतिष शास्त्र की प्रासांगिकता
- 10- करण एवं सिद्धान्त ग्रन्थों का तुलनात्मक अध्ययन

Module V: Emerging Trends and Major Thrust areas in Discipline Specific Research Approaches (03 Credits: 90 Hrs.) (Jyotish)

- सिद्धान्त एवं फलित ज्योतिष में अभिनव प्रयोग
- सिद्धान्त एवं फलित ज्योतिष में शोध के प्रमुख विविध क्षेत्र

Note: The nature of this paper is dynamic, hence the paper has not fixed syllabus. It will be decided by the school for every batch.

Module VI: Formulating a Research Proposal (03 Credits: 90 Hrs.)

SOUDCE CODE	PROGRAMME STRUCTURE COURSE NAME	CREDIT-	TOTAL
COURSE CODE	12	MARINO	
CRTI- 101	Background and Introduction of Right to	6	100
CRTI- 102	Application of Right to Information	6	100

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Paper-2 Application of Right to Information

Block-1- Information Exempted from Disclosure

Unit- 1- Information Exempted from Disclosure Unit-2- Public Interest Test for Exemption, Unit-3- Grounds for partial disclosure and third party Information

Block-2 Appellate Authorities

Unit-4-Appeal for seeking Information Unit-5- First Appeal Unit-6- Second Appeal

Block-3-Functions and Powers of Information Commission

Unit-7- Constitution of Central and State Information Commissions Unit-8- Functions and Powers of the Information Commissions Unit-9-Investigation, Fines and Penalties

Block-4- Role of Government and Right to Information

Unit-10- Provisions regarding promotion of RTI Unit-11-Monetering of implementation of RTI Unit-12-Miscellaneous Provisions

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DRTI- 101 Background and Introduction of RTI								
BLOCK 1- Genesis of Right to Information	BLOCK 3- Duties and Responsibilities of Public Information Officers							
Unit 1- Definition and Purpose of Right to Information	Unit 7- Duties of Public Information Officer Unit 8- Responsibilities of Public Information							
Unit 2- Movement of Right to Information in India Unit 3- State and Central Acts on RTI	Officers Unit 9- Issues and Constrains faced by Public Information Officers							
BLOCK 2- Public Authorities Unit 4- Public Authority: Meaning and Scope Unit 5- Obligations of Public Authorities Unit 6- Instrumentalities of Public Authorities	BLOCK 4- Disposal of Information requestsUnit 10- Process of disposal of Information requestsUnit 11- Fee and Costs and exemption frompaymentUnit 12- Interface with the demand side							
<u>DRTI- 102 Ap</u>	plication of RTI							
BLOCK 1- Information Exempted from Disclosure	BLOCK 3- Functions and Powers of Information Commission Unit-7- Constitution of Central and State							
Unit-2- Public Interest Test for Exemption. Unit-3- Grounds for partial disclosure and third party Information	Unit-8- Functions and Powers of the Information Commissions Unit-9-Investigation,Fines and Penalties							
BLOCK 2- Appellate Authorities Jnit-4-Appeal for seeking Information Init-5- Provisions for First Appeal and Second ppeal	BLOCK 4- Role of Government and Right to Information Unit-10- Provisions regarding promotion of RTI Unit-11-Monitering of implementation of RTI							
nit-6- RTI Rules, 20 <u>12</u>	Unit-12-wiscenatious 1 tovisions							

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		Duration (Years)		E (Details of Fee (INR)								
Programme name (Code)	Eligibility	Minimum	Maximum Mode of Exa (Annual/Sen		SLM		Programme Fee Project/Lab Workshop Fee Exam Fee Practical Fee Viva - Voce Identity Card Student Welfare		Student Welfare	Degree Fee Grand Total				
Certificate in Right to Information (DRTI-17)	10+2	1/2	2	I semester	English- Hindi	Ι	1000	-	300		50	100	300	1750

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Programme Name (Code)	Eligibility	Minimum	Maximum	SLM	Mode of Exan (Annual/Sem)	Semester	Programme Fee	Project/Lab Workshop Fee	Exam Fee	Practical Fee	Viva - Voce	Identity Card	Student Welfare	Degree Fee	Grand Total
Diploma in Right to Information (DRTI)	10+2	I	3	English/ Hindi	Semester	II	1500		450		500	50	100	300	2900

	PROGRAMME STRUCTURE		
COURSE CODE	CREDIT	TOTAL MARKS	
	Semester- I		
DRTI- 101	Background and Introduction of RTI	6	100
DRTI- 102	6	100	
	Semester-II		
DRTI- 103	Judiciary and Important Legislatures effecting RTI	6	100
DRTI-104	Constitutional and Comparative study of RTI	6	100
DRTI-105	Viva-voce	4	100

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DRTI- 103 Judiciary and Impo	ortant Legislatures effecting RTI
 BLOCK 1- Role of Judiciary and Position of RTI Unit-1- Judicial Interpretation of Freedom of Speech and Expression Unit-2- Observation of the Court regarding proactive disclosure of Information Unit-3- Important Judicial Guidelines on Good Governance, Transparency and Disclosure 	BLOCK 3- Laws relating to protection of RTI Activists Unit-7- Threats to the life of RTI Activists Unit-8- Supreme Court Guidelines Unit-9-Laws protecting RTI Activists
BLOCK 2- Important Judicial Propositions on RTI Unit-4- Supreme court on Right to Information Unit-5-High Courts on Right to Information Unit-6-Other Important Pronouncements	BLOCK 4- Important Legislatures effecting RTI Unit-10- Official Secrets Act,1923 Unit-11- Public records Act ,1993 Unit-12-Representation of peoples Act,1951
DRTI- 104 Constitutional a BLOCK 1- Constitutional Perspectives Unit-1- Freedom of Speech and Expression	nd Comparative study of RTI BLOCK 3- Role of RTI in Good Governance, Transparency and Accountability Unit-7- Good Governance: Definition, Meaning and Concept
Ul i 2 Di l t V V v v vitavia far verticinatore	Unit-8- Transparency and Accountability

Unit-3- Right to Know-criteria for participatory democracy Unit-9- Role of RTI in realizing the goal of Good Governance and Transparency. BLOCK 4- Important Disclosures through RTI: BLOCK 2- Comparative study Case Study Unit-10- Karnataka villagers insist on Right to Food Unit-4- Right to information in Sweden Unit-11- Rajasthan villagers use RTI to end woes, Unit-5- Right to information in U.K. Voices raised over the issue of overcrowding of jails through RTI in UP. Unit-6- Right to information in South Africa and Mexico Unit-12-Other Important Success Stories etc.

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PROGRAMME STRUCTURE

Ph.D. Physics

Department of Physics

School of Science



Uttarakhand Open University

Teenpani, Haldwani, Nainital - 263139 Uttarakhand **Preface:** Uttarakhand Open University (UOU) started B.Sc. and M.Sc. programmes in different subjects from year 2013. Physics Department of School of Sciences participates in the undergraduate core programme (B.Sc.) and runs M. Sc. programme in Physics. To get the nation and international recognition, research is one of the important components of Science education. Physics department is in process of rapid expansion and can offers Ph.D. programme also. In many area of research, laboratory is not essentially required. However, if required it can be managed by collaborating with other universities/ study centers.

- The Ph.D. programme shall be offered as per latest University Grants Commission (Minimum Standards and Procedure for Award of M.Phil./Ph.D. Degrees) Regulations, 2016 and UOU Research Ordinance 2016.
- 2. The syllabus for the entrance test for PhD programme is according to syllabus prescribed by CSIR-NET.
- 3. The course work in Ph.D. physics is to be according to requirement of Physics subject. The required course work is designed for Ph.D. Physics programme is attached herewith. The course work is completed by available faculty in the department with the help of outsourced faculty at university main campus. The course work can also be completed with the collaboration of other institute.
- 4. The structure, courses and syllabus are compatible to the syllabus and course structure of different other universities.
- 5. According to regular mode, the reference books are recommended for course work. Study material shall not be provided for course work.

Ph.D. Programme Structure

Name of the
Programme:Doctor of Philosophy

Programme Code: PHDPH18

Total Credits: 80

Courses Work (1 Semester and onwards)

S. No.	Courses category	Course (Module) Name	Credits
1	Core courses CW01	Module I	6
	Core courses CW02	Module II,III	
2	Elective courses (Physics) CW03	from the list of Elective courses Module IV,V	4
3	Core courses CW04	Module VI	4
4	Core courses CW05	Module VII	4
5		Doctoral Seminar I	1
6		Doctoral Seminar II	1
7		Ph.D. Thesis	60
			Total Credit= 80

**Elective Courses

As per the research requirement and latest developments of Physics in different area of Physics, a number of elective courses are designed. A student can elect any course/es according to his/her choice of research. This course will be highly beneficial for the further research in the field of his interest. Some more elective courses may also be introduced in future. In second and further next semesters the thesis credits shall be allotted. Doctoral Seminar I may be offered during the research work and Doctoral Seminar II is to be offered/ completed before the submission of Thesis.

Course Structure

First Semester (Full time regular mode):

			Mar	·ks			
S.N.	Course Name	Course Code					Credits
			1 st	Assi	End	Total	
			ter	gn	term		
			m	men	exam		
1	Modulo I (as por	CW01	10	t.	•	100	04
1.	Records directorete	CWUI	10	10	80	100	04
	Kesearch directorate						
-	000)						
2.	Module IV,V	CW03	10	10	80	100	04
	(Elective courses						
	Physics)		1.0	1.0		100	
3.	Module II,III (as per	CW02	10	10	80	100	04
	Research directorate						
	UOU)						
4.	Module VI(as per	CW04	10	10	80	100	04
	Research directorate						
	UOU)						
5	Module VII (as per	CW05					
	Research directorate						
	UOU)						
	Total Credits	•		•	•	•	16

Second Semester and further (Full time regular mode):

			Mar	ks			
S.N.	Course Name	Course Code					Credits
			1 st	Assi	End	Total	
			ter	gn	term		
			m	men	exam		
				t.	•		
1	Doctoral Seminar I	PHDPH704				50	01
2	Doctoral Seminar II	PHDPH705				50	01
	(before the submission)						
							18
	Total Credits						

**Elective Courses (at least one of the following)

				Marks			
S.N •	Course Name	Course Code	1 st term	Assig n.	End term exam	Total	Credits
1.	Advanced Quantum Mechanics	PHDPH706	10	10	80	100	04
2.	Optoelectronics	PHDPH707	10	10	80	100	04
3.	Basic Solid state physics and Material Science	CWO3	10	10	80	100	04
4.	Nano Science and Technology	PHDPH709	10	10	80	100	04
5	Laser Physics	PHDPH710	10	10	80	100	04
6.	Astrophysics	PHDPH711	10	10	80	100	04
7.	Plasma Physics	PHDPH712	10	10	80	100	04

Elective Courses (at least one) Course 4: Advanced Quantum Mechanics Course code PHDPH706

Credit: 4

BLOCK 1 Scattering Theory

Unit -1: The scattering problem, formulation, scattering amplitude, cross sections

Unit –2 : Partial wave analysis, optical theorem

Unit -3 : Phase shifts, scattering length and effective range, Low energy scattering

Unit -4 : Born approximation and its validity.

BLOCK 2 Perturbation Theory

Unit –5 : Time dependent perturbation theory, Constant and harmonic perturbations

Unit -6 : Transition probabilities, Fermi's-Golden rule, Selection rules for dipole radiation

Unit –7: Adiabatic approximation, sudden approximation

Unit –8: Semi classical treatment of an atom with electromagnetic radiation.

BLOCK 3 Relativistic Quantum Mechanics

Unit –9: Klein-Gordon equation, Failures, Dirac equation

Unit -10: Plane, wave solutions, Interpretation of negative energy states

Unit –11: Antiparticles, Spin of electron, Magnetic moment of an electron due to spin

Unit -12: Energy values in a coulomb potential

BLOCK 5 Quantisation of Fields

Unit –13: Relativistic Lagrangian and Hamiltonian of a charged particle in an electromagnetic field.

Unit -14: Second quantization of Kelin-Gordon field

Unit -15: Creation and annihilation operators, Commutation relations

Unit –16: Quantization of electromagenetic field, Quantization of Schroedinger's field - Quantization of Dirac field.

Reference Books:

1. P.M. Mathews and K. Venkatesan, *A Text book of Quantum Mechanics*, Tata Mc Graw-Hill, New Delhi.

2. L.I. Schiff, *Quantum Mechanics*, McGraw-Hill

3. E. Merzbacher, *Quantum Mechanics*, John Wiley and Sons, New York.

4. Stya Prakash, Advanced Quantum mechanics, Ramnath Kedarnath Publication Delhi

5. V. Devanathan, Quantum Mechanics, Narosa Publishing House, New Delhi.

6. P.A. M. Dirac, The Principles of Quantum Mechanics, Oxford University Press, London.

7. B.K. Agarwal, Quantum Mechanics and Field Theory, Lokbharti Publications, India.

Course 5: Optoelectronics Course code PHDPH707

Credit: 4

BLOCK 1 Elemental and compound semiconductors

- Unit –1 : Crystal growth and device processing.
- Unit –2 : Electronic properties of semiconductors
- Unit –3 : Band structure, doping and carrier transport

BLOCK 2 Optical properties of semiconductors

- Unit –4 : Interband and intraband transitions
- Unit –5 : Charge injection and radiative jnonradiative recombination
- Unit –6 : Exitonic effects and modulation of optical properties
- Unit –7 : Semiconductor junction theory.

BLOCK 3 Optoelectronic

Unit –8: Optoelectronic detectors

Unit -9: Solar cell, Light emitting diode

Unit –10: Laser diode: static and dynamic properties

Unit -11: Optical modulators and Amplifiers.

Unit –12: Optical fibers

Reference Books:

1. S.M. Sze, Semiconductor Devices - Physics and Technology, Wiley, New York.

2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw Hill.

3. P. Bhattacharya, Semiconductor Optoelectronic Devices, Pearson Education,

4. J. Singh, *Optoelectronics: An Introduction to Materials and Devices*, Tata McGraw Hill.

Course 6: Basic Solid state physics and Material ScienceCourse code: PHDPH708Credit: 4

BLOCK -1: Overview of materials

Unit –1: Crystalline and amorphous materials, crystal structure, glasses, semiconductors materials, compound semiconductors, solar energy materials, luminescent and optolectronic materials,

Unit –2: Polymer, liquid crystals, ceramics, classification according to bonding, Pauling and Philips theories.

Unit –3: Synthesis and preparation of materials, Single crystal growth, zone refining, doping techniques of elemental and compound semiconductors,

Unit -4: Fabrication and control of thin films, PVD and CVD processes

Unit –5: Principles of polymer processing, preparation of ceramics powders, mechanical and chemical methods

BLOCK 2: Characterization of materials

Unit –6: Defects and microstructures; Diffraction techniques: X-ray diffraction, structure determination from XRD data

Unit -7: Thermal methods: DTA, TGA, DSC;

Unit –8: Microscopy: TEM, SEM

Unit –9: Optical spectroscopy: UV and IR

Unit -10: Nuclear techniques: NMR, ESR, M ossbauer and Positron annihilation

Unit –11: Heat treatments, quenching and annealing; Radiation damage

BLOCK 3: Polymer, Ceramics and Glass

Unit -12: Polymers, Polymerization mechanism, Polymer structures,

- Unit –13: Deformation of polymers, Behavior of polymers.
- Unit –14: Ceramics, Ceramic phases, Structure, classes
- Unit –15: Effect of structure on the behaviour of ceramic phases, composites.
- Unit -16: Glasses, Definitions, properties of glass transition, tunnelling states

Reference Books:

- 1. G.K. Narula, K.S. Narula, and V.K. Gupta, Material Science, TMH, New Delhi.
- 2. A.J. Dekker, Solid State Physics, McMillan Co.
- 3. V. Ragavan, Material Science and Engineering, Prentice Hall of India, New Delhi.
- 4. M. Arumugam, Materials Science, 3rd Edition, Anuradha Agencies.

Course 7: Nanophysics Course code PHDPH709

Credit: 4

BLOCK 1: Nanoparticles: Synthesis and Properties

Unit –1: Introduction, Historical perspective of nanoparticle, Classification of nono materials Unit –2: Method of Synthesis: RF Plasma Chemical Methods, Thermolysis, Pulsed Laser Methods

Unit –3: Biological Methods, Synthesis using micro-organisms, Synthesis using Plant Extract, Metal Nanoclusters, Magic Numbers

Unit -4: Modeling of Nanoparticles, Bulk to Nano Transitions.

Unit –5: Ball milling technique.

BLOCK 2: Carbon Nanostructure

Unit –6: Nature of Carbon Clusters, Discovery of C60, Structure of C60 and its Crystal, Superconductivity in C60

Unit -7: Carbon Nanotubes: Synthesis, Structure, Electrical and Mechanical Properties

Unit -5: Graphene: Discovery, Synthesis and Structural Characterization through TEM

Unit -8: Elementary Concept of its applications,

Unit –9: Quantum Wells, Wires and Dots, Preparation of Quantum Nanostructures, Size Effects

BLOCK 3 Analysis Techniques for Nano Structures/ Particles

Unit –10: Different technique for characterization (XRD, TEM, SEM, AFM, SPM), Unit –11: Diffraction Techniques, Spectroscopic Techniques, Magnetic Measurements

BLOCK 4 Bulk Nanostructure Materials

Unit –12: Methods of Synthesis, Solid Disorders Nanostructures, Mechanical Properties Unit –13: Nanostructure Multilayers, Metal Nanocluster, Composite Glasses, Porous Silicon

Reference Books:

- 1. Introduction to Nanotechnology: Poole and Owners
- 2. Quantum Dots : Jacak, Hawrylak and Wojs
- 3. Handbook of Nanostructured Materials and Nanotechnology: Nalva (editor)
- 4. Nano Technology/ Principles and Practices: S.K. Kulkarni
- 5. Carbon Nanotubes: Silvana Fiorito
- 6. Nanotechlongy: Richard Booker and Earl Boysen

Course 8: Laser Physics Course code PHDPH710

Credit: 4

BLOCK 1 Introduction to Laser

Unit -1: Semi classical theory, stimulated emission, life times and line widths, Einstein Coefficients Unit -2: Gaussian bean and its properties, stable two mirror optical resonator, longitudinal and transverse mode of laser cavity, mode selection,

Unit –3 : Laser rate equations, gain in regenerative laser cavity, gain coefficient

Unit -4 : Threshold conditions, threshold of 3 and 4 level system, gain saturation

Unit -5 : Generalization of ultrafast process, mode locking, pulse compression

BLOCK 2 Laser systems and Laser applications

Unit –6: Different types of lasers systems, Solid state lasers, He-Ne laser, Nd- YAG laser, semiconductor lasers, diode pump semiconductor laser

Unit -7: Gas lasers, Nitrogen laser, Carbon dioxide laser, Dye laser, high power laser system

Unit –8: Laser induced fluorescence, fluorescence spectroscopy and laser induced multi photon process and their application

Unit –9: Ultra high resolution spectroscopy with laser and its application

BLOCK 3 Non Linear Processes:

Unit -10: Propagation of Electromagnetic Waves in Nonlinear medium,

Unit –11: Self Focusing, Phase matching condition, Fiber Lasers,

Unit –12: Stimulated Raman Scattering and Raman Lasers, CARS, Saturation and Two photon spectroscopy.

Unit –13: Cooling and Trapping of Atoms, Principles of Doppler and Polarization Gradient Cooling

Reference Books:

1. W. Demtroder, Laser Spectroscopy and Instrumentation.

- 2. O. Svelto, Principles of Lasers.
- 3. P.N. Ghosh, Laser Cooling and Trapping.

4. S.P. Sengupta, Frontiers in Atomic, Molecular and Optical Physics.

Course 9: Astrophysics Course code PHDPH711

Credit: 4

BLOCK 1 Basic Background and Instrumentation

- Unit -1: Elementary radioactive transfer equations, absorption and emission
- Unit -2: atomic processes, continuum and line emission;
- Unit -3: Optical and radio telescopes,
- Unit -4: Fourier transform methods, detectors and image processing;
- Unit -5: Distance measurements in astronomy, Hubbles law;
- Unit -6: Modern observational techniques (qualitative discussion only)

BLOCK 2 Spectral Classification of Stars

- Unit -7: Saha's equation; Harvard system, luminosity effect;
- Unit –8: Absolute and apparent luminosity
- Unit –9: Mass luminosity relation, spectroscopic parallax.

BLOCK 3 Evolution of Stars

Unit -10: Observational basis, protostars, disks, bipolar outows, hydrostatic equilibrium Unit -11: Sources of stellar energy: gravitational collapse, fusion reactions (p-p chain, CNO cycle, triple α reactions);

- Unit –12: formation of heavy elements;
- Unit -13: Hertzsprung-Russell diagram, evolution of low-mass and high-mass stars
- Unit -14: Chandrasekhar limit; Pulsars, neutron stars, and black holes

BLOCK 3 Binary of Stars and basic Cosmology

Unit -15: Different types of binary stars, Different types of binary stars

- Unit –16: Accretion; Gravitational radiation.
- Unit –17: Schwarzschild geometry and black holes
- Unit -18: FRW geometry and the expanding universe; Riemann curvature; Einstein equations.
- Unit –19: Hubble's observation and expanding universe; Friedmann cosmology

Unit –20: Red shift and expansion; Big bang theory; Constituents of the universe; Dark matter and dark energy (as a nonzero cosmological constant);

Reference Books:

1 Baidyanath Basu, An introduction to Astrophysics.

2. K.D Abhyanker, Astrophysics, Galaxies and Stars.

3. Motz, Astrophysics.

Course 10: Plasma Physics Course code PHDPH 712

Credit: 4

BLOCK 1 Introduction to Plasma

Unit –1: Elementary concept, derivation of moment

Unit –2: Boltzmann equation, plasma oscillation

Unit -3: Debye Shielding, plasma parameter

Unit -4: Magneto plasma, plasma confinement;

BLOCK 2 Magneto hydromagnetics

Unit -5: Hydrodynamical description of plasma, fundamental equation;

Unit -6: Hydromagnetic waves, magneto sonic and Alfven waves.

Unit -7: Wave phenomena in magneto plasma, polarization;

Unit -8: Phase velocity, group velocity, cutoffs

Unit –9: Resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field.

BLOCK 3 Plasma propagation and fluid plasma

Unit –10: propagation at finite angle and CMA digram

Unit -11: propagation through ionosphere and magnetosphere, Helicons

Unit –12: Faraday rotation, Fluid equation for a plasma, Continuity equation;

Unit -13: Momentum balance equation, equation of state

Unit –14: Two fluid equations, plasma resistivity

Reference Books:

Bittencourt, Plasma Physics.

Chen, Plasma Physics.

Robert J Goldston and Paul H Rutherford, Introduction to plasma.

पी–एच.डी. कोर्स वर्क योग प्रश्न पत्र–द्वितीय योग विज्ञान में अनुसंधान क्षेत्र

मॉड्यूल – 1

श्रेयांक –2

<u>इकाई –1</u> दार्शनिक क्षेत्र

वेद, उपनिषद्, भारतीय दर्शन, पुराण, स्मृतियां, गीता, महाभारत, रामायण, आयुर्वेद का संक्षिप्त परिचय तथा उनमें सहित सम्भावित अनुसंधान क्षेत्र।

इकाई –2 साहित्यकीय क्षेत्र

पातंजलयोगसूत्र, हठप्रदीपिका, घेरण्ड संहिता, स्वामी चरणदास कृत भक्तिसागरादि (अष्टांगयोग), शिवस्वरोदय, वशिष्ठ संहिता,शिव संहिता एवं गोरक्ष संहिता का संक्षिप्त परिचय एवं इनके संभावित अनुसंधान क्षेत्र।

इकाई -3 संतो एवं योगीजनों का परिचय व योग के क्षेत्र में योगदान

संत कबीर, तुलसीदास, स्वामी चरणदास, स्वामी दयानन्द सरस्वती, श्री अरविन्द, स्वामी विवेकानन्द,महर्षि रमण,श्यामाचरण लाहिडी,नीब करोली बाबा, शिरडी के साई बाबा ,स्वामी शिवानन्द सरस्वती, स्वामी सत्यानन्द सरस्वती, स्वामी कुवल्यानंद, श्रीराम शर्मा आचार्य का संक्षिप्त परिचय तथा योग के क्षेत्र में उनके योगदान सम्बन्धित सम्भावित अनुसंधानीय क्षेत्र।

मॉड्यूल – 2

श्रेयांक –2

<u>इकाई –1</u> स्वास्थ्य एवं चिकिस्कीय क्षेत्र

आहार एवं स्वास्थ्य की मूलभूत जानकारी, नियमावली, चिकित्सीय उपयोगिता, स्वर आधारित स्वस्थवृत्त नियमावली एवं सम्भावित अनुसंधान क्षेत्र। स्वास्थ्य एवं व्याधि की अवधारणा, यौगिक चिकित्सा की अवधारणा, क्षेत्र, सिद्धान्त एवं सीमायें कायिक, मनोकायिक एवं मनोरोगों सम्बन्धी अनुसंधान के उदाहरण सहित सम्भावित अनुसंधानीय क्षेत्र। यौगिक चिकित्सा एवं वैकल्पिक चिकित्साओं का सम्बन्ध व उदाहरण सहित सम्भावित अनुसंधान क्षेत्र।

इकाई–2 शिक्षण क्षेत्र

प्राथमिक, माध्यमिक, उच्च व उच्चतर विद्यालयीन शिक्षा में योग शिक्षा का स्वरूप, सिद्धान्त व विधियां तथा उदाहरण सहित उनके अनुसंधान क्षेत्र, विद्यालयीन शिक्षा में योग शिक्षा लागू करने के आवश्यक पहलू तथा रूकावटें व सम्भावित अनुसंधानीय क्षेत्र। सामाजिक, औद्यौगिक, प्रशासनिक, शारीरिक शिक्षा व खेलकूद तथा नैतिक शिक्षा में योग की भूमिका व सम्भावित अनुसंधानीय क्षेत्र।

<u>इकाई–3</u>

वर्तमान में परिचलित योग के विभिन्न प्रारूप एवं अधुनातन प्रवृत्तियाँ।