COURSE OUTCOME
B. B. A. PROGRAMME

HONOURS COURSE

COURSE No	COURSES OFFERED	NAME OF THE PAPER	SEMESTER	CREDIT	FULL MARKS	COURSE OUTCOME
101	AECC-I	Environmental Studies	1ST	2	100	To acquaint the students with the fundamentals of environmental issues.
102	CC-I	Principles of Management & Organization Behaviour	1ST	6	75	To acquaint the students with the fundamentals of managing business and to understand individual and group behavior at work place so as to improve the effectiveness of an organization. The course will use and focus on Indian experiences, approaches and cases.
103	CC-II	Business Regulatory Framework	1ST	6	75	To gain knowledge of the branches of law which relate to business transactions, certain corporate bodies and related matters. Also, to understand the applications of these laws to practical commercial situations.
104	GC-I	Managerial Economics	1ST	6	75	To apply micro economic concepts and techniques in evaluating business decisions taken by firms. The emphasis is on explaining how tools of standard price theory can be employed to formulate a decision problem, evaluate alternative courses of action and finally choose among alternatives.
201	AECC-II	English Communication [MIL]	2ND	2	50	Common Syllabus notified by the Board of Studies in English/ MIL subject.
202	CC-III	Business Mathematics	2ND	6	75	The objective of this course is to familiarize students with the applications of mathematics and statistical techniques in business decision-making.
203	CC-IV	Financial Accounting for Managers	2ND	6	75	To familiarize students with the mechanics of preparation of financial statements, understanding corporate

						financial statements, their analysis and interpretation.
204	GC-II	Business Environment	2ND	6	75	To acquaint students with the contemporary issues regarding the environment of business to facilitate a better insight into that environment.
301	CC-V	Income Tax/Laws & Practice	3RD	6	75	To provide basic knowledge and equip students with application of principles and provisions of Income-tax Act, 1961 and the relevant Rules.
302	CC-VI	Cost & Management Accounting	3RD	6	75	To acquaint the students with basic concepts used in cost accounting, various methods involved in cost ascertainment and cost accounting book keeping systems.
303	CC-VII	Financial Management	3RD	6	75	To acquaint students with the techniques of financial management and their applications for business decision making.
304	GC-III	Quantitative Techniques	3RD	6	75	To acquaint students with the construction of mathematical models for managerial decision situations and to use computer software packages to obtain a solution wherever applicable. The emphasis is on understanding the concepts, formulation and interpretation.
305	SEC-I	E-Commerce	3RD	2	75	To enable the student to become familiar with the mechanism for conducting business transactions through electronic means.
401	CC-VIII	Human Resource Management	4TH	6	75	The objective of this course is to help the students to develop an understanding of the concept & techniques of essential functions of human resource management. The course will use and focus on Indian experiences, approaches and cases.
402	CC-IX	Marketing Management	4TH	6	75	This course aims to familiarize students with the marketing function in organizations. It will equip the students with understanding of the Marketing Mix elements and sensitize them to certain emerging issues in Marketing. The course will use and focus on Indian experiences, approaches and cases.
403	CC-X	Production Management	4TH	6	75	This course aims to familiarize students with the production

						function in organizations. It will equip the students with understanding of the Production process and sensitize them to certain emerging issues in Production. The course will use and focus on Indian experiences, approaches and cases.
404	GC-IV	Entrepreneurship Development	4TH	6	75	The purpose of the paper is to orient the learner toward entrepreneurship as a career option and creative thinking and behavior.
405	SEC-II	GST & Customs Duty	4TH	2	75	This course aims to familiarize students with the GST & Customs Duty.
501	CC-XI	Business Statistics	5th	6	75	To familiarize the students with various Statistical Data Analysis tools that can be used for effective decision making. Emphasis will be on the application of the concepts learnt.
502	CC-XII	Strategic Management	5th	6	75	To familiarize the students with strategic management principles that can be used for effective decision making. Emphasis will be on the application of the concepts learnt.
5FA	DSE-I & DSE-II	Corporate Accounting	5th	6	75	To enable the students to acquire the basic knowledge of the corporate accounting and to learn the techniques of preparing the financial statements.
5FB	DSE-I & DSE-II	Financial Markets & Institutions	5th	6	75	To provide the student a basic knowledge of financial markets and institutions and to familiarise them with major financial services.
5FC	DSE-I & DSE-II	Microfinance & Financial Inclusion	5th	6	75	To enable the students to acquire the basic knowledge of the micro-finance and to learn the techniques of such financing .
5MA	DSE-I & DSE-II	Marketing of Services	5th	6	75	To enable the students to acquire the basic knowledge of marketing of Services and to learn the techniques of such marketing.
5MB	DSE-I & DSE-II	Consumer Behaviour	5th	6	75	The objective of this course is to provide basic knowledge of concepts, dimensions and issues of consumer behavior and the skills of understanding and analyzing consumer behavior to develop marketing strategies.
5MC	DSE-I	Product &	5th	6	75	The objective of this course is to

		& DSE-II	Brand Management				provide basic knowledge of concepts, dimensions and issues of product and brand management and developing branding strategies.
5HA	DSE-I & DSE-II	Labour Legislation	5th	6	75	To familiarize the students with the concept of various labour legislations in the modern organizational setting.
5HB	DSE-I & DSE-II	Human Resource Development	5th	6	75	To explore the concepts and techniques of the essential elements of HRM and to enable the students to recognise its critical issues .The course aims to understand HRM concerns.
5HC	DSE-I & DSE-II	Organisational Development	5th	6	75	The course gives an overview of the need for OD and OD practices which can develop and improve an Organization's systems and strategies leading to an optimal HRD climate.
601	CC-XIII	Computer Application in Business	6TH	6	75	To provide computer skills and knowledge for commerce students and to enhance the student understands of usefulness of information technology tools for business operations.
602	CC-XIV	Report on Project Work	6TH	6	75	This course aims at providing the general understanding of business research and the methods of business research. The course will impart learning about how to collect, analyze, present and interpret data.
6FA	DSE-III & DSE-IV	Financial Statement Analysis	6TH	6	75	The aim of this course is to provide a conceptual framework for analysis of the financial statements of a Company.
6FB	DSE-III & DSE-IV	Investment Banking & Financial Services	6TH	6	75	The objective of this paper is to know the different aspects of Investment banking, mergers and acquisition and the detailed SEBI guidelines on issue management.
6FC	DSE-III & DSE-IV	Security Analysis and Portfolio Management	6TH	6	75	The aim of this course is to provide a conceptual framework for analysis for man investor's perspective of maximizing return on investment – a sound theoretical base with examples and references related to the Indian financial system.
6MA	DSE-III & DSE-IV	Advertising and Sales Promotion	6TH	6	75	The objective of this course is to provide basic knowledge of concepts, issues, tools and techniques of advertising and sales promotion.

6MB	DSE-III & DSE-IV	Distribution and Retail Management	6TH	6	75	The objective of the course is to develop an understanding about the role of Marketing channels, distribution and retailing. The course is also designed to prepare students for positions in the retail sector or positions in the retail divisions of consulting companies.
6MC	DSE-III & DSE-IV	International Marketing	6TH	6	75	The objective of the course is to develop an understanding about the role of international Marketing.
6HA	DSE-III & DSE-IV	Training and Development	6TH	6	75	To familiarize the students with the concept and practice of training and development in the modern organizational setting.
6HB	DSE-III & DSE-IV	Human Resource Development 6HB Discipline and Grievance Management	6TH	6	75	To acquaint students with concepts of Industrial Relations and various legislations related to Labour Welfare and Industrial Relations.
6HC	DSE-III & DSE-IV	6HC Labour Welfare and Compensation	6TH	6	75	To familiarize students about concepts of performance and compensation management and how to use them to face the challenges of attracting, retaining and motivating employees to high performance.

Program Outcome and Course Outcome

(Department of Bengali) [Courses Offered: B.A. Honours in

Bengali and B.A. Program in Bengali]

Semester I
(B. A. Honours in Bengali] Bangla Sahityer Itihas (Prachin o Madhyajug)-BNGH-CC-1-1

1. To make students interested in Bengali Society, culture, literature and history of the Bengali people.
2. To create a sense of history and historical analysis about Literature among the students.
3. To make students aware about basic textual nuances of Medieval and Modern Bengali Literature.
4. To make students aware about the evolution of the history of Bengali Literature and Culture.
5. To give the idea of the inextricable interconnection between Literature and Culture.
6. To create a strong foundation of studying future course of literature
7. Studying History of Bengali Literature helps students to know about Religion, Society, Culture and development of the Bengali Literature use in the Prose , poetry , drama , short story and novel . Our vision is to see our won literature, manifestation of our nationality transformation of content, form and style of writing technique through ages and indication of future direction in literature.

Madhyajuger Kabya o Kabita-: BNG-H-CC-1-2

This course comprises of Vaishnava Padavali and Shakta Padavali and traces the transformation of society, culture and religious formations of Bengal in the medieval period of Bengal as depicted through these works of literature. This course will

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

1. help students acquire a sound foundation in the knowledge interested in Socio-economic and cultural history of medieval period of Bengal.
2. make students aware about Vaishnava and Shakta Religion and Philosophy and religious literature and social values of these times and Middle Bengali literature as such, in a socio-cultural perspective.
3. provides insights on how oral literacy documents though greatly inadequate give a sense of realization of a multi-layered hierarchy within a socio-cultural pyramid.
4. provides an understanding of the historiography and connection of the king's patronising authority and influence on a genre formation.
5. To give basic ideas about the Vaishnava Padavali & Shakta Padavali on Medieval Period to the students.
6. To make students aware about Vaishnava and Shakta Religion and Philosophy.
7. To give basic ideas about Religious Literature and Social values of this form of Literature.

Semester II (B. A. Honours in Bengali]

Bangla Sahityer Itihas(Aadhunik Yug)BNG-H-CC-2-3

Studying History of Bengali Literature helps students to know about Religion, Society, Culture and development of the Bengali Literature use in the Prose , poetry , drama , short story and novel . Our vision is to see our won literature, manifestation of our nationality transformation of content, form and style of writing technique through ages and indication of future direction in literature. Study of origin of Bengali language is the most important. Students will understand Bengali language in an historical context and they will learn how Bengali language origin from Indo-European or Aryan Family of Languages and changed over time and how it varies from situation to situation and place to place. Study of Origin of Bengali Language will also help in making the foundation of language stranger and will improve the practical and intellectual skills.

Bhasatatya o bhashabigyan: BNG-H-CC-2-4

1. Study of origin of Bengali language is the most important. Students will understand Bengali language in an historical context and they will learn how Bengali language origin from Indo-European or Aryan Family of Languages and changed over time and how it varies from situation to situation and place to place. Study of Origin of Bengali Language will also help in making the foundation of language stranger and will improve the practical and intellectual skills.

2. Student will be familiar with the aspect of the Bengali language-including sounds, words, sentences and meaning. Students will understand Bengali language in an historical context and they will learn how Bengali language changed over time and how it varies from situation to situation and place to place. Study of Linguistics will also help in making the foundation of language stranger and will improve the practical and intellectual skills.

(B. A. Honours in Bengali] Mangalkabya o Charit sahitya: BNG-H-CC-3-5

To make students interested in Socio- Economic and cultural history of medieval period of Bengal.

Chanda o Alamkar- BNG-H-CC-3-6

1. To make students aware about the importance of Rhetoric and Prosody while studying poetry.
2. To give practical lesions of Rhetoric and Prosody to students.
3. To prepare students about the ornamental use of language in constructing sentences while speaking and writing.
4. Introducing the foundation of Prosody along with the basic knowledge of Linguistics.

Unish shataker Kabi o kabya : BNG-H-CC-3-7

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

Bengali Poetry has been deeply influenced by the colonial modernism. Poets of this genre are Madhusudan Dutta, Rabindranath Tagore and Kazi Nazrul Islam to name a few. Post-colonial period has seen the emergence of poets in the modern, socialist and post-modern genre. In this course students get a comprehensive understanding about the poetry composed by the poets of such genres with a detailed knowledge of the twentieth century poetry, trends and intentions from Rabindranath to the later modern poets.

1. Reading of transformation of imagery and development of other aesthetic trends and novel notations from a colonial perspective of renaissance.
2. Understanding of semiotics in poetry through a post- colonial thread starting from the Modern poetry till late sixties.
3. Analytical observations of Drama, symbolist tendencies, the changing means of communication in satire, wit and contemporary individual voices of protest, theme and history of new experiments.

Bangla Byakaran:BNG-H-SEC-3-1

Student will be familiar with the aspect of the Bengali language-including sounds, words,sentences and meaning. Students will understand Bengali language in an historical context and they will learn how Bengali language changed over time and how it varies from situation to situation and place to place. Study of Linguistics will also help in making the foundation of language stranger and will improve the practical and intellectual skills.

Semester IV (B. A. Honours in Bengali]

Unish shataker Natak & Bish Shataker Natak: BNG-H-CC-4-8

Knowledge of different forms of drama, satire or theatre with its social background with special emphasis on contemporary political culture. Concept and impact of Proscenium theatre, folk opera, street theatre, farce and satirical dramas on women's education, practice of Sati, widow remarriage, the prevalent social traditions and customs and their imposition on the liberal individual.

Unish-Bish shataker Uponyas: BNG-H-CC-4-9

This Course deals with the Forms and features of contemporary novels,aiming at introducing the student to the analysis of a novel as a relatively long work of narrative fiction in prose and imparting a more mature understanding to the students about the challenging issues of the contemporary such as conflicts of interests between the society and the individual, the socio-cultural canopy of casteism, religious taboos, women's position in the Bengali household,environmental issues and people's struggle for socio-economic and political existence Uponyas. Introducing and analysis a novel is a relatively long work of narrative fiction in prose.

Honours Unish Bish shatakert Kabita: BNG-H-CC-4-10

1. Reading of transformation of imagery and development of other aesthetic trends and novel notations from a colonial perspective of renaissance.
1. Understanding of semiotics in poetry through a post- colonial thread starting from the Modern poetry till late sixties.

Program outcome and course outcome
(department of Bengali)courses offered:B A. Honours in Bengali
and B.A Program in Bengali

Semester V(B.A in Bengali)

Adhunik Bangla Uponyas: BNG-H-CC-5-11

This Course deals with the Forms and features of contemporary novels,

aiming at introducing the student to the analysis of a novel as a relatively long work of narrative fiction in prose and imparting a more mature understanding to the students about the challenging issues of the contemporary such as conflicts of interests between the society and the individual, the socio-cultural canopy of casteism, religious taboos, women's position in the Bengali household, environmental issues and people's struggle for socio-economic and political existence.

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A.   in Bengali]

Bangla choto golpo:BNG-H-CC-5-12

The Course introduces the student to

1. Story writing based on some plot; cinema and television script writing, dialogue writing, editing, screen play.

2. Correct pronunciation of Bengali words, rhyming and recitation 3. The inter-relation between cinema and literature.

Unish Shataker Prabandha : BNG-H-CC-5-1

This course will impart knowledge of the emergence and growth of the essay, arguments, discourses, subjective perspectives from mid-19th century and will provide a comprehensive knowledge of
1. linguistic and psychological tendencies of the 19th century, essays, categories of journalist views, reporting, personal essays, diary entries
2. the transitional phases during the World wars and other adversities which involves new experimentations in form and narratives on fascist tendencies and xenophobic attitude towards the colonised, cultural hegemony and diversity.

Tarashankar o Manik Bandyopadhyer chotogalpo:BNG-H-CC-5-2

The Course introduces the student to

1. Story writing based on some plot; cinema and television script writing, dialogue writing, editing, screen play
2. Correct pronunciation of Bengali words, rhyming and recitation

3. The inter-relation between cinema and literature

Semester VI (B. A. Honours in Bengali]

Sangskrita Hindi o Engreji Sahityer Itihas: BNG-H--CC-6-13

This course helps in learning about the evolution of literature in other Indian languages that have had a profound influence on the socio-cultural formations in India since early times and have also enriched Bengali language and literature. In this course students gain knowledge about a comprehensive knowledge of comparative analysis of the Sanskrit Literature, along with English literature and main cultural trends.

Sahityatattwa:BNG-H-CC-6-14

The course is an organised methodology for achieving a knowledge of how to interpret poems, concepts of Rhetoric and Prosody. It discusses verses and early songs, the history of the evolution of lyric poetry, ballads and experiments with different genres. The course

1. makes students aware about Indian idea of Rhetoric and Prosody, practical learning and importance of Rhetoric and Prosody while studying poetry.
2. gives them a thorough insight into the middle Bengali Language and literary culture, theories of rhetoric and prosody and analytical concept.
3. prepares students about the ornamental use of language in constructing sentences while speaking and writing, different intonations of speech.
4. introduces the foundation of Prosody along with the basic knowledge of Linguistics and the aesthetics of language while studying Prosody.
5. Enables the understanding of different opinions related to diction, syntax and language of a literary genre, history of construction of the literary theories in Poetics.

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A. ____ in Bengali]

Patrasahitya o Atmajibani: BNG-H-CC-6-3

1. This is an enriching course which enhances students' knowledge of biographies, autobiographies and travelogues as separate creative formats which may help in many career opportunities.

Lokosangskriti O Lokosahitya: BNG-H-CC-6-4

This course imparts a good knowledge of folklore, folk culture and a general overview of contemporary folk culture and history that would help students secure a broader horizon of depth and understanding to qualify for various competitive exams in Law, multimedia, Civil Service and other disciplines.

Program in Bengali

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

Semester I

Bangla sahityer Itihas o Bangla Bhasar Itihas- BAPBNGC101

1. To make students interested in Bengali Society, culture, literature and history of the Bengali people.
2. To create a sense of history and historical analysis about Literature among the students.
3. To make students aware about basic textual nuances of Medieval and Modern Bengali Literature.
4. To make students aware about the evolution of the history of Bengali Literature and Culture.
5. To give the idea of the inextricable interconnection between Literature and Culture.
6. To create a strong foundation of studying future course of literature
7. 7. Studying History of Bengali Literature helps students to know about Religion, Society, Culture and development of the Bengali Literature use in the Prose , poetry , drama , short story and novel . Our vision is to see our won literature, manifestation of our nationality transformation of content, form and style of writing technique through ages and indication of future direction in literature. Study of origin of Bengali language is the most important. Students will understand Bengali language in an historical context and they will learn how Bengali language origin from Indo-European or Aryan Family of Languages and changed over time and how it varies from situation to situation and place to place. Study of Origin of Bengali Language will also help in making the foundation of language stranger and will improve the practical and intellectual skills.
8. Student will be familiar with the aspect of the Bengali languageincluding sounds, words,sentences and meaning. Students will understand Bengali language in an historical context and they will learn how Bengali language changed over time and how it varies from situation to situation and place to place. Study of Linguistics will also help in making the foundation of language stranger and will improve the practical and intellectual skills.

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A.   in Bengali]

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A.   in Bengali]

Semester II

Chanda o Alamkar- BAPBNGC201

1. To make students aware about the importance of Rhetoric and Prosody while studying poetry.
2. To give practical lesions of Rhetoric and Prosody to students.
3. To prepare students about the ornamental use of language in constructing sentences while speaking and writing.
4. Introducing the foundation of Prosody along with the basic knowledge of Linguistics.
5. Introduce to the students about the aesthetics of language while studying Prosody.
6. To make students aware about Indian idea of Rhetoric and Prosody

Semester III

(B. A. Program in Bengali] Madhyajuger Padabali-: BAPBNGC301

This course comprises of Vaishnava Padavali and Shakta Padavali and traces the transformation of society, culture and religious formations of Bengal in the medieval period of Bengal as depicted through these works of literature. This course will

1. help students acquire a sound foundation in the knowledge interested in Socio-economic and cultural history of medieval period of Bengal.
2. make students aware about Vaishnava and Shakta Religion and Philosophy and religious literature and social values of these times and Middle Bengali literature as such, in a socio-cultural perspective.
3. provides insights on how oral literacy documents though greatly inadequate give a sense of realization of a multi-layered hierarchy within a socio-cultural pyramid.
4. provides an understanding of the historiography and connection of the king's patronising authority and influence on a genre formation.
5. To give basic ideas about the Vaishnava Padavali & Shakta Padavali on Medieval Period to the students.

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A.   in Bengali]

6. To make students aware about Vaishnava and Shakta Religion and Philosophy.
7. To give basic ideas about Religious Literature and Social values of this form of Literature.

Semester IV

Rabindranather Kabita O Adhunik Bangla Kabita-BAPBNGC401

1. Reading of transformation of imagery and development of other aesthetic trends and novel notations from a colonial perspective of renaissance.
2. Understanding of semiotics in poetry through a post- colonial thread starting from the Modern poetry till late sixties.

Semester V

Chotogalpo Udbhav o kramabikash -BAPBNGDSE501

The Course introduces the student to
1. story writing based on some plot; cinema and television script writing, dialogue writing, editing, screen play
2. correct pronunciation of Bengali words, rhyming and recitation the interrelation between cinema and literature
3. linguistic and psychological tendencies of the 19th century, essays,categories of journalist views, reporting, personal essays, diary entries the transitional phases during the World wars and other adversities which
4. involves new experimentations in form and narratives on fascist tendencies and xenophobic attitude towards the colonised, cultural hegemony and diversity.

Program Outcome and Course Outcome
(Department of Bengali) [Courses Offered: B.A. Honours in Bengali and B.A. Program in Bengali]

(B. A.   in Bengali]

Semester VI

(B. A. Program in Bengali] Unish Bish shataker Natak Uponyas o chotogalpo-BAPBNGC601

Knowledge of different forms of drama, satire or theatre with its social background with special emphasis on contemporary political culture. Concept and impact of Proscenium theatre, folk opera, street theatre, farce and satirical dramas on women's education, practice of Sati, widow remarriage, the prevalent social traditions and customs and their imposition on the liberal individual.

SUKANTA MAHAVIDYALAYA

DEPARTMENT OF ZOOLOGY

COURSE OUTCOME OF B.Sc Programme COURSE

SEMESTER	COURSE	COURSE NAME	COURSE OUTCOME
1st	DSC1	ANIMAL DIVERSITY	• By studying this student can know the various type of animal in the world, their origin and the relationship among them. • At the end of this semester student will be familiar with the major groups of animals,their similarities and differences, and their evolutionary pathways that resulted in the current numbers and varieties of animal species. • Purpose of animal diversity is to motivate and guide student observation of animal and plant similarities, diversity, and appropriateness to live in different environments; to show that stories sometimes give plants and animals attributes that they don't really have.
2nd	DSC2	COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES	• Comparative anatomy is the study of the anatomy of different species of animals. • Scientists compare the differences and similarities between the body structures and genetic information of the animals in order to study the way the animals have adapted to the environment during the periods of evolution, or, in other words, to examine how they evolved. • Developmental Biology aims to understand the processes that lead from the fertilisation of an egg cell (or equivalent) to the formation of a well-structured and functional multicellular organism .

3rd	DSC3	PHYSIOLOGY AND BIOCHEMISTRY	• Animal physiology is a branch of physiology, which is responsible for studying the biological functioning of different animal species. These analyzes can be performed at the organ level or at the cellular level • Animal physiology is the study of how animals work, and investigates the biological processes that occur for animal life to exist. These processes can be studied at various levels of organization from membranes through to organelles, cells, organs, organ systems, and to the whole animal. • Biochemistry is the study of the chemistry of living things. This includes organic molecules and their chemical reactions.so student can know about the various biomolecules that present in the living organisms and the various biochemical reaction that exist within them.
	SEC1	APICULTURE	• Apiculture is the scientific method of rearing bees for nurturing bee colonies and ensuring their livelihood in a safe and secure manner. Apiculture has different purposes, it is used for commercial, educational and reproductive purposes. • By practicing this student can self dependent in their future.
4th	DSC4	GENETICS AND EVOLUTIONARY BIOLOGY	• Genetics is a branch of biology concerned with the study of genes, genetic variation, and heredity in organisms. • By studying student can know about genetic research works towards finding the genes that cause disease. Genetic research is the study of human DNA to find out what genes and environmental factors contribute to diseases. • The importance of studying Evolutionary biology is mainly to understand the principles behind the origin and extinction of species.
	SEC2	SERICULTURE	• Sericulture plays a significant role in the rural economy of India, is not bound to just worms, but includes all activities

			related to the silk culture like mulberry cultivation and even post-cocoon technology. Today, India and China are the two main producers, with more than 60% of the world's annual production. • By studying this student has immense scope on research and development in this field, where one can obtain a Ph.D. or even a post-doctoral.
5th	DSE1	AQUATIC BIOLOGY	• By studying this student can pursue their careers in the conservation of marine and other resources, gain employment with fisheries, and undertake work in areas such as aquaculture and water quality control
	SEC3	APICULTURE	• Apiculture is the scientific method of rearing bees for nurturing bee colonies and ensuring their livelihood in a safe and secure manner. Apiculture has different purposes, it is used for commercial, educational and reproductive purposes. By practicing this student can self dependent in their future. • By practicing this student can self dependent in their future.
6th	DSE2	REPRODUCTIVE BIOLOGY	• Student gain knowledge about reproductive health.Reproductive health implies that people are able to have a responsible, satisfying, healthy reproductive system and safer sex life and that they have the capability to reproduce and the freedom to decide if, when, and how often to do so. • A good education on reproduction helps to prevent some sexually transmitted diseases like HIV, Genital herpes, gonorrhea, chlamydia, etc.
	SEC4	SERICULTURE	• Sericulture plays a significant role in the rural economy of India, is not bound to just worms, but includes all activities related to the silk culture like mulberry cultivation and even post-cocoon technology. Today, India and China are the two main producers, with more than 60% of the world's annual production. • By studying this student has immense scope on research and development in

			this field, where one can obtain a Ph.D. or even a post-doctoral.

Name of Programme	Year of Introduction	Status Implementation in CBCS Curriculum (Yes/No)	Programme Outcome	Course Outcome
Chemistry Hons.		YES	This programme will make the students eligible for understanding the various physical, chemical and biochemical processes occurring in nature. They can choose their career in various chemical, biochemical, pharmaceutical, ceramic, polymer and analytical industries by learning this programme.	**CC1**: This course provides knowledge about the structure of atoms, which gives a great insight into the entire class of chemicals and their physical properties.
				CC2: Study of this course gives ideas how ideal, real gas, solvent behaves and how structure of solid crystals can be determined. This course also gives ideas of acidity and alkalinity of electrolytic solution in terms of reaction equilibrium.
				CC3: Stereochemistry is of critical importance to drug action because the shape of a drug molecule is an important factor in determining how it interacts with the various biological molecules that encounters in the body.
				CC4: Thermodynamics gives the foundation knowledge for heat engines, power plants, chemical reactions, refrigerators, materials science and aerospace engineering etc. Students have a wide range of scope to develop their career in science and engineering areas, including physical chemistry, biochemistry,

				chemical engineering, and mechanical engineering etc.
				CC5: Study of this course is very useful for almost every sector of chemical industry including catalysis, materials science, medicine and polymer industry.
				CC6: Organic chemistry plays a part in the development of common household chemicals, medicine, foods, drugs and fuels most of the chemicals part of daily life.
				CC7: This course gives ideas about why some reactions are slow and fast, how catalysts alter the rate of a reaction without changing equilibrium constant. Study of phase behaviors of one and two components systems gives knowledge tapes of phase present different temperature and pressure.
				SEC1: Studying pharmaceutical chemistry allows students to contribute to life-saving remedies, enhance the speed of new medications and help others.
				CC8: This course gives a detailed discussion about co-ordination compounds which have important roles in industrial catalysts in controlling reactivity and in essential biochemical processes.

				CC9: The heterocyclic compounds have critical importance for medicinal chemists, because using them, it is possible to expand the available drug-like chemical space and drive more effective drug discovery programs.
				CC10: This course helps to understand the driving force of a redox chemical reaction and how it changes with different conditions. By studying the properties like Electric, Magnetic and conductivity of atoms, molecules and ions help to understand the physical properties of compounds.
				SEC2: Green chemistry aims to design and produce cost-competitive chemical products and processes that attain the highest level of the pollution prevention hierarchy environment pollution at its source.
				CC11: This course helps to learn synthesis of many important organic compounds using light and heat. Students also get knowledge in this course how catabolism and anabolism and enzymes work in different living bodies.
				CC12: This course is the bridge between microscopic and macroscopic properties of molecules that help to know how properties

				change from small quantity to ensemble average quantity. Spectroscopy part is used to quantitatively measure the different physical properties of a molecule.
				DSE1: This course provides the idea about quantitative analysis of different inorganic and industrial and agriculture chemicals.
				DSE2: This course provides a clear idea about industrial chemicals and development of thousands of new and improved synthetic fibers, paints, adhesives, cosmetics, electronic components, lubricants and other products.
				CC13 : This course enables the students to develop chemical analytical skills to measure quantitatively inorganic compounds and also provides a clear idea about the effect of catalysts on a reaction mechanism.
				CC14: Spectroscopy is used as a tool for studying the structures of atoms and molecules, and carbohydrates serve as energy sources and essential structural components in organisms.

				DSE3: This course will help to understand the physical, chemical properties and synthesis techniques of polymer compounds. Understanding of Kinetics Mechanism will help to control the length of polymer compound and suitable materials design.
				DSE4: This course helps to build a great career opportunity in industrial chemists including agriculture, medicine, energy, and the environment. Students can learn the ideas to manage the different harmful chemicals for lower potential for global warming, ozone depletion, smog formation, chemical disruption of ecosystems, water pollution and air pollution.
Chemistry Programme			This programme will make the students eligible for understanding the various physical and chemical processes occurring in nature. They can choose their career in various chemical, pharmaceutical and analytical	DSC1: This course includes fundamentals of organic chemistry, stereochemistry as well as some name reactions which is essential for the comprehension of almost all aspects of modern organic chemistry. In another section the course provides knowledge about the structure of atoms, which gives a great insight into the entire class of chemicals and their physical properties.
				DSC2: This course helps to predict the outcome and mechanism of some

				industries by learning this programme.	simple organic reaction using a basic understanding of relative reactivity of functional groups. In another section students learn basic thermodynamics that help to predict natural occurring physical and chemical processes.
					DSC3: This course includes carbohydrates, amino acids, peptides, proteins, carboxylic acids which help students to understand about properties of such molecules and their synthesis process. In other section students get knowledge phase diagrams, conductive properties of electrolytes and electrochemical processes that help to understand physical and chemical properties of matter.
					DSC4: This course gives a detailed discussion about co-ordination compounds which have important roles in industrial catalysts in controlling reactivity and in essential biochemical processes. In other sections students get knowledge about solid, liquid and gaseous state.
					GE1: : This course includes fundamentals of organic chemistry, stereochemistry as well as some name reactions which is essential for the comprehension of almost

				all aspects of modern organic chemistry. In another section the course provides knowledge about the structure of atoms, which gives a great insight into the entire class of chemicals and their physical properties.
				GE2: This course helps to predict the outcome and mechanism of some simple organic reaction using a basic understanding of relative reactivity of functional groups. In another section students learn basic thermodynamics that help to predict natural occurring physical and chemical processes
				GE3: This course includes carbohydrates, amino acids, peptides, proteins, carboxylic acids which help students to understand about properties of such molecules and their synthesis process. In other section students get knowledge phase diagrams, conductive properties of electrolytes and electrochemical processes that help to understand physical and chemical properties of matter.
				GE4: This course gives a detailed discussion about co-ordination compounds which have important roles in industrial catalysts in controlling reactivity

				and in essential biochemical processes. In other sections students get knowledge about solid, liquid and gaseous state.
				SEC1 (DSC): Studying pharmaceutical chemistry allows students to contribute to life-saving remedies, enhance the speed of new medications and help others.
				SEC2 (DSC): Green chemistry aims to design and produce cost-competitive chemical products and processes that attain the highest level of the pollution prevention hierarchy environment pollution at its source.
				DSE1 (DSC) : This course provides a clear idea about industrial chemicals and development of thousands of new and improved synthetic fibers, paints, adhesives, cosmetics, electronic components, lubricants and other products.
				SEC3 (DSC) : Students get the knowledge regarding how to increase agriculture productivity by protecting crops from pests, diseases and weeds with use of pesticide. It provide the awareness on Acute effects (rashes, nausea, diarrhea etc) and Chronic effects as (cause birth defects, cancers, neurological harm, reproductive harm) at the using time of Pesticide.

				DSE2 (DSC): This course helps to build a great career opportunity in industrial chemists including agriculture, medicine, energy, and the environment. Student can learn the ideas to management the different harmful chemical for lower potential for global warming, ozone depletion, smog formation, chemical disruption of ecosystems water pollution and air pollution.
				SEC4 (DSC): Learning this course students have chances to get a job in a perfume company as perfume chemists to focus on fragrance production. To know how we enhance our appearance and boost our self-esteem through cleaning and make-up the beauty by using of cosmetic and perfume.

Department of Computer Science

Sukanta Mahavidyalaya

Dhupguri, Jalpaiguri

Programme Outcomes, Programme Specific Outcomes
and Course Outcomes for UG Programme

Programme Name: *B.Sc Computer Science program*

Number of Semesters: 6

Programme Outcomes

The Computer Science Department's Bachelor of Computer Science Program course must enable students to attain, by the time of graduation:

- With the B.Sc. Computer Science, students will be able to apply for a range of computational and mathematical jobs in the creative industries, business, finance, education, medicine, engineering and science.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Provide students with knowledge, general competence, and analytical skills in Computer Science on an advanced level.
- Prepare them for academics, industry, and research.
- Provide hands-on experience to apply computing skills in all other fields of study like Mathematics, Geography, Bio Sciences, Physics, Chemistry, Linguistics, Music, Medical Sciences etc.

Programme Specific Outcomes

Students will:

- Become technology-oriented with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society as a whole.
- Acquire some development experience within a specific field of Computer Science, through project work.
- Gain ability to apply knowledge of Computer Science to the real-world issues.
- Get familiar with current research trends in various fields of Computer Science.
- Use creativity, critical thinking, analyses and research skills.
- Get prepared for placement by developing personality and soft skills.
- Gain ability to communicate scientific information in a clear and concise manner.
- Build up programming, analytical and logical thinking abilities.
- Know the recent developments in IT, future possibilities and limitations, and understand the value of lifelong learning.
- Get an ability to participate in debates, discussions in the society constructively.

Course Outcomes

SEMESTER—I		
Course Code	Course Name	Course Outcomes
CC 1	Computer System Architecture	Knowledge gained: • Understand the theory and architecture of hardwired and microprogram controlled central processing units

- Learn the concepts of parallel processing, pipelining and inter-processorcommunication.
- Define different number systems, binary addition and subtraction, 2'scomplement representation and operations

Skills gained:
- Analyze some of the design issues in terms of speed, technology, cost,performance
- Design a simple CPU with applying the theoretical concepts
- Understand the architecture and functionality of central processing unit

Competency developed:
- Use appropriate tools to design verify and test the CPU architecture.
- Exemplify in a better way the I/O and memory organization.

Semester II		
Course Code	Course Name	Course Outcomes
CC 2	**Programming Fundamentals using C**	Knowledge gained: • Understanding a functional hierarchical code organization. • Ability to define and manage data structures based on problem subject domain. • Ability to work with textual information, characters and strings. • Ability to work with arrays of complex objects. • Understanding a concept of object thinking within the framework of functional model. • Understanding a concept of functional hierarchical code organization. • Understanding a defensive programming concept. Ability to handle possible errors during program execution. Skills gained: • Logical thinking • C Programming Competency developed: • Ability to write programs of moderate complexity in C Programming • Developing real world application using C Programming
CC 2L	**Programming Fundamentals using C Lab**	Knowledge gained: • This lab work provides hands-on experience for C Programming. • Read, understand and trace the execution of programs written in C language. • Write the C code for a given algorithm. • Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor. • Write programs that perform operations using derived data types Skills gained: • Programming in C Competency developed: Developing application to solve real world problem using C

Semester III		
Course Code	**Course Name**	**Course Outcomes**
CC 3	**Computer Networks**	Knowledge gained: • Basic networking concepts, types of networks, various topologies andapplication of networks • types of addresses, data communication. • wired and wireless networks, its types, functionality of layer • importance of network security and cryptography • concept of networking models, protocols, functionality of each layer Skills gained: • Learn basic networking hardware and tools. • Create hybrid topologies using the existing topologies, and checkefficiency. • Apply different encoding and decoding mechanisms involved in different types of transmission media and to measure the transmission impairments. Competency developed: • Create a new protocol and test its efficiency. • Design various categories of networks and test thetransmission rate.
SEC 1	**Office Automation Tools**	Knowledge gained: • 0ffice Automation tools course would enable the students in crafting professional word documents, excel spread sheets, power point presentations using the Microsoft suite of office tools. • To familiarize the students in preparation of documents and presentations with office automation tools. Skills gained: • to perform documentation • to perform accounting operations • to perform presentation skills
Semester IV		
Course Code	**Course Name**	**Course Outcomes**
CC 4	**Data Structures**	Knowledge gained: • Describe how arrays, records, linked structures, stacks, queues, trees, andgraphs are represented in memory and used by algorithms • Describe common applications for arrays, records, linked structures,stacks, queues, trees, and graphs • Write programs that use arrays, records, linked structures, stacks, queues,trees, and graphs • Demonstrate different methods for traversing trees • Illustrate various technique to for searching, Sorting and hashing • Describe the concept of recursion, give examples of its use, describe

		howit can be implemented using a stack • Discuss the computational efficiency of the principal algorithms forsorting, searching, and hashing. • Summarize different categories of data Structures Skills gained: • Compare alternative implementations of data structures with respect toperformance • Compare and contrast the benefits of dynamic and static data structuresimplementations • Explain the significance of dynamic memory management Techniques • Identify different parameters to analyze the performance of an algorithm. Competency developed: • Choose appropriate data structures to solve real world problemsefficiently. • Design and implement an appropriate hashing function for an application • Design algorithms to perform operations with Linear and Nonlinear data structures
CC 4L	Data Structures Lab	Knowledge gained: • Write programs using structures, unions, dynamic memory allocation functions and command line arguments • Implement code for linear data structures like stacks, queues, linked listsusing static and dynamic allocation and their applications • Implement program for binary search tree using nonlinear data structure. • Write programs using arrays, strings, dynamic memory allocation functions • Implement program for binary search tree and Graphs using nonlinear data structure. Skills gained: • Programming real life application in C/C++ Competency developed: • Understand and choose the appropriate data structure for solving real world problems.
SEC 2	HTML Programming	Knowledge gained: • To introduce the fundamentals of Internet, and the principles of web design. • To construct basic websites using HTML and Cascading Style Sheets. • To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms. • To develop modern interactive web applications using PHP, XML and MySQL Competency developed: • To learn HTML tags and JavaScript Language programming concepts and techniques.

		• To develop the ability to logically plan and develop web pages. • To learn to write, test, and debug web pages using HTML and JavaScript.

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Semester V

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Course Code	CourseCode	CourseCode
DSE 1A	**Data Base Management Systems**	Knowledge gained: • Types of databases • Detailed architecture, define objects, load data, query data andperformance tune databases. • Writing SQL queries for the given problem statement Skills gained: • Establish a basic understanding of the process of Database • Develop ER diagram for representing conceptual data model • Convert ER diagram into a set of relations representing logical data model Competency developed: • Gain ability to handle large volumes of structured, semi-structured, andunstructured data using database technologies. • Appreciate the need for DB approach and understand the components androles of DBMS • Apply DB system development life cycle to business problems • Implement a set of relations in the chosen DBMS • Development and Administration using MySQL. • Analyze and Select storage and recovery techniques of database system. Competency developed: • Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
	Operating Systems	Knowledge gained: • To understand Complexity of Operating system as a software • To understand design issues related to process management and variousrelated algorithms • To understand design issues related to memory management and variousrelated algorithms • To understand design issues related to File management and variousrelated algorithms • Allocate Main Memory based on various memory managementtechniques • Compare Memory allocation using Best fit, Worst fit, and first fit policies • Apply page replacement policies for dynamic memory management • Schedule CPU time using scheduling algorithm for processors • Compare various device scheduling algorithms Skills gained: • To evaluate, and compare OS components through instrumentation forperformance analysis. • To analyze the various device and resource management techniques fortimesharing and distributed systems

		Competency developed: • To design and understand the following OS components: System calls, Schedulers, Memory management systems, Virtual Memory and Pagingsystems. • To develop and analyze simple concurrent programs using transactionalmemory and message passing, and to understand the trade-offs and implementation decisions
SEC 3	**Visual Basic Programming**	Knowledge gained: • This course provides the skills and knowledge required to use essential features and capabilities of Visual BASIC, a programming system used to produce Graphical User Interfaces and applications in a Windows environment. • It includes basic programming concepts, problem solving, programming logic, and the design of event-driven programming. Competency developed: • The student will demonstrate knowledge of visual programming • The student will demonstrate knowledge of program design • The student will apply and synthesize knowledge of user interface design • The student will demonstrate understanding and application of a modern Integrated Development Environment (IDE) • The student will demonstrate the ability to synthesize knowledge of fundamental computer programming • The student will demonstrate the ability to analyze program development and maintenance

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Semester VI

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Course Code	CourseCode	CourseCode
DSE 1B	**Project Work**	Knowledge gained: • Identify and define the problem statement • Define and justify scope of the proposed problem • Gather and analyze system requirements • Propose an optimized solution among the existing solutions • Practice software analysis and design techniques • Develop a functional application based on the software design • Apply coding, debugging and testing tools to enhance the quality ofthe software • Construct new software system based on the theory and practice gained through this exercise • Prepare the proper documentation of software projects following the standard guidelines • Develop technical report writing and oral presentation Skills gained: • Software Project Development

		Competency developed: • Professional Software Developer
SEC 4	**My SQL**	Knowledge gained: • Understand basic concepts of how a database stores information via tables. • Understand SQL syntax used with MySQL. • Learn how to retrieve and manipulate data from one or more tables. • Learn how to filter data based upon multiple conditions. • Update and insert data into the existing tables. • Understand how the relationships between tables will affect the SQL. • Understand the advantages of stored procedures along with storing data using variables and functions. • Boost ability through innovative and independent learning. • Get a certificate on successful completion of the course. Competency developed: • Gain familiarity with the MySQL development environment • Understand basic concepts of database development: SQL, Database design, Administration, and Security • Design and code a database solution

Department of Computer Science

Sukanta Mahavidyalaya

Dhupguri, Jalpaiguri

Programme Outcomes, Programme Specific Outcomes
and Course Outcomes for UG Programme

Programme Name: *B.Sc Computer Science Honours*

Number of Semesters: 6

Programme Outcomes

The Computer Science Department's Bachelor of Computer Science Honours course must enable students to attain, by the time of graduation:

- With the B.Sc. Computer Science, students will be able to apply for a range of computational and mathematical jobs in the creative industries, business, finance, education, medicine, engineering and science.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Provide students with knowledge, general competence, and analytical skills in Computer Science on an advanced level.
- Prepare them for academics, industry, and research.
- Provide hands-on experience to apply computing skills in all other fields of study like Mathematics, Geography, Bio Sciences, Physics, Chemistry, Linguistics, Music, Medical Sciences etc.

Programme Specific Outcomes

Students will:

- Become technology-oriented with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society as a whole.
- Acquire some development experience within a specific field of Computer Science, through project work.
- Gain ability to apply knowledge of Computer Science to the real-world issues.
- Get familiar with current research trends in various fields of Computer Science.
- Use creativity, critical thinking, analyses and research skills.
- Get prepared for placement by developing personality and soft skills.
- Gain ability to communicate scientific information in a clear and concise manner.
- Build up programming, analytical and logical thinking abilities.
- Know the recent developments in IT, future possibilities and limitations, and understand the value of lifelong learning.
- Get an ability to participate in debates, discussions in the society constructively.

Course Outcomes

SEMESTER—I		
Course Code	**Course Name**	**Course Outcomes**
CC 12	**Programming Fundamentals using C**	Knowledge gained: • Understanding a functional hierarchical code organization. • Ability to define and manage data structures based on problem subject domain. • Ability to work with textual information, characters and strings. • Ability to work with arrays of complex objects. • Understanding a concept of object thinking within the framework of functional model. • Understanding a concept of functional hierarchical code organization. • Understanding a defensive programming concept. Ability to handle possible errors during program execution.

		Skills gained: • Logical thinking • C Programming Competency developed: • Ability to write programs of moderate complexity in C Programming • Developing real world application using C Programming
CC 13	**Computer System Architecture**	Knowledge gained: • Understand the theory and architecture of hardwired and microprogram controlled central processing units
		• Learn the concepts of parallel processing, pipelining and inter-processor communication. • Define different number systems, binary addition and subtraction, 2's complement representation and operations Skills gained: • Analyze some of the design issues in terms of speed, technology, cost, performance • Design a simple CPU with applying the theoretical concepts • Understand the architecture and functionality of central processing unit Competency developed: • Use appropriate tools to design verify and test the CPU architecture. • Exemplify in a better way the I/O and memory organization.
CC 12L	**Programming Fundamentals using C Lab**	Knowledge gained: • This lab work provides hands-on experience for C Programming. • Read, understand and trace the execution of programs written in C language. • Write the C code for a given algorithm. • Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor. • Write programs that perform operations using derived data types Skills gained: • Programming in C Competency developed: • Developing application to solve real world problem using C
CC 13L	**Computer System Architecture Lab**	Knowledge gained: • Analyze the behaviour of logic gates • Understanding the behavior of Logic Gates, Adders, Decoders, Multiplexers, Demultiplexer, Encoder, Decoder and Flip-Flops. • Design combinational circuits for basic components of computer system and applications. • Analyze the operational behaviour and implement various flip-flop, registers, Counters.

Semester II		
Course Code	**Course Name**	**Course Outcomes**
CC 22	**Programming in JAVA**	Knowledge gained: • This lab work provides hands-on for Java. Java Programming assignments based on class, inheritance, abstraction, encapsulation, dynamic binding, polymorphism, I/O systems, exception handling Skills gained: • Programming in Java Competency developed:

		Skills gained: • Programming in Java Competency developed: • Developing application to solve real world problem using Java • Implement core Java programs to solve simple problems • Implement Client and Server end Java programs Knowledge gained
CC 23	**Discrete Structures**	Knowledge gained: • basics of Combinations and Permutations • relations matrices and graphs. Skills gained: • Mathematical and logical thinking towards a real world problem solving • Mathematical modelling of real world problems • Demonstrate the working of Grammars and Languages Competency developed: • Comprehend and evaluate mathematical arguments revolving around computation • Apply the knowledge on Graphs and Trees to real world applications.
CC 22L	**Programming in JAVA Lab**	Knowledge gained: • This lab work provides hands-on for Java. • Java Programming assignments based on class, inheritance, abstraction, encapsulation, dynamic binding, polymorphism, I/O systems, exceptionhandling Skills gained: • Programming in Java Competency developed:

| | | • Developing application to solve real world problem using Java |
| | | • Implement core Java programs to solve simple problems Implement Client and Server end Java programs Knowledge gained. |

Semester III

Course Code	Course Name	Course Outcomes
CC 31	**Data Structures**	Knowledge gained: • Describe how arrays, records, linked structures, stacks, queues, trees, andgraphs are represented in memory and used by algorithms • Describe common applications for arrays, records, linked structures,stacks, queues, trees, and graphs • Write programs that use arrays, records, linked structures, stacks, queues,trees, and graphs • Demonstrate different methods for traversing trees • Illustrate various technique to for searching, Sorting and hashing • Describe the concept of recursion, give examples of its use, describe howit can be implemented using a stack • Discuss the computational efficiency of the principal algorithms forsorting, searching, and hashing. • Summarize different categories of data Structures Skills gained: • Compare alternative implementations of data structures with respect toperformance • Compare and contrast the benefits of dynamic and static data structuresimplementations • Explain the significance of dynamic memory management Techniques • Identify different parameters to analyze the performance of an algorithm. Competency developed: • Choose appropriate data structures to solve real world problems efficiently. • Design and implement an appropriate hashing function for an application • Design algorithms to perform operations with Linear and Nonlinear data structures
CC 32	**Operating Systems**	Knowledge gained: • To understand Complexity of Operating system as a software • To understand design issues related to process management and various related algorithms • To understand design issues related to memory management and various related algorithms • To understand design issues related to File management and various related algorithms • Allocate Main Memory based on various memory management techniques • Compare Memory allocation using Best fit, Worst fit, and first fit policies • Apply page replacement policies for dynamic memory management • Schedule CPU time using scheduling algorithm for processors • Compare various device scheduling algorithms

		Skills gained:
		• To evaluate, and compare OS components through instrumentation for performance analysis. • To analyze the various device and resource management techniques for timesharing and distributed systems Competency developed: • To design and understand the following OS components: System calls, Schedulers, Memory management systems, Virtual Memory and Paging systems. • To develop and analyze simple concurrent programs using transactional memory and message passing, and to understand the trade-offs and implementation decisions
CC 33	**Computer Networks**	Knowledge gained: • Basic networking concepts, types of networks, various topologies andapplication of networks • types of addresses, data communication. • wired and wireless networks, its types, functionality of layer • importance of network security and cryptography • concept of networking models, protocols, functionality of each layer Skills gained: • Learn basic networking hardware and tools. • Create hybrid topologies using the existing topologies, and checkefficiency. • Apply different encoding and decoding mechanisms involved in different types of transmission media and to measure the transmission impairments. Competency developed: • Create a new protocol and test its efficiency. • Design various categories of networks and test thetransmission rate.
CC 31L	**Data Structures Lab**	Knowledge gained: • Write programs using structures, unions, dynamic memory allocation functions and command line arguments • Implement code for linear data structures like stacks, queues, linked listsusing static and dynamic allocation and their applications • Implement program for binary search tree using nonlinear data structure. • Write programs using arrays, strings, dynamic memory allocation functions • Implement program for binary search tree and Graphs using nonlinear data structure. Skills gained: • Programming real life application in C/C++ Competency developed: Understand and choose the appropriate data structure for solving realworld problems.

CC 32L	Operating Systems Lab	• Understand basic commands of Linux operating system and use them in Linux environment (ubuntu, fedora etc.) • Understand commands related to process control and apply them to manage processes. • Understand the concepts of control structure, loops, case and functions in shell programming and apply them to create shell scripts. • Associate the concepts of arrays with Linux and apply them to create, compile and execute shell script in Linux terminal • Compare different editors (vi, gedit, nano) and use them to create shell script for given problem • To understand the inner workings of UNIX-like operating systems.
CC 33L	Computer Networks Lab	• Understand the practical approach to network communication protocols. • Understand network layers, structure/format and role of each network layer. • Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission. • Understand the various Routing Protocols/Algorithms and Internetworking.
SEC 35T L	E1: Digital Electronics and System Maintenance	• An ability to understand theory of Digital Design and Computer Organization to provide an insight of how basic computer components are specified. • An ability to understand the functions of various hardware components and their building blocks. • An ability to understand and appreciate Boolean algebraic expressions to digital design • An in depth understanding of realization of different combinational/sequential circuits • An in depth understanding of how different hardware components are related and work in coordination • An ability to understand computer buses and input/output peripherals
	E2: Website Design with HTML and PHP	Knowledge gained: • Learn Core-PHP, Server Side Scripting Language • Learn PHP-Database handling. • Learn different technologies used at client Side Scripting Language • Learn XML, CSS and XML parsers. • One PHP framework for effective design of web application. • Learn JavaScript to program the behavior of web pages. Skills gained: • Design and Develop Web Applications using HTML,CSS, JavaScript, XML, PHP. Competency developed: • Developing application to solve real world problems

	E3: Python Programming	Knowledge gained: • To understand why Python is a useful scripting language for developers. • To learn how to use lists, tuples, and dictionaries in Python programs. • To learn how to identify Python object types. • To learn how to use indexing and slicing to access data in Pythonprograms. • To define the structure and components of a Python program. • To learn how to write loops and decision statements in Python. • To learn how to write functions and pass arguments in Python. • To learn how to build and package Python modules for reusability. • To learn how to read and write files in Python. • To acquire programming skills in core Python. Skills gained: • Learn how to design and program Python applications. Competency developed: • To develop the ability to write database applications in Python • To develop the skill of designing Graphical user Interfaces in Python
		Semester IV
Course Code	**Course Name**	**Course Outcomes**
CC 41	**Design and Analysis of Algorithms**	Knowledge gained: • Analyze the running time and space complexity of algorithms. • Describe, apply and analyze the complexity of divide and conquer strategy. • Describe, apply and analyze the complexity of greedy strategy. • Describe, apply and analyze the complexity of dynamic programming strategy. • Explain and apply backtracking, branch and bound and string matching techniques to deal with some hard problems. • Describe the classes P, NP, and NP Complete and be able to prove that acertain problem is NP-Complete. • Describe analysis techniques for algorithms. • Identify appropriate data structure and design techniques for differentproblems • Identify appropriate algorithm to be applied for the various application likegeometric modeling, robotics, networking, etc. • Appreciate the role of probability and randomization in the analysis ofalgorithm • Differentiate polynomial and non-deterministic polynomial algorithms. Skills gained: • To provide mathematical approach for Analysis of Algorithms • To solve problems using various strategies • To provide mathematical approach for Analysis of Algorithms.

		• To teach advanced data structures. • To solve complex problems in real life applications. Competency developed: • To analyze strategies for solving problems not solvable in polynomial time Analyze various algorithms.
CC 42	**Software Engineering**	Knowledge gained: • Learn the phases of software development • Develop process models and process system models • Gather, understand, analyze and specify requirements • Elicit, analyze and model requirements • Schedule projects, identify risk strategies and manage risks. • Understanding importance of Object Orientation in Software engineering • Understand the components of Unified Modeling Language • Develop architectural diagram, and implement by following coding principles • Estimate software scope feasibility and resources • Identify and apply SQA tasks, goals, and metrics Skills gained: • To develop strategies to calculate risk factors involved in IT projects • To use project management software to control the design, implementation, closure, and evaluation of IT projects • To estimate, plan, calculate, and adjust project variables. Competency developed: • Apply project management practices to launch new programs, initiatives, products, services, and events relative to the needs of stakeholders. • Apply Agile process model for Software Development Apply testing strategies and handle software product maintenanceissues
CC 43	**Database Management Systems**	Knowledge gained: • Types of databases • Detailed architecture, define objects, load data, query data and performance tune databases. • Writing SQL queries for the given problem statement Skills gained: • Establish a basic understanding of the process of Database • Develop ER diagram for representing conceptual data model • Convert ER diagram into a set of relations representing logical data model Competency developed: • Gain ability to handle large volumes of structured, semi-structured, and unstructured data using database technologies. • Appreciate the need for DB approach and understand the components and roles of DBMS • Apply DB system development life cycle to business problems • Implement a set of relations in the chosen DBMS • Development and Administration using MySQL.

		• Analyze and Select storage and recovery techniques of database system. Competency developed: • Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
SEC 45TL	**E1: Android Programming**	Knowledge gained: • Pass data between fragments • To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment. • An ability to use the techniques, skills, and modern technology. Skills gained: • Debug android apps and create UI fragments • Create database and communicate with mobile apps Competency developed: • Design apps with audio play back. • To develop the different applications that mobile computing offers to people, employees, and businesses To develop high levels of technical competence in the field of mobiletechnology
	E2: Programming in MATLAB	Knowledge gained: • Able to implement loops, branching, control instruction and functions in MATLAB programming environment. • Able to program curve fitting, numerical differentiation and integration, solution of linear equations in MATLAB and solve electrical engineering problems. • Able to understand implementation of ODE using ode 45 and execute Solutions of nonlinear equations and DFT in MATLAB. • Able to simulate MATLAB Simulink examples Skill gained: • Apply a top-down, modular, and systematic approach to design, write, test, and debug sequential MATLAB programs to achieve computational objectives. • Design and document computer programs and analyses in a careful and complete manner so as to effectively communicate results, to facilitate evaluation and debugging by another programmer, and to anticipate and resolve user errors. Competency developed: • Fundamentals of MATLAB tool. • Program curve fitting & solve Linear and Nonlinear Equations. • Demonstrate understanding and use of fundamental data structures (classes). • Create and control simple plot and user-interface graphics objects in MATLAB.
	E3: VB.NET Programming	Knowledge gained: • Understand .NET Framework and describe some of the major enhancements to the new version of Visual Basic. • Describe the basic structure of a Visual Basic.NET project and use main features of the integrated development environment (IDE) • Create applications using Microsoft Windows Forms • Create applications that use ADO. NET

		Skill developed:
		- Create a rich GUI for web-based application using a rich set of controls - Create secure (authentication and authorization) web applications - Create asynchronous web applications using ASP.NET - Create and use web services - Deploy web applications Competency developed: - Analyze program requirements - Design/develop programs with GUI interfaces - Code programs and develop interface using Visual Basic .Net - Perform tests, resolve defects and revise existing code

Semester V

Course Code	CourseCode	CourseCode
CC 51	Internet Technologies	Knowledge gained: - Learn Core-PHP, Server Side Scripting Language - Learn PHP-Database handling. - Learn different technologies used at client Side Scripting Language - Learn XML,CSS and XML parsers. - One PHP framework for effective design of web application. - Learn JavaScript to program the behavior of web pages. - Learn AJAX to make our application more dynamic. Skills gained: - Design and Develop Web Applications using Node.js, Express.js,AngularJS - Create and connect MongoDB to web application - Connect Mongoose to MongoDB - Create a MEAN CRUD Module for web application Competency developed: Developing application to solve real world problems
CC 52	Theory of Computation	Knowledge gained: - To have an understanding of finite state and pushdown automata. - To have a knowledge of regular languages and context free languages. - Recognize to which class in the Chomsky hierarchy the language described (by a grammar or machine) belongs Skills gained: - Define the various categories of languages and grammars in the Chomsky hierarchy - Define various categories of automata (deterministic and nondeterministic finite state automata, and variants of Turing machines) - Define the notions of computability and decidability - Recognize problems reducible to/from well-known decidable/undecidable problems - Reduce a problem to another (when possible), to develop proofs of decidability/undecidability; - Apply Rice's theorem, when appropriate

		Competency developed: • Derive an appropriate machine description from a grammar, and vice versa; • Design a Turing machine that accomplishes a specific task, using macros when appropriate. • A Infer properties of a language from a grammar or machine description; Infer the equivalence of languages described using different grammars or machines.
DSE 53	**E1: Microprocessor**	Knowledge gained: • Understand the architecture of 8085 and 8086. • Impart the knowledge about the instruction set. • Understand the basic idea about the data transfer schemes and its applications. • Develop skill in simple program writing for 8085 & 8086 and applications. Skill gained: • Develop skill in simple program writing for INTEL 8085 and INTEL 8086. • become familiar with the architecture and the instruction set of Intel microprocessors/ microcontrollers. Competency developed: • Describe the Intel 8085/8086 architecture with explanation of internal organization of some popular microprocessors/microcontrollers. • Construction of a maintainable assembly language program for an algorithm. • Conclude the Intel 8085/8086 real mode memory addressing. • Describe the functioning of different peripheral ICs analyze • Designing of microprocessors/microcontrollers-based systems.
	E2: Information Security	Knowledge gained: • Exhibit knowledge to secure corrupted systems, protect personaldata, and secure computer networks in an Organization. Practice with an expertise in academics to design and implement security solutions. • Understand key terms and concepts in Cryptography, Governanceand Compliance. • Develop cyber security strategies and policies • Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks throughcyber/computer forensics software/tools. Skills gained: • Analyze and evaluate the cyber security needs of an organization. • Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation. • Measure the performance and troubleshoot cyber security systems. Competency developed: • Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools. • Comprehend and execute risk management processes, risk treatment

		methods, and key risk and performance indicators • Design and develop security architecture for an organization. • Design operational and strategic cyber security strategies andpolicies.
	E3: Modelling and Simulation	Knowledge gained: • Understand the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems through available software. • Learn different types of simulation techniques. • Learn to simulate the models for the purpose of optimum control by using software Skills gained: • Grasp modeling concepts with emphasis on performance analysis. • Build simulation models and their parameterization. • Analyze simulation output data to evaluate performance criteria Competency developed: • Grasping modeling concepts using mean value analysis with some information technology applications. • Grasping how to build appropriate simulation models together with their parameterization and the analysis of simulator output data.
DSE 54	**E1: Operational Research for Computer Science**	Knowledge gained: • Identify and develop operational research models from the verbal description of the real system. • Understand the mathematical tools that are needed to solve optimization problems. • Use mathematical software to solve the proposed models. • Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in computer science. Skills gained: • Building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints. Competency developed: • Enabled the student to understand and analyze managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively.
	E2: Combinatorial Optimization	Knowledge gained: • The student knows the theory of combinatorial optimization problems Skills gained: • The student can formualate a combinatorial optimization problem efficiently model industrial planing problems in terms of combinatorial optimization

		Competency developed:
		• The student can explain how fast a combinatorial optimization problem can be solved explain the mathematical theory underlying algorithms for combinatorial optimization
	E3: Numerical Methods	Knowledge gained:
		• Adequate exposure to learn alternative methods and analyze mathematical problems to determine the suitable numerical techniques.
		• Use the concepts of interpolation, eigen value problem techniques for mathematical problems arising in various fields.
		• Demonstrate elementary programming language, implementation of algorithms and computer programs to solve mathematical problems.
		Skills gained:
		• Solve initial value and boundary value problems which have great significance in engineering practice using ordinary and partial differential equations.
		Competency developed:
		• It is used for solving a system of equations
		• It has application in all branches of engineering.
		• To know how to find the roots of transcendental equations.
		• To learn how to interpolate the given set of values
		• To understand the curve fitting for various polynomials
		• To learn numerical solution of differential equations

Semester VI

Course Code	CourseCode	CourseCode
CC 61	**Artificial Intelligence**	Knowledge gained: • Understand concept of knowledge representation and predicatelogic and transform the real life information in different representation. • Understand state space and its searching strategies. • Understand machine learning concepts and range of problems thatcan be handled by machine learning. • Understand the numerous applications and huge possibilities in thefield of AI

		Skills gained:
		- To analyze and formalize the problem as a state space, graph,design heuristics - Ability to represent solutions for various real-life problem domainsusing logicbased techniques - Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques - Apply these techniques in applications which involve perception, reasoning and learning - Use different machine learning techniques to design AI machineand enveloping applications for real world problems. - Develop knowledge of decision making and learning methods. Competency developed: - Analyze and design a real world problem for implementation and understand the dynamic behavior of a system - Ability to express the ideas in AI research and programming language related to emerging technology. Apply the machine learning concepts in real life problems.
CC 62	Computer Graphics	Knowledge gained: - Learn the concepts of projections, viewing and graphics pipeline Skills gained: - Develop line and circle generation algorithms Competency developed: - Apply 2D and 3D transformations Develop clipping algorithms for point, line and polygons
DSE 63	E1: Digital Image Processing	Knowledge gained: - Analyze general terminology of digital image processing. - Describe and explain basic principles of digital image processing. - To study the image fundamentals and mathematical transforms necessary for image processing. - Examine various types of images, intensity transformations andspatial filtering. - Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression. - Evaluate the methodologies for image segmentation, restoration etc. - Learn the signal processing algorithms and techniques in image enhancement and image restoration, and image compression procedures. - Implement image process and analysis algorithms. - Understand the rapid advances in Machine vision. - Learn different causes for image degradation and overview of image restoration techniques. - Learn different feature extraction techniques for image analysis and recognition - Understand and analyze image processing problems - Understand the role of alternative color spaces, and the design requirements leading to choices of color space. Skills gained: - Get broad exposure to and understanding of various applications ofimage processing in industry, medicine, and defence. - Design algorithms to solve image processing problems and meetdesign

		specifications.
		• Be able to conduct independent study and analysis of image processing problems and techniques.
		• Apply image processing algorithms in practical applications.
		• Review the fundamental concepts of a digital image processing system.
		Competency developed:
		• Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.
		• Design and implement algorithms that perform basic image processing and image analysis
		• Assess the performance of image processing algorithms and systems.
		• Interpret Image compression standards, image segmentation and representation techniques.
	E2: Introduction to Data Sciences	Knowledge gained:
		• Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics.
		• Practice problem analysis and decision-making.
		• Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.
		Skills gained:
		• Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
		• Apply ethical practices in everyday business activities and makewell-reasoned ethical business and data management decisions.
		• Apply principles of Data Science to the analysis of business problems.
		• Employ cutting edge tools and technologies to analyze Big Data.
		• Apply algorithms to build machine intelligence.
		Competency developed:
		• Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
		• Demonstrate knowledge of statistical data analysis techniqueutilized in business decision making.
	E3: Data Mining	Knowledge gained:
		• Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics.
		• Practice problem analysis and decision-making.
		• Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.
		Skills gained:
		• Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
		• Apply ethical practices in everyday business activities and makewell-reasoned ethical business and data management decisions.

		• Apply principles of Data Science to the analysis of business problems. • Employ cutting edge tools and technologies to analyze Big Data. • Apply algorithms to build machine intelligence. Competency developed: • Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques. • Demonstrate knowledge of statistical data analysis techniques utilized in business decision making. • Use data mining software to solve real-world problems.
CC 61L	Artificial Intelligence Lab	• Apply various pre-processing techniques on different datasets. • Construct Machine learning programs for Supervised, Unsupervised and Semi supervised learning models. • Develop Deep learning programs for Supervised & Unsupervised learning models. • Identify and Apply Artificial Intelligence concepts to solve real world problems.
CC 62L	Computer Graphics Lab	• Programming User-interface issues • Concepts of 2D & 3D object representation • Implementation of various scan & clipping algorithms • 2D modeling • Implementation of illumination model for rendering 3D objects. • Visibility detection & 3D viewing • Implementation of a project based on learned concepts.
DSE 63L	E1: Digital Image Processing Lab	Knowledge gained: • To implement basic and advanced image processing algorithms • To learn about compression and coding schemes. Skills gained: • Programming for different operations on image Competency developed: Programming related to image operations
	E2: Introduction to Data Sciences Lab	• Students will develop relevant programming abilities. • Students will demonstrate proficiency with statistical analysis of data. • Students will develop the ability to build and assess data-based models. • Students will execute statistical analyses with professional statistical software. • Students will demonstrate skill in data management. • Students will apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively
	E3: Data Mining Lab	Knowledge gained: • Practical exposure on implementation of well known data mining tasks. • Exposure to real life data sets for analysis and prediction. • Learning performance evaluation of data mining algorithms in a supervised and an unsupervised setting. • Handling a small data mining project for a given practical domain Skills gained: • The data mining process and important issues around data cleaning, pre-processing and integration. Competency developed: • The principle algorithms and techniques used in data mining, such as clustering, association

		mining, classification and prediction.
DSE 64	**E1: Machine Learning**	Knowledge gained: - To understand the basic theory underlying machine learning. - To be able to formulate machine learning problems corresponding to different applications. - To understand a range of machine learning algorithms along with their strengths and weaknesses. - To be able to apply machine learning algorithms to solve problems of moderate complexity. - To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models. Competency developed: - Appreciate the importance of visualization in the data analytics solution - Apply structured thinking to unstructured problems - Understand a very broad collection of machine learning algorithms and problems - Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory - Develop an appreciation for what is involved in learning from data.
	E2: System Programming	Knowledge gained: - Interpret the mathematical results in physical and other forms. - Identify, formulate and solve the Linear Differential Equations. - Classify and solve the contour integration of complex functions. Competency developed: - To understand the basics of system programs like editors, compiler, assembler, linker, loader, interpreter and debugger. - Describe the various concepts of assemblers and macro-processors. To understand the various phases of compiler and compare its working with assembler. - To understand how linker and loader create an executable program from an object module created by assembler and compiler. - To know various editors and debugging techniques.
	E3: Cloud Computing	Knowledge gained: - the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges; - The basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations; - Different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud; Software

		Defined Networks (SDN) and Software Defined Storage (SDS);
		• Cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;
		• The variety of programming models and develop working experience in several of them.
		Skills gained:
		• Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications that are resilient, elastic and cost-efficient.
DSE 64L	**E1: Machine Learning Lab**	• Develop an appreciation for what is involved in Learning models from data • Understand a wide variety of learning algorithms • Understand how to evaluate models generated from data • Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models
	E2: System Programming Lab	• Build low level system programs using the OS kernel functions, APIs, C programming languages, and utility tools. • Practice basic knowledge of writing device, file system and filter drivers
	E3: Cloud Computing Lab	• Use the grid and cloud tool kits. • Design and implement applications on the Grid. • Design and Implement applications on the Cloud • To understand the basic concepts Cloud Computing & its Services • To understand the taxonomy and types of Cloud Computing • To understand different hypervisors of Clouds for the Virtualization • To understand how to secure the Cloud & how to Demystify the Cloud
	DSE 64P : Project	Knowledge gained: • Identify and define the problem statement • Define and justify scope of the proposed problem • Gather and analyze system requirements • Propose an optimized solution among the existing solutions • Practice software analysis and design techniques • Develop a functional application based on the software design • Apply coding, debugging and testing tools to enhance the quality ofthe software • Construct new software system based on the theory and practicegained through this exercise • Prepare the proper documentation of software projects following the standard guidelines • Develop technical report writing and oral presentation Skills gained: • Software Project Development Competency developed: • Professional Software Developer

COURSE OUTCOMES (Political Science)

After successfully completing this course, students will be able to

Part-I		
Course Code	Course Name	Course Outcomes
Paper-I (H)	Political Thought	• Understanding the root of western political thought. • Understanding the contribution of Roman political thought. • Understanding the contributions of different political thinker toward political thought. • Understanding the Indian political thinkers thought towards society.
Paper-II (H)	Political Theory	• Understanding the meaning and importance of political science. • Understanding the sub-disciplines of political science. • Understanding the key concept of political science. • Understanding the theories of the state: socialist, Idealist, Individualist. • Understanding the root concept of Marxism.
Paper-I (G)	Political Theory	• Understanding the meaning and importance of political science. • Understanding the sub-disciplines of political science. • Understanding the key concept of political science. • Understanding the theories of the state: socialist, Idealist, Individualist. • Understanding the root concept of Marxism. • Understanding the concept of Nationalism and Imperialism.
Paper-II (G)	Comparative Constitutions and Government	• Understanding the major concepts of Government and Constitution.

		- Understanding the UK constitution and Government. - Understanding the Russia constitution and government. - Understanding the Switzerland constitution and government.
Paper-III(G)	Government and Politics in India	- Understanding the framing of Indian constitution. - Understanding the Preamble, Fundamental Rights, Duties, Federalism of India. - Understanding the legislature, executive of Indian constitution. - Understanding the relation of Union and States.

Part-II		
Course Code	Course Name	Course Outcomes
Paper-III (H)	Government and Politics in India	- Understanding the framing of Indian constitution. - Understanding the Preamble, Fundamental Rights, Duties, Federalism of India. - Understanding the legislature, executive of Indian constitution. - Understanding the relation of Union and States. - Understanding the judiciary system. - Understanding party system, electoral process, classes of interest. - Understanding the concept of regionalism in India.
Paper-IV (H)	Comparative Government and Politics.	- Understanding the major concepts of comparision of Government and Politics. - Understanding the UK,USA, PRC and Switzerland politics and Government. - Understanding the legislature, executive and judiciary of UK,

		USA, and PRC. • Understanding the rights, and duties of UK, USA, PRC.
Paper-I (G)	Political Theory	• Understanding the concept of Marxism. • Understanding the concept of democratic socialism.. • Understanding the classifications of party system. • Understanding the political parties and interest groups.
Paper-II (G)	Comparative Constitutions and Government	• Understanding the constitution of US • Understanding the Legislature, Executive and Judiciary of US. • Understanding the constitution of Peoples Republic of China.
Paper-III(G)	Government and Politics in India	• Understanding the judiciary. • Understanding amendment procedure. • Understanding election commission. • Understanding local self government, party system. • Understanding major issues in Indian politics.

Part-III		
Course Code	Course Name	Course Outcomes
Paper-V (H)	International Relations	• Understanding the main concept of International Relation. • Understanding the basic concept of power, foreign policy. • Understanding the different ideologies like Imperialism, colonialism, neo-colonialism etc.. • Understanding the importance of Second World War. • Understanding the third world concept. • Understanding the foreign policies

		of India, USA and China. • Understanding the different organizations of UNO.
Paper-VI (H)	Society, State and Politics	• Understanding the major concepts of society, state and Politics. • Understanding the concept of Nationalism. • Understanding the social stratifications, politics and social inequality. • Understanding the power and authority, religion and society.
Paper-VII (H)	Public Administration	• Understanding the concept and theories of Public administration. • Understanding the concept of bureaucracy, new public administration. • Understanding the Indian administration. • Understanding the UPSC, PSC district administration, planning administration local self government etc.
Paper-VIII (H)	Colonialism and Nationalism in India and Women Politics	• Understanding the impact of British Rule. • Understanding the Indian nationalism. • Understanding the Swadeshi movements. • Understanding the Gandhian movements, government india act 1935, movements. • Understanding the feminism, women's suffrage and empowerment.
Paper-IV(G)	Contemporary Political Issues and the UNO	• Understanding the theoretical issues. • Understanding the SAARC. • Understanding the Human Rights. • Understanding the concept of Globalization. • Understanding major concept of UNO.

Department of Political Science

PROGRAMME OUTCOMES

After successfully completing B.A.Political Science Programme Students will have

PO-1	In-depth knowledge of Indian Political system, Political thinkers, administrative system
PO-2	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO-3	Skills of working collaboratively in teams and plan as well as manage their workload.
PO-4	Awareness of personal strengths and weaknesses. Will have self-reflection and discipline
PO-5	Elicit views of others, mediate disagreements and help reach conclusions in-group settings.
PO-6	Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO-7	Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PROGRAMME SPECIFIC OUTCOMES

After successfully completing B.A . Political Science Programme Students will have

PSO-1	Ability to discuss about Indian Constitution and Political process.
PSO-2	Ability to discuss Political thinking in western world.
PSO-3	Ability to describe Administrative Process and thinking in western thinking, as well as Indian context
PSO-4	Capacity to analyses Political Theory and its contemporary impact on civilization

COURSE OUTCOMES

After successfully completing this Course, Students will be able to

Semester-I		
Course Code	**Course Name**	**Course Outcomes**
Core-101	**UNDERSTANDING POLITICAL SCIENCE**	• Understanding the meaning and importance of Political Science. • Understanding the sub-disciplines of Political Science. • Understanding key concepts of political science. • Understanding theories of the State: Social Contract, Idealist, Liberal and Neo-liberal, Anarchist
Core-102	**Perspectives on Public Administration**	• Explaining the nature, scope of Public Administration; Politics • Discussing the personnel administration • Discussing Financial Administration, budgetary process in India • Critically examining Administrative Thinkers with focus on Henri Fayol, Max Weber •

Semester-II		
Course Code	**Course Name**	**Course Outcomes**
Core-203	**INDIAN GOVERNMENT AND POLITICS**	• Understanding the making of Indian constitution • Understanding the philosophy of Indian Constitution. • Understanding Fundamental Rights; Fundamental Duties, Directive Principles of State Policy • Understanding critically analyzing legislature, executive and judiciary system of India
Core-204	**Western Political Thought**	• Define Plato`s thinking, like Ideal State & Philosopher King • Interpret Aristotle`s thought on State, Property, Slavery • Describe Machiavelli`s views on Human

		Nature, Religion • Describe Karl Marks theorization on Historical Materialism

Semester-III		
Course Code	**Course Name**	**Course Outcomes**
Core-305	**COMPARATIVE POLITICS**	• Understanding Comparative Politics: development, nature and scope. • Explaining Major governing principles: Constitutionalism; Conventions; Rule of law; • Understanding and critically analyzing the political system of U.K. • Understanding and critically analyzing the political system of U.S.A. • Understanding and Critically analyzing the political system of China • Understanding and Critically analyzing the political system of Switzerland
Core-306	**Public Policy and Administration**	• Explaining the nature, scope of Public Policy • Understanding and Critically analyzing Public Policy in India • Understanding and Critically analyzing Citizen and Administration interface • Explaining the nature, scope of Social Welfare Administration and Policies
Core-307	**Nationalism In India**	• Understanding the Approaches to the Study of Nationalism in India • Understanding Nationalist Politics and Expansion of its Social Base • Explaining the Women's Question: Participation in the National Movement and its Impact

Semester-IV		
Course Code	**Course Name**	**Course Outcomes**
Core-408	**INTRODUCTION TO INTERNATIONAL RELATIONS**	• Understanding Origin and growth of International Relations (IR) – meaning and scope of IR. • Explaining Basic concepts: National Power; National Interest; Balance of Power; Bipolarity • Explaining Major Theories of IR: Realist Theory • Understanding Collective Security: Meaning and Safeguards --Pacific Settlement of International Disputes
Core-409	**Political Sociology**	• Understanding Political Sociology: Nature and Development • Explaining Social stratification and politics: Class, Elite. Caste in India • Understanding Political culture: Types , Influence , Political socialization: Agencies • Explaining Political development, modernisation and social change: Concepts and Theories
Core-410	**Political Theory: Concepts and Debates**	• Understanding Importance of Freedom, Negative Freedom: Liberty, Positive Freedom: Freedom as Emancipation and Development • Understanding Significance of Equality, Formal Equality: Equality of opportunity • Understanding Indispensability of Justice, Procedural Justice, Distributive Justice, Global Justice • Explaining the Universality of Rights, Natural Rights, Moral and Legal Rights, Three Generations of Rights

Semester-V		
Course Code	**Course Name**	**Course Outcomes**
Core-511	**Understanding Global Politics**	• Explaining evolution of the State System, the concept of Sovereignty • Explaining the Global Economy, Discussing the Bretton Woods Institutions and WTO , Ideological underpinnings , Transnational Economic Actors ,Identity and Culture • Explaining Global Inequalities: Violence: Conflict, War and Terrorism • Explaining Global Environment, Global Civil Society
Core-512	**Indian Political Thought**	• Understanding Ancient Indian Political Thought: Main Features– Contribution of Kautilya, Medieval Political Thought: Main Features. • Explaining Indian Awakening and birth of Modernity: Rammohun and Syed Ahmed Khan • Explaining Ideas of Nationalism: Bankimchandra, Tilak and Rabindranath • Understanding B. R. Ambedkar: on social justice.
Elective-501A	**Party System in India**	• Knowledge gained: About the ideology and the organization of political parties in India and changing party systems. • Skill gained: To study manifestos, organizations and campaign strategies of different political parties and changing part systems in India • Competency gained: To apply the knowledge in understanding and predicting the role of political parties
Elective-502B	**International Organisations**	• Knowledge gained : Understanding the contemporary relevance of the UN and its relationship with other IGOs • Skill gained: to contextualize recent international crises and their resolution. • Competency gained: Faculty to represent the country in diplomatic circles, armed with the proper knowledge of international organizations.

	Semester-VI	
Course Code	**Course Name**	**Course Outcomes**
Core-613	**India's Foreign Policy in a Globalised World**	• Knowledge gained : About the bases of power and influences of major powers in global politics • Skill gained : Theoretical and practical insight into the foreign policy making of the major powers • Competency gained: To apply the knowledge to predict the trends and the foreign policy decisions of the major powers
Core-614	**Political Ideology**	• Knowledge gained: Of major modern ideologies and their core assumptions including major ideologues and ideological debates. • Skill gained: To critically engage, understand the contemporary ideologies. • Competency gained: To apply it to understand political realities
Elective-603A	**India and Her Neighbours**	• Understanding the relations of India with neighboring countries. • Evaluating India's relations with Pakistan, Bangladesh, Nepal and Sri Lanka
Elective-604A	**Grass Root Democracy in India**	• Knowledge gained : About rural local self-government and administration in India • Competency gained :To apply the knowledge to grass root level situations • Knowledge gained : About urban local self-government and administration in India • Competency gained: To apply the knowledge to grassroots level situations and design alternatives

Paper code	Paper Name	Course Outcomes	Programme outcomes
DSC-101	Introductory Microeconomics	Recognizes the students about the demand and supply and its behaviour in different perspective. Enables the students about households' behaviour in various conditions. Provide the knowledge about firm's and producer's behaviour. Provide the knowledge about the cost's behaviour in different situations	1.Introduces the students to the fundamental methods of explaining the economic issues. 2.Makes the students to identify the basic problems of the economy. 3.By achieving the extensive knowledge regarding basic economics, the Indian economy as well as global economy, students will be ready for further higher study. 4. Students who will complete the programme become confident in the sense that they will feel they are employable.
DSC-102	Mathematical Methods for Economics-I	Provides the basic knowledge regarding different mathematical tools which are useful to solve the economic problems.	
DSC-203	Introductory Macroeconomics	Provides the knowledge about fundamental theory of macro economics (like classical theory, Keynesian theory, invest theory, national income accounting, etc)	
DSC-204	Mathematical Methods for Economics-II	Provides the basic knowledge regarding different mathematical tools (such as Difference equations, Differential equations, Linear programming and Game theory) which are useful to solve the economic problems.	
DSC-305	Intermediate Microeconomics-I	Provides the knowledge about different market structures in different conditions with their mathematical applications. With this student will know about what is general equilibrium and welfare economics.	
DSC-306	Intermediate Macroeconomics-I	Introduces the students about the knowledge of money market and LM curve and Goods market and IS curve and its application in equilibrium in economy. To understand the concept of multiplier, effectiveness of monetary policy and fiscal policy in different context.	
DSC-307	Statistical Methods for Economics-I	Provides the knowledge about the different type of data, how to handle the different types of data with the various type of statistical tools	
DSC-408	Intermediate Microeconomics-II	Students will gather knowledge regarding the choice under uncertainty. What is market failure and how does it solve. Application of game theory in various economic situations.	
DSC-409	Intermediate Macroeconomics-II	1.This syllabus will provide vital knowledge regarding inflation,	

		what is the relation between inflation unemployment, what is new classical economics and new Keynesian economics.
		It also helps to explore the knowledge about consumption behaviour and its related hypothesis and various growth theories.
DSC-410	Statistics and Econometrics	It will help the students providing the knowledge regarding probability, random variables and its distribution, method of sampling. It will also help the gathering knowledge about bivariate and multiple linear regression and its applications in economics.
DSC-511	Indian Economy	Enables the students to understand the structure and constraints of Indian economy, development of Indian economy since independence in different sectors like agriculture, industry as well as foreign trade. It will also help the students to understand the growth of Indian economy and its distributional effect on the people.
DSC-512	Development Economics	This part will provide the basic knowledge regarding the development theories and their limitations. It will enable the students to know regarding the differences among the growth, development and sustainable development and its necessity in context of poverty alleviation, environment sustainability.
DSC-613	International Economics	Enables the students about the knowledge of international economics. How to utilise trade model examples to show the benefits of exchange brought about by trading with other countries. Recognize the impact of international factor mobility. Recognize the impact that tariffs and import quotas have on a country's foreign trade. Recognize the crucial role that various international institutions play in facilitating global trade. Recognize how various policies may impact a country's welfare

		and exchange rate. Knowing how various currency rate regimes, such as the gold standard, fixed exchange rates, and flexible exchange rates, operate Knowing how various international institutions operate in terms of the rate of currency and the flow of international	
DSC-614	Public Economics	How to use microeconomic principles in public policy Recognize the significance of the direct and indirect taxation systems for Recognize the idea of public spending and its significance for the Recognize the significance of the public budget for a	
DSE-701	Economics of Health and Education	Enables the students to know the importance of education and health to promote the human development as well as economic development of a country. What is the economics behind it and what will be the role of public and private institutions to promote the economic development eradicating poverty and inequality.	
DSE-702	Economic History of India (1857-1947)	This part will help to know the economic scenario under the British Rules. Enables the students what are the weakness and strongness of our economy in different sectors.	
DSE-707	Topics in International Economics	Identify key trade indicators of Balance of payment and understand the structure, disequilibrium and analyse the growth and learn the efficacy of corrective measures. The students will be able to know the functioning of foreign exchange market, classification of rates of exchange and determination of foreign exchange rate and convertibility of Rupee. The students are able analyse the major concepts of Foreign Investment, Brain Drain and its effects on trade and growth. The students are able to identify the relationship between Regionalism,	

		Multilateralism and trade specifically and growth, stability in real and nominal terms in general. The students will also be able to understand and list the impact of global trade and institutions that govern global trade.	
DSE-708	Dissertation/Project		

Generic Elective (GE) for Other Honours Programme Courses (Excluding Economics
Honours) in Semesters I and II (or Semesters in III and IV)

Paper Code	Paper Name	Course Outcomes	Programme outcomes
GE-I	Indian Economy-I	Enables the students to know the economic structure of our country as well as problem related with it. It will help the students to know the national income,trend of national income and its trend since 1951. As well as population structures and trend.To study the significance of agriculture and land reforms in economic development and problems related regarding promotional policy.	.Introduces the students to the fundamental issues of Indian economy. .Makes the students to identify the basic problems of the economy. .By achieving the extensive knowledge regarding the Indian economy as well as global economy students who will complete the programme become confident in the sense that they will feel they are employable for the administrative jobs also.
GE-II	Indian Economy-II	Provides the knowledge about our industrial sector mainly small and cottage industry and its importance in Indian economy.It also deals regarding the labour conditions and role of trade unions.Provides the knowledge about economic planning and monetary policy and its limitations and role of foreign trade in economic development.	

Skill Enhancement Course (SEC)

Paper Code	Paper Name	Course Outcomes	Programme Outcomes
SEC-I	Basic Computer Applications	Enables skills and concepts for basic use of a computer. Understand to appropriate tool of MS office to prepare basic documents, charts, spreadsheets and presentations. Enables themselves to make power point presentations and its applications It will help themselves to use the software to analyze the economic problems.	1. Demonstrate basic understanding of computer hardware and software. 2. Apply skills and concepts for basic use of a computer. 3. Identify appropriate tool of MS office to prepare basic documents, charts, spreadsheets and presentations. 4. Create spreadsheets, charts and PP presentations. 5. Analyze data using charts and applications in economic problems.
SEC-II	Tourism Management	Provides the knowledge about tourism and its measurement. Enables the idea regarding our cultural heritages and its importance for socio-economic development of a country. It also helps the students to understand about the special interest tourism particularly in West Bengal and its trends.	If a students complete the course competently then he or she will know the reality of tourism. And they will be employable in this sector or they will start the tourism business.

Discipline Specific Core Course (DSC)

Paper Code	Paper Name	Course Outcomes	Programme Outcomes
DSC-I	Microeconomics	Explain the nature and structure of Economics. To identify and explain economic concepts and theoriesrelated to behavior of economic agents, markets, industry.	1.Introduces the students to the fundamental methods of explaining the economic issues. 2.Makes the students to identify the basic problems of the economy. 3.By achieving the extensive knowledge regarding the Indian economy as well as global economy students who will complete the programme become confident in the sense that they will feel they are employable for the administrative jobs also.
DSC-II	Macroeconomics	Identify key macroeconomic indicators and measures of economic change, growth and development. The students are trained in understanding the distinction and functioning of macro economies and the macro economic issues. The students are able to analyse the major concepts of GDP and its measurement. The students are able to identify and describe the relationship of GDP growth, stability in real and nominal terms. The students are able to understand monetary, fiscal, demographic indicators, variables and economic model building	
DSC-III	Development economics	This part will provide the basic knowledge regarding the development theories and their limitations. It will enable the students to know regarding the differences among the	

		growth, development and sustainable development and its necessity in context of poverty alleviation, environment sustainability. To understand the several parameters of development ofthe nation.	
DSC-IV	Elementary Statistics	Provides the knowledge about the different type of data, how to handle the different types of data with the various type of statistical tools	
DSE-I	Indian Economy-I	Enables the students to know the economic structure of our country as well as problem related with it. It will help the students to know the national income, trend of national income and its trend since 1951. As well as population structures and trend. To study the significance ofagriculture and land reforms in economic development and problems related regarding promotional policy.	
DSE-II	Indian Economy-II	Provides the knowledge about our industrial sector mainly small and cottage industry and its importance in Indian economy. It also deals regarding the labour conditions and role of trade unions. Provides the knowledge about economic planning and monetary policy and its limitations and role of foreign trade in economic development.	

Sukanta Mahavidyalaya

Department of Education

Program Outcome

One of the Subjects of Bachelor of Arts is Education. Sukanta Mahavidyalaya also offers Honors and Program courses in Education. Topics covered in this subject like philosophical foundation of education, psychological foundation of education, sociological foundation of education, historical foundation of education, Educational Research, Value education,Life long learning,They help the students to gain practical and practical experience along with their Physical, Mental, Social, Emotional development. Also this subject paves way for the students to move ahead in future life.

Course Outcome

Sukanta Mahavidyalaya is a college under North Bengal University. Honors and program courses are taught at the graduate level in the Department of Education of this college. Here follows the syllabus of North Bengal University. The paper-wise outcomes of the papers taught in the Honors and Program courses in this syllabus are described below-

Discipline specific Core courses (DSC):

1. EDU-H-DSC-T-1:Philosophical Foundation of Education

After completion of the course the learners will be able to:

sophy.

⬜ Describe the knowledge, reality and value of different Indian schools of philosophy namely Sankhya, Nyaya, Yoga and Buddhism, Charvaka, Jain.

estern schools of philosophy namely Idealism, Naturalism, Pragmatism, Marxism.

⬜ Explain about the Philosophy of Indian Great Educators like - Swami Vivekananda, Rabindranath Tagore and Mahatma Gandhi

rs like - Rousseau, Pestalozzi, Froebel and Montessori

2. EDU-H- DSC -T-2:Sociological Foundation of Education

After completion of the course the learners will be able to-

 Discuss the meaning, nature and scope of Educational sociology and Relation between Education and Sociology.

 Define social groups, socialization and Social Institution and Agencies of Education.

3. EDU-H- DSC -T-3:Psychological Foundation of Education

After completion of this course the learners will be able to -

 Discuss the concept, nature, scope and uses of Psychology in education.

 Explain the influence of growth and development in education.

     meaning and concept of learning, its theories and factors.

 Explain the application of learning theories in classroom situation.

 Discuss the concept and theories of intelligence and creativity.

4. EDU-H- DSC -T-4:History of Education in Ancient and Medieval India

After end of this course the learners will able to:

 Discuss the features, aims, objectives, curriculum, teaching methods, student teacher relationship and evaluation system of Brahmanic system of Education.

 Explain the education system of different educational institutions of Brahmanic system of education.

Discuss the features, aims, objectives, curriculum, teaching methods, student teacher relationship and evaluation system of Buddhistic system of Education.

 Explain the education system of different educational institutions of Buddhistic system of Education.

 Compare between Brahmanic and Buddhistic system of Education.

aching methods, student teacher relationship and evaluation system of Islamic system of Education.

 Discuss the educational contribution of Akbar, Aurangageb.

 Explain the women and vocational education in Ancient and Medieval India.

5. EDU-H- DSC -T-5:Psychology of Instruction

After completion of the course the learners will be able to:

's Interactional analysis

he nature of classroom teaching, traditional teaching, and constructivist teaching.

-teaching

6. EDU-H- DSC -T-6:Educational Evaluation & Statistics

After completion of the course the learners will be able to:

 Discuss the concepts, scope and need of measurement and evaluation

 Explain the relation between Evaluation & Measurement and scale of Measurement

nd tabulate data

 Explain different types of measuring scales and their uses in education

 Describe different types of Tools and Techniques in the field of Education.

Elaborate the concept and methods of validity, reliability and norms and their importance in educational measurement.

7. EDU-H- DSC -T-7:History of Education in Colonial India

After completion of this course the learners will be able to:

India in historical perspectives.

 Elaborate the contributions of Education Commission in post independent India.

 Discuss Bengal Renaissance and its influence on Indian Education

Education Movement and its impacts on Education.

 Discuss the impact of the colonial rule on the development of Indian Education

8. EDU-H- DSC -T-8:Inclusive Education

After completion the course the learners will be able to:

 Explain the development of competencies for Inclusive Education.

the practices of Inclusive Education

 Describe the Infrastructural facilities for an ideal Inclusive School.

9. EDU-H- DSC -T-9:Educational Management and Administration

After completion the course the learners will be able to:

 Explain the Meaning, Nature, Scope, Function and Needs and types of Educational management.

 Explain the meaning and function of Educational Administration.

sh between supervision and inspection.

 Illustrate educational planning and types of educational planning.

 Discuss the functions of some selected administrative bodies.

10. EDU-H- DSC -T-10: History of Education in Post-Independence India

After completion of the course the learners will be able to:

Describe the Preamble, various articles and act on education in Indian Constitution.

Explain the recommendations and educational importance of various Education Commission in post Independent India

Discuss the functions of some educational bodies in West Bengal

Discuss the National Policy on Education in different time.

Describe the Human Rights Education in National and International Context

11. EDU-H- DSC -T-11:Contemporary issues in Education

After completion of the course the learners will be able to:

 Explain constitutional provisions with special reference to RTE Act. DPEP, SSA-SSM of Universalization of Elementary Education.

 Describe the meaning, aims & objectives, significance of Universalization of Secondary Education and Role of RMSA.

 Explain the concept, role of Higher Education and Knowledge Commission and RUSA.

- Peace Education, Sustainable development, Inclusive Education, Open & Distance learning, Equality & Equity in Education, Women Education.

 Discuss Gender and its importance in educational and social context

12. EDU-H- DSC -T-12:Educational Technology

After completion of the course the learners will be able to:

nature and scope of educational technology.

▢ Explain the role of communication & multimedia approach in the field of Education.

▢ Discuss the role Seminar, Panel Discussion. Team teaching in the field of education.

ern teaching-learning process.

13. EDU-H- DSC -T-13:Curriculum Studies

After completion of the course the learners will be able to -

▢ Illustrate the meaning, nature, scope, determinants and functions of Curriculum.

ulum.

-2005.

▢ Discuss the basis of curriculum construction, evaluation and innovation.

14. EDU-H- DSC -T-14:Educational Research

After completion of the course the learners will be able to:

▢ Define and explain the meaning and nature of Educational research.

Describe the meaning of Research problem, Review of Related Literature.

▢ Explain the concept of Hypothesis, Variables, and Research data.

B. Discipline specific elective courses (DSE)

1. EDU-H-DSE-T-1/2(A):Value Education

After end of this course learner will able to-

☐ Explain the meaning, nature, classify value and its reflection in Indian Constitution.

Education

☐ Describe the role of value education through Curriculum, Co-curricular activities.

☐ Explain the meaning, advantages and disadvantage of Storytelling, Play-way method and Role plays

2. EDU-H-DSE-T-1/2(B):Population Education

After end of this course learner will able to-

☐ Explain the meaning, concept, scope & objectives of Population Education.

☐ Discuss the historical development of Population Education.

☐ Describe the definition, factors, causes and prevention of population growth.

the Population Education curriculum and policies.

3. EDU-H-DSE-T-1/2(C):Distance Education

After completing of the course the students will be able to-

☐ Explain the meaning, characteristics, objectives, merits &demerits of distance & open education.

iscuss the mode and strategies of distance education.

-formal, Correspondence, Distance and Open Education.

☐ Discuss the present status of distance and open education in India.

-media in Distance and Open Education.

☐ Discuss the problems and remedies of distance and open education in India.

4. EDU-H-DSE-T-1/2(D):Great Educator

After end of this course learner will able to-

☐ Discuss the philosophies of great thinker of the east and west

plain the educational ideas of great thinker of the east and west

☐ Explain some experiments on education of eastern and western philosophers and thinkers

☐Discuss the ideas of contemporary thinkers on education of eastern and western philosophers and thinkers

5. EDU-H-DSE-T-3/4(A):Mental Hygiene

After completion of the course the learner will be able to:

☐ Discuss the concept, nature, aims and scope of Mental Hygiene

☐ Discuss the concept, nature, symptoms and causes of mental illness

different characteristics of mental disorder

6. EDU-H-DSE-T-3/4(B):Comparative Education

After completion of the course the learners will be able to:

☐ Discuss the meaning, nature, scope, importance, and methods of Comparative Education.

☐ Explain the concept of Universalization of Elementary and Secondary Education in UK & USA.

n Education system with UK

7. EDU-H-DSE-T-3/4(C):Guidance & Counselling

After completion of the course the learners will be able to:

Explain the concept, nature, scope, types & importance of Guidance.

nce of Counselling.

 Discuss different tools and techniques used in Guidance & Counselling.

8. EDU-H-DSE-3/4(D):a. Educational Tour b. Project.

After completion of the course the learners will be able to:

 apply the knowledge gained through different courses in practical field.

nalyse and interpret data.

C. Generic elective courses (GE):

1. EDU-H-GE-T-1(A): Lifelong Learning and Education

After completion of the course the learners will be able to:

 Explain the concept, characteristics, aims, nature, scope and need of Life Long Education

 Explain the different teaching methods of Life Long Learning

tion of Life Long Learning

 Describe the different recommendations of different education commission on Life Long Learning.

2. EDU-H-GE-T-1(B): Gender and Society in Educational Context

After completion of the course the learners will be able to:

• To understand the basic terms, concepts used in gender studies.

• To understand the gender discrimination in construction and dissemination of knowledge.

• To develop an awareness and sensitivity.

3. EDU-H-GE-T-2(A):Yoga Education

After completion of the course the learners will be able to:

 Explain the meaning, nature, aims and role of teacher of Yoga education

significance of Yoga Education

 Discuss the relationship among Yoga, Sankhya Philosophy and Bhagwat Gita

4. EDU-H-GE-T-2(B):Human Rights Education

After completion of the course the learners will be able to:

• To know the basic concept of human rights

• To know the role of United Nations and human rights

• To understand enforcement mechanism in India

• To know the role of advocacy groups

E. Skill enhancement courses (SEC)

1. EDU-H-SEC-T-1(A): Statistical Analysis

After completion of the course the learners will be able to:

🗆 Explain the concept of central tendency, variability and their properties

Rank and its application.

-relation and their application

-Parametric Test

🗆 Apply the knowledge and calculate different statistical values

2. EDU-H-SEC-T-1(B):Computer Application

After completion the course the learners will be able to:

🗆 Explain the beginning, basic editing, templates by using MS word

🗆 Work with Desktop Publishing, Mail Mergeby using MS word

roofing, Printing, Publishing, Comparing, Merging and Protecting Documentsby using MS word

🗆 Apply Edit, save, print and publish by using MS Power Point

3. EDU-H-SEC-T-2(A):Community Development

After completion the course the learners will be able to:

• To know the basic concept of community and its development

• To understand community group dynamics

• To understand the concept of equality, diversity, social justice within community

• To know community development programme in India

4. EDU-H-SEC-T-2(B): Lesson Planning

After completion of the course the learners will be able to:

g and characteristics of Lesson Plan

Course outcomes

Semester I

Course name	Learning outcomes	PSOs are attained by
CC 1: English Language: overview and usage; literary types:	**CO 1:** Students are introduced to the different phases of English language in its process of evolving into a literary language. Students are introduced to different literary forms like tragedy and comedy; its origin and functions and its aesthetic values. Students also learns the basic literary terminology and styles of composition in prose and verse. **CO 2:** students get to learn and understand the development of English language and literature. **CO 3:** students also learn how a language attains abilities in course of time due to several socio political relevance. **CO 4:** students encounter archaic words and its modern equivalents and understand the fluidity of language. Students learn different genres and understand the differences among them.	Students are trained in getting acquainted with the different periods of English language, different literary genres and literary devices through classroom lectures and discussions. Students are encouraged to read texts and passages and critical essays and develop their own ideas and arguments around English language and different literary genres and rhetoric and prosody. Students also learn and develop an understanding on the topics through continuous writing assignments and presentations.
CC 2: European Classical Literature	**CO 1:** students are introduced to ancient Greek literary traditions such as Epics and other texts. **CO 2:** Students get to learn and understand the fundamental acts of 'reading' poetic and dramatic texts from the Greek literary tradition. **CO 3:** students learn how to analyze a text or textual passages (poetry & drama) keeping in mind the historiography, mythology and cultural ethics associated therein in the ancient Greek context. **CO 4:** students learn basic terms on literary aesthetics	Students are getting familiarized with Indian classical literary forms and genres through classroom lectures and discussions. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around classical texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions.

	like imageries, similes, metaphors.	

Course Outcomes

Semester II:

Course Name	Learning Outcomes	PSOs are attained by
CC 3: Indian Classical Literature and Indian writing in English	**CO 1:** students are introduced to ancient Indian literary traditions such as Epics and other texts. Indian writing in English introduces students to the role of English literary writings in resisting Colonialism and champion the cause of the colonized. **CO 2:** Students get to learn and understand the fundamental acts of 'reading' poetic and dramatic texts from the Indian domain. **CO 3:** students understand how to analyze a text or textual passages (poetry & prose) keeping in mind the historiography, mythology and cultural ethics associated therein in an Indian context. **CO 4:** students learn about various themes, socio political, cultural discourse and how Indian writings became a tool to dismantle colonial hegemony. They also learn some basic terms on literary aesthetics like imageries, similes, metaphors.	Students are familiarized with Indian classical literary forms and genres through classroom lectures and discussions. Students learn through adequate emphasis on history of Indian English literature. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around classical texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions.
CC 4: British Literature: Old English period to 14th century	**CO 1:** Students learn about the literary writings in the old English period and the development in the old and middle English prose and poetry writing. **CO 2:** students understand the development in the prose and poetry writing in the old English and middle English period. **CO 3:** students learn about	Students are familiarized with the literary output through classroom lectures and discussions. Students learn through adequate emphasis on history of British English literature. Students are encouraged to read texts and associated critical essays and develop

| | the social cultural discourse in the 14th and 15th century England. | their ideas and arguments around the texts.

Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions. |

Semester III:

Course outcomes:

Course name	Learning outcomes	PSOs are attained by
CC 5: American Literature	**CO 1:** Students are able to locate American Literature as a distinct literary site, different from the conventional British Literature and students read American poetry, novel and drama. **CO 2:** Students learn about the post- world war-I period where American prosperity and great depression occurred. Students learn about the struggle between blacks and white settlers.	Undertaking reading- based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Film screening is done and test exam and presentations are done.
CC 6: British Poetry and Drama: 14th to 17th century	**CO 1:** Students get to know the historical art/ drama movements in Europe especially the Renaissance. Students learn how it dealt with superstitions of the Middle Ages and looked forward to an era of liberty in art, literature. **CO 2**: Students learn about progress in intellectual domain reading through plays and poetic compositions. **CO 3:** Students are encouraged to understand the themes imbedded the literary texts through multiple interpretations of texts. Texts like Macbeth and Edward the second connect students' learning with renaissance	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding

Course name	Learning outcomes	PSOs are attained by
	thoughts and liberal humanism.Authors like Spenser and Donne illuminates the students' understanding about love and life. **CO 4:** Students get to know the major literary forms like tragedy, comedy, sonnet and other poetic devices involved therein.	through continuous writing assignments, presentations and question- answer sessions.
CC 7: British Poetry and Drama:17th and 18th century	**CO 1**: This Core Course makes the students learn British Literature of the 17th century, the historical ruptures and intellectual debates of the time such as puritanism. **CO 2:** The course makes the students explore the issues on succession and individualism pertinent to Jacobean age. **CO 3:** Students develop their takes on the idea of the good/evil, virtue /vice and the Christian idea about 'Fall of Man' as found in "Paradise lost". **CO 4:** Students identify and recognize literary forms and areas like 'mock epic' and 'epic' poems.	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions.

Semester IV

Course outcomes:

Course name	Learning outcomes	PSOs are attained by
CC 8: British Literatures: 18th century	**CO 1:** Students get to know the popularity of drama as a mode of entertainment. The students get to understand the fashions and mindset of the contemporary British people through dramatic representation. **CO 2:** Students understand and develop their knowledge around the rise of the novel in English literature. **CO 3:** Students get to know the rise of political literature with 'Robinson Crusoe' and 'Gulliver's Travel'. **CO 4:** Students identify and recognize the literary form like satire and some of the constituent elements of romantic movements in the poems of Gray and Thomson.	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
CC 9: British Romantic	**CO 1:** Students get to know of the influences of the French Revolution in England. This	Undertaking reading-based assignments on thematic topics.

Literature:	course offers some lyrical poetry and nature poetry written by the Romantics who had strong belief in the idea of 'Liberty, Equality and Fraternity' **CO 2:** Students get to learn about romantic writers and their ideals through the poems and novels. Students can easily connect a poet with his literary texts through close reading. **CO 3:** The poems enable the students to understand musicality in poetry/art and the use of poetry for the common people. **CO 4:** This course makes the student think about the impact of nature on human mind.	Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
CC 10: British Literatures: 19th century	**CO 1:** A picture of 19th century England is shown to the students through reading of the domestic novel and Victorian poems. A reading and analysis of 'A Tale of Two Cities' allows students to have an understanding of the causes of French Revolution. **CO 2:** Students understands the optimism and the conflict between science and religion that get reflected in the poems of Browning and Tennyson. **CO 3:** Students learn about the issues of sexuality through the reading of Christina Rossetti's poem. Students learn and understand the social code of conduct, religion and Victorian attitude towards women through a reading and analysis of Charlotte Bronte's "Jane Eyre"	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions

Semester V

Course outcomes:

Course name	Learning Outcomes	PSOs are attained by
CC 11: Women's writing	**CO 1:** This course focuses on writings by women. Students learn women's writings as different texts highlights different issues like women's subjectivity, socio- psychological roles and duties and female agencies. **CO 2:** The short stories, poems,	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and

	autobiographies and theoretical writings articulate women's struggle to define experiences and challenge patriarchal constructs.	arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
CC 12: British Literature : early 20th century	**CO 1:** Students learn about intellectual movements, art movements of the 20th century and the idea of modernism with its salient features. **CO 2:** Student learn Modernism as an intellectual movement with the literary productions. Students also learns about colonial experiences in texts. **CO 3:** students also get to know the developments in fiction writing and narrative techniques of the same. Students also understands the aspects of psychological novel. Students understands the Modernist poets and their writing style.	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
DSE 1:Literary theory and criticism	**CO 1:** The students learn about the development of ideas in the 20th century and the material and discursive condition of intellectual production. Students can critically assess the merits of major upheavals in political, social and intellectual fields in the 20th century. **CO 2:** It enables students to understand the theoretical progress in gender articulations. Readings from feminist critics help students in forming critical perspectives on gender hierarchy and women's position and role in society. **CO 3:** Students also understands the postcolonial conditions. Students get to know the different techniques of colonialism and postcolonial assessment of colonial conditions and the theoretical development in postcolonial field of study.	Interactive group discussions, students critical thinking and writing on different aspects of theories and engaging students in exam questions. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
DSE 2: Literature of the Indian Diaspora	**CO 1:** This course introduces students to the study of diaspora literature and transnationalism. **CO 2:** Students learn and understand the consciousness of the authors'	Interactive group discussions, students critical thinking and writing on different aspects of diaspora literature and engaging students in exam questions.

	the cultural heritage and the deep attachment to their Indian origin and their thoughts about India.	Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions

Semester VI

Course outcomes:

CC 13: Modern European Drama	**CO 1:** This provides students with an overview if theatrical movements in Europe. The plays included focus on innovative performance trends that began at the end of 19th century and evolved into diverse forms in the 20th century. **CO 2:** Students learn and understand about the deep engagement of theatre with important socio political issues of Europe. **CO 3:** Students also observe shifts in the language and stylistic developments of drama as art and as performative literature.	Undertaking reading-based assignments on thematic topics. Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
CC 14: Postcolonial literature	**CO 1:** Students read texts to understand the postcolonial paradigm with 'third world' subject positions. **CO 2:** Students practice critiques of 'third world'/ 'postcolonial' delineations of themes and characters together with the distinct use of language.	Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions
DSE 3: Modern Indian writing in English Translation	**CO 1:** Students learn the vast diversity of modern Indian writings encompassing multiple regions **CO 2:** This also gives students an idea about translation studies. It helps to bridge the gap between vernacular language and English	Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops

	providing cross cultural references and link it with political and social movements.	deeper understanding through continuous writing assignments, presentations and question- answer sessions
DSE 4: Partition Literature	**CO 1:** Students learn the significance of partition and trace the trajectory of Partition in literary representations. **CO 2:** Students are enabled to appreciate the differences between cinematic and fictional representations. students understand the ideological contours of the representation of partition. **CO 3:** Students understand the trauma associated with partition and how creative writers find ways to bring out this dimension of the tragedy.	Interactive discussions in small groups are arranged to have a good understanding on the topic. Students are encouraged to read texts and associated critical essays and develop their ideas and arguments around the texts. Students also learns and develops deeper understanding through continuous writing assignments, presentations and question- answer sessions

Programme specific outcomes

B.A English (Hons)	PSO 1: students learn both the artistry and utility of English language through an artistic /aesthetic study of language through texts and various historical and contemporary forms of culture. PSO 2: The programme provides students with space for enhancing critical thoughts around literary texts. Subsequently it will help the students to build their thoughts in an increasingly complex and interdependent world. PSO 3: This programme builds capabilities among the students to perform research, scrutiny and undertake analysis of texts/art work. It enables students to pursue criticism of literary and cultural texts from various genres in different historical and stylistic perspective. PSO 4: students develop intellectual flexibility which, in turn, improves creativity and helps in respective career professions inculcate a lifelong learning. PSO 5: the programme also makes the students aware about geographies and continent; their cultural and historical pasts. Students get familiar with literary portrayal of socio-cultural values, mythologies and their religious and mystical significance. PSO 6: This programme coordinates between knowledge and character building. Students encounter a plethora of characters be it type or radical. In depth analysis of the characters drawn from various socio-cultural locations enable students to facilitate themselves with strong character building and becoming a responsible citizen/human in the world. PSO 7: students are enabled to think in various ways and process. While dealing with a given problem or situation where different perspective such as social political economic cultural merge/juxtaposed together, students become strong enough to think confidently on real life issues/situations. PSO 8: The programme connects learner to popular narratives, popular media forms and content and develop interest in these areas. PSO 9: Students can connect themselves with trajectories of time: students read literatures from a vast range of time-space ranging from the ancient Greek to ancient Sanskrit texts to readings of modern contemporary authors from Africa, India, and the western world. Students understand the historiography of literary content. PSO 10: students pursuing this course are trained in developing their oratorial skills, organizational skills, interactive skills and argumentative skills through group discussion, debates, extempore. PSO 11: This programme also exposes students to innovative teaching practices (i.e., use of PPT, audio-visual tools) which a significant percentage of graduate students subsequently use in their own teaching pedagogy.

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Subject: Environmental Studies

Programme Outcome

- to promote environmental education/awareness among students/pupils
- to aware the students/pupils regarding existing environmental burden
- to delineate the solutions of environmental problems to achieve environmental sustainability
- to make "Pollution free Environment" for live more sustainably

Course Outcome

- to build up sound knowledge on concept of environment, environmental education & ecosystem
- to understand about different types of environmental pollution and its effects, and their management processes
- to gain in-depth knowledge on environmental laws and policies of India
- to build up sound knowledge on different natural resources and their conservation processes
- to gain knowledge on biological diversity, different ecosystem services and safeguarding practices
- to know or understand the global environmental problems and their management for achieving circular bioeconomy

Name of the programme	Year of introduction	Status of implementation in CBCS curriculum (Yes/No)	Programme out come	Course outcome
Geography (Honours)	*2018-2019*	*Yes*	Geography is the study of places and the relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. They also examine how human culture interacts with the natural environment and the way those locations and places can have an impact on people. Geography seeks to understand where things are found, why they are there, and how they develop and change over time. The study of the diverse environments, places, and spaces of Earth's surface and their interactions. It seeks to answer the questions of why things are as they are where they are. The modern academic discipline of geography is rooted in ancient practice, concerned with the characteristics of places, in particular their natural environments and peoples, as well as the relations between the two.	**Geotectonics** **CC1-01PR** • The main practical topics are map scale and map projection. The map scales are used to determine physical distance and size of geographical area. • It indicates the distance between 2 points on a map bears the distance between the corresponding points on the actual ground. • The method used to portray a part of the spherical Earth on a flat surface whether a paper map or a computer. • In other words a map projection systematically renders a 3D ellipsoid of Earth to a 2D map surface. 3D services cannot be perfectly displayed in two dimensions hence distortions occur. • Therefore each type of projection preserves a particular property distorting the other properties. • It is up to the

				cartographer to determine which projection is most suitable for this purpose.
				Geomorphology **CC1-02PR** - Topographic maps show physical and cultural features with the help of conventional symbols. It has multiple uses in the present day in any type of Geographic planning or large scale architecture, earth sciences, civil engineering and even the present Remote Sensing and GIS. - The study of Rocks and Minerals help students understand the constituent minerals they are composed of and structure, the relationship between rocks and landform features.
				Human Geography **Course Code: GEO-H-CC-2-03-PR–Practical** - While studying human geography students will learn

				how spatial processes such as migration, landscape change and spatial planning shape people's lives and activities. • The study of these devices and tools which are involved in their construction and use. • Practical approach explains the techniques of surveying and Cartography, using mathematical and Statistical methods.
				GEO-H-CC-2-04-PR – Practical • The primary aim of studying settlement geography is to acquaint with the spatial and structural characteristics of human settlements under varied environmental conditions. • It helps to identify the economic and social development of a place and can show its main activity. • Most large settlements have more than one function though in the past one function

				was maybe the most important in defining the success and growth in importance of the settlement.
				Climatology **CC3-05-PR** • The topic includes meteorological instruments and daily weather interpretation and representation of the climatic data. • These topics help students learn how to measure the air temperature, air pressure on a daily or monthly basis. • The topic also helps to learn to interpret the symbols used in Indian weather maps and analyze and how to represent climatic data through the technique of climograph and hythergraph.
				Statistical method in geography **CC3- 06-PR** • The topics include basic statistical terms, calculation of measures of Central tendency correlations. • The topics are mathematical science

				that works with numerical data.
				• It helps better understanding and accurate description of nature's phenomena and also helps in efficient planning in many fields of study.
				• It helps to form a base for research and how real life experiments of a phenomenon can be numerically validated.
				Geography of India **CC3-07-PR** • The topics of study are rainfall and temperature graphs in selected stations and decadal growth rate of population. The inequality measuring methods are Lorenz curve and Gini coefficient. • The farmer is the graphical method of expression and the letter is the mathematical method of measuring the inequality regarding any population nature. • The students will learn about the various ways of expressing the population

				characteristics.
				Economic Geography **Course Code: GEO-H-CC4-08-PR –Practical** • Economic geography is a sub-field within the larger subjects of geography and economics. • Researchers within this field study the location, distribution, and organization of economic activity around the world. • Economic Geography is important in both developed and underdeveloped nations such as the United States, India, China, Bangladesh because it allows researchers to understand the structure of the area's economy and its economic relationship with other areas around the world.
				Regional Planning and Development **Course Code: GEO-H-CC4-09-PR – Practical** • Regional Planning is a multidisciplinary approach which aims

				at holistic development of a region.
				• Regional Planning is a specific type of planning, based on, specific planning structure for inducing public action aimed at societal wellbeing.
				• It implies that Regional Planning is concerned fundamentally with the society in the context of space.
				• Regional Planning is considered as a geo-technology for comprehensive development of regions through rational transformation of regional space.
				• It seeks to recognize space more rationally with a view to achieving greater regional integration
				• Field research is defined as a qualitative method of data collection that aims to observe, interact and understand people while they are in a natural environment. For example, nature conservationists observe behavior of animals in their natural surroundings

				and the way they react to certain scenarios. In the same way, social scientists conducting field research may conduct interviews or observe people from a distance to understand how they behave in a social environment and how they react to situations around them. • To complete and analyze a few objectives students need to follow a distinct methodology. 4th semester (H) and 6th semester (H) students of 2022 went to **Dzongri village, Upper Pelling, Sikkim** to study and observe their way of life to cope up with landslide hazards.
				1. Environmental geography CC5-11-PR • The content for both Honors and Program courses are the same in this paper. The content of the course is preparation of a project report based on environmental problems. • The syllabus will make the students learn and practically understand the

				burning environmental issues today. • They will be more aware about the problem as well as they will learn how to design, collect data and assimilate as well as write a project report
				Remote sensing and GIS **CC5-12-PR** • This is the new development as well as the most advanced topic in geography as a science. • The knowledge of Remote sensing and GIS as well as the aerial photo interpretation, satellite imagery image processing classification etc. constitute the content of this paper. • The content will help the students learn about the new techniques in Remote Sensing and GIS, their application in various subjects and the importance of these modern techniques which is very vital in the modern times.
				1. Population Geography

				DSE 5-01-PR
				• The content includes population projection, density mapping, and work participation rate.
				• The topics help to learn about the population projection, the concept of density of the population, area identification of low and high density, and its relationship with other causal factors for population growth and distribution.
				• The study also includes the number of people participating in different sectors of the economy which help to identify the real life situation of the people participating as there will be use of authentic data like Census of India, NSSO. etc
				1. Urban geography GEO-DSE5-02-PR
				• In this paper, topics include rank size method, State wise variation and trend in urbanization.
				• The paper helps to understand the pattern of distribution of urban

				centers scientifically.
				• Rank size method is one of the accepted methods for studying or analyzing the pattern of distribution of urban centers.
				• The exact state wise variation and trend of urbanization can be observed from the data taken from census population.
				1. Advanced Cartography **Course Code: GEO-H-DSE-6-03-PR: Advanced Cartography** • Cartography or mapmaking is the study and practice of making maps .Map making involves the application of both scientific and artistic elements, combining graphic talents and specialized knowledge of compilation and design principles with available techniques for product generation. • Map function as visualization tools for spatial data. Spatial data is stored in a database and extracted for a variety of purposes.

				• The traditional analog methods of map making have been replaced by digital interactive maps that can be manipulated digitally.
				• Modern cartography like many other fields of "information technology" has undergone.
				• Rather than merely drawing maps the cartographic process is concerned with I) Data manipulation, II) Data capture, III) Image processing and IV) Visual display.
				• Cartographic representations may appear in printed form or as dynamic images generated on a computer display screen.
				• Computer assisted mapping systems have added a new and exciting dimension to cartographic techniques and traditional methodologies have to be augmented with new skills. The fundamental nature of cartography has changed with the evolving technologies,

				providing cartographers with new methods for visualization and communication of spatial information.
				Social Geography **Course Code: GEO-H-DSE-6-04-PR** • Social geography is the branch of human geography that is interested in the relationships between society and space, and is most closely related to social theory in general and sociology in particular, dealing with the relation of social phenomena and its spatial components. In a nutshell, social geography focuses on the scientific study of **the relationship of society and space (spatial components)**. • It is interested in answering the questions of how societal processes determine space and its structures and how spatial conditions determine the existence of societies.

Name of the programme	Year of introduction	Status of implementation in CBCS curriculum (Yes/No)	Programme outcome	Course outcome
Geography (Programme course)	*2018-2019*	*Yes*	Geography mainly concerns changes in spatial attributes in a temporal perspective. The Geography is tailored to meet the students' specific educational and professional goals in mind. It focuses on spatial studies, qualitative as well as quantitative, and emphasizes on human-environment relationship. During the first year of the programme, the students are trained on advanced concepts of physical and human geography. The third year allows them to concentrate on specific areas of the subject, on which they complete their field reports. After completing the course, the students will be amply prepared for professional careers in geography and allied disciplines like GIS and Remote Sensing.	**Physical Geography** **Course Code: GEO-P-CC-1-01-PR: Practical** • Physical geography is the study of the processes that shape the Earth's surface, the animals and plants that inhabit it, and the spatial patterns they exhibit. Self-identified in the mid- to late 1800s, physical geographers and in particular geomorphologists dominated the discipline of geography to the late 1930s **Human Geography** **Course Code: GEO-P-CC-2-02-PR: Practical** • While studying human geography students will learn how spatial processes such as migration, landscape change and spatial planning shape people's lives and activities. • The study of these

				devices and tools which are involved in their construction and use.
				• Practical Geography: A systematic approach explains the techniques of surveying and Cartography, using mathematical and Statistical methods.
				Regional Development **Course Code: GEO-P-CC-3-03-PR** • Regional development is a broad term but can be seen as a general effort to reduce regional disparities by supporting (employment and wealth-generating) economic activities in regions
				Spatial Information Technology **Course Code: GEO-P-CC-4-04-PR** • Spatial information technology aims to provide information about the Earth's surface.

				• It includes all the tools and technologies that enable us to acquire information and provide decision-making capability towards planning and sustainable management. • The most important technologies are remote sensing, GPS and GIS.
				Disaster Management **Course Code: GEO-P-DSE-5-01-PR** • The content for both Honors and Program courses are the same in this paper. • The content of the course is preparation of a project report based on environmental problems. • The syllabus will make the students learn and practically understand the burning environmental issues today. • They will be more aware about the problem as well as they will learn how

				to design, collect data and assimilate as well as write a project report.
				Climate Change: Vulnerability and Adaptation **Course Code: GEO-P-DSE-6-02-PR** • Climate change threatens people with food and water scarcity, increased flooding, extreme heat, more disease, and economic loss. • Human migration and conflict can be a result. The World Health Organization (WHO) calls climate change the greatest threat to global health in the 21st century. • The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. • It is a function of the character, magnitude and rate of climate

				variation to which a system is exposed, its sensitivity, and its adaptive capacity. Climate change adaptation refers to actions that reduce the negative impact of climate change, while taking advantage of potential new opportunities.
				• It involves adjusting policies and actions because of observed or expected changes in climate.

Name of the programme	Year of introduction	Status of implementation in CBCS curriculum (Yes/No)	Programme out come	Course outcome
SKILL ENHANCEMENT COURSE – SEC	*2018-2019*	*Yes*	Skill Enhancement Courses (SEC) from a pool of courses designed to provide value-based and/or skill-based	**Course Code: GEO-SEC-A-3-01-TH: Remote Sensing** • This is the new development as

| | | | knowledge. In the Semester system, the Under-Graduate Examinations will be held in six parts — (i) The First and Second Semester for the first year students and (ii) The Third & Fourth Semester and Fifth & Sixth Semester for the second and third year students respectively. The academic sessions including the examinations for first, third and fifth semester are July to December and that for second, fourth and sixth semester are January to June.

A student will have, at the most, five academic years or ten semesters to complete the course.

In our college students do choose Remote Sensing and GIS as their SEC programme. | well as the most advanced topic in geography as a science.

- The knowledge of Remote sensing as well as the aerial photo interpretation, satellite imagery image processing classification etc. constitute the content of this paper.

- The content will help the students learn about the new techniques in Remote Sensing, their application in various subjects and the importance of these modern techniques which is very vital in the modern times. |
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Course Code: GEO-SEC-A-4-02-TH: Geographical Information System

- Comprehend fundamental concepts and practices of Geographic Information Systems (GIS) and advances in Geospatial Information Science and Technology |

				(GIS&T).
				• Apply basic graphic and data visualization concepts such as color theory, symbolization, and use of white space.
				• Demonstrate organizational skills in file and database management.
				• Give examples of interdisciplinary applications of Geospatial Information Science and Technology.
				• Apply GIS analysis to address geospatial problems and/or research questions.
				• Demonstrate proficiency in the use of GIS tools to create maps that are fit-for-purpose and effectively convey the information they are intended to.
				• Effectively communicate and present project results in oral, written, and graphic forms.
				• Demonstrate confidence in undertaking new (unfamiliar) analysis using GIS, troubleshoot problems in GIS,

				and seek help from software/website help menus and the GIS community to solve problems. • Apply mathematical concepts, including statistical methods, to data to be used in geospatial analysis. • Gather and process original data using a Global Positioning System (GPS) or other Global Navigation Satellite Systems (GNSS).
Name of the programme	**Year of introduction**	**Status of implementation in CBCS curriculum (Yes/No)**	**Programme out come**	**Course outcome**
GEOGRAPHY GENERIC ELECTIVE	2018-19	Yes	An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure to other discipline/subject is called a Generic Elective. A core course offered in a discipline/subject may be treated as an elective by other	**COURSE CODE: GEO-GE-01-TH PHYSICAL GEOGRAPHY** Learning the Physical Geography and Solar System. Understand the composition and types of rocks. Comprehend the weather phenomena and

			discipline/subject and vice versa and such electives may also be referred to as Generic Elective. The Generic Elective has equal credit as that of core paper. The student has to study one GE each in first four semesters of the course. These GEs are called as GE-1, GE-2, GE-3 and GE-4 referring to the corresponding semester only. The advantages of this programme are: • Prepare them to look for inter-disciplinary research. • Provides the students with an alternative option for masters/Post Graduate (PG) degree. Two GEs in any other discipline/ subject are required to pursue PG in the corresponding discipline. • Many courses have limitations to have studied minimum 2 semester papers in a	denudation work. Understand the hydrosphere in detail. Students will get objective types of question and will expose competitive exams Also students will come to types of rocks and their denudation process. Learn the difference between weather and climate.

			specific discipline other than the core subjects. This GE can fulfil that limitation to pursue master's study in desired field.	
				COURSE CODE: GEO-GE-02-TH GEOGRAPHY OF INDIA 1. Understand the political division of the World. 2. Learning the natural regions of the world. 3. Understand the economic activities of the World. 4. Evaluate the population pattern and distribution. 5. The economic processes operating at different geographical scales are depending on the complex economic-political-social interactions that are framed at the global level. 6. The course explores the processes of globalization and seeks to provide understanding of today's increasingly interdependent world. 7. Students will be familiarized with economic processes such

				as globalization, trade and transportation and their impacts on economic, cultural and social activities.

COURSE OUTCOME
B.A Honors
SUBJECT-HISTORY

CORE COURSE

SERIAL	COURSES OFFERED	NAME OF THE PAPER	SEMESTER	CREDIT	COURSE OUTCOME
1	CC Paper-I	History of India-I (from earliest time to 300 AD)	I	6	Students will acquire knowledge regarding the primitive life and cultural status of the people of ancient India. They can gather knowledge about the society, culture, religion and political history of ancient India. They will also acquire the knowledge of changing socio-cultural scenarios of India.
2	CC Paper-II	Social formations and Cultural Patterns of the Ancient world	I	6	Students will acquire knowledge about the evolution of human society,and transformation of ancient civilizations & also Students will learn the history of evolution of earth, people and society through this course.
3	GE-Paper-I	History of India from Earliest Times up to 1193 CE	I	6	In this long history lesson, students will learn in detail the history of India from the ancient period to the advent of Islam.
4	CC Paper-III	History of India-II (from 300AD to 750A.D)	II	6	From this paper students will know the history of ancient India and socio-economic and cultural history of ancient India.
5	CC Paper-IV	Social Formations And cultural Patterns of the Medieval World	II	6	The students will know the crossroads of medieval history, the rise of the Roman Empire, the social picture of the medieval world, the economy, the history of the arrival of Islam, etc.
6	GE Paper-II	History of India from 1193 to 1950 CE	II	6	Students will learn about the social economic and other aspects of the medieval history of India. Apart from this, the history of India's modern era, social reform movement, rise of nationalism, Gandhi's non-cooperation movement and the achievement of independence will be known in detail.
7	CC Paper-V	History of India-III(750-1206 A.D	III	6	The students would also be enlightened. Also the last phase of the history of ancient India and the emergence of feudalism will be known, besides the characteristics of the early medieval history and urbanization, the history of trade and commerce will be known.

8	CC Paper-VI	Rise of the Modern West-I	III	6	A History of Europe from the Middle Ages to the Modern Era. Students will learn about the economic history of historical Renaissance and Medieval Europe
9	CC Paper-VII	History of India-IV (1206-1550)	III	6	Students will learn about the arrival of Islam in India and their system of governance. Social, political and economic conditions will be known as a result of the advent of Islam
10	CC Sec-Paper-I	Understanding Heritage or Archives & Museum	III	2	As we can learn about the country's traditions, continuity etc. from this course, on the other hand students can also learn about ongoing and permanent traditions. People can also be conscious in keeping the country's traditions and culture
11	GE Paper-III	History of India from Earliest Times up to 1193 CE	III	6	In this long history lesson, students will learn in detail the history of India from the ancient period to the advent of Islam.
12	CC Paper-VIII	Rise of the Modern West-II	IV	6	In this course, students will learn about the history of modern Europe as well as the history of mercantilism and the history of the American war of independence.
13	CC Paper-IX	History of India-V(1550-1605)	IV	6	The arrival of the Mughals is a very important event in the history of India. Through this course, students will learn about the arrival of Mughals in India, their political thought, history of governance and their cultural activities.
14	CC Paper-X	History of India-VI (1605-1750)	IV	6	Aurangzeb's reign is highly controversial in the history of the Mughal Empire. Historians have discussed much about his activities. The decline of the Mughal Empire began during his time. Moreover, the contribution of Mughal Empire will be known from this course
15	CC SEC Paper-II	Art Appreciation an introduction to Indian Art Or Understanding Popular Culture.	IV	2	Through this course students can learn about Indian heritage and history as well as about the country's cultural heritage, arts etc. Moreover, we can gather historical material from the various temples and mosques built by Indian kings in different times.
16	GE Paper-IV	History of India from Earliest Times up to 1193 CE	IV	6	Students will learn about the social economic and other aspects of the medieval history of India. Apart from this, the history of India's modern era, social reform movement, rise of nationalism, Gandhi's non-cooperation movement and the achievement of independence will be known in detail.

17	CC Paper-XI	History of Modern Europe-I (1789-1939)	V	6	Through this course we learn the history of the first bourgeois democratic revolution in the history of the world, which took place in France in 1789. The Declaration of the Rights of Man, the rise of Napoleon and the French Empire under Napoleon, the emergence of nationalism in Europe
18	CC Paper-XII	History of India-VII (1750-1857)	V	6	This course covers the social, political and economic history of 18th century India, the arrival of the English East India Company and their ideology & policy towards India.
19	CC-DSE Paper-I	History of Modern East Asia-I(1840-1949)	V	6	Through this course, students will learn about the past political, social and economic history of a traditional Asian country like China. As an Indian it is very important to know the history of China
20	CC-DSE Paper-II	History of Modern East Asia-II-Japan (1868-1945)	V	6	This lesson discusses the history of Japan, another powerful country in Asia. It is also important to know the history of Japan with China, so students can learn the history of Japan's development from this paper.
21	CC Paper-XIII	History of India-VIII (1857-1950)	VI	6	Through this course one will know the true character of British rule and history of exploitation in India. As a result of British rule, resentment arose among all sections of the people in the country, and peasant revolts broke out in various parts of India. Moreover, we can get to know the various aspects of Indian politics, the development of nationalism, etc. from here
22	CC Paper-XIV	History of Modern Europe-II (1780-1939)	VI	6	In this course we find the details of the events that characterize the modern era. The arrival of Marxism and the revolution in Russia based on it, the arrival of capitalism in the post-feudal era, the development of imperialism, and the Great War are all known from now on.
23	CC-DSE-III	History of North Bengal-I	VI	6	In recent times the study of social science and regional history has occupied an important place. Based on that, the students will be able to gain special knowledge about the importance of the history of North Bengal
24	CC-DSE-IV	History of North Bengal-II	VI	6	British imperialism established its authority in North Bengal. Although we read the history of Bengal as a whole, the history of North Bengal has a special character and characteristic. This particular feature of history is discussed in detail in this lesson from which students will no doubt benefit.

DEPARTMENT OF HISTORY
SUKANTA MAHAVIDYALAYA

SUKANTA NAGAR, DHUPGURI. JALPAIGURI-735210, WEST BENGAL, INDIA.

Ref No…HD/7……………..
Date…29.08.22

Programme Specific Outcome (PSO)
B. A. Three Year, Six Semester Honors Degree Programme
Under NORTH BENGAL UNIVERSITY

From the Academic Session **2018-19**, **CBCS** was introduced by the ***NORTH BENGAL UNIVERSITY***, which is our affiliating university at present. The first batch of students under the newly introduced semester system is, therefore, supposed to complete graduation in the year 2022. It thus appears difficult to measure programme specific outcomes on definite terms. Besides, the University itself is yet to provide concrete Programme Specific outcomes to its affiliated Colleges. However, our esteemed teachers of the Department of History pondered over the current syllabus and tried to chalk out some specific outcomes of B.A. three year, six semesters Honors Degree Programme of their own. Such expected Programme Specific Outcomes may be listed as follows:

Sound Knowledge of different Historical Periods:

The CBCS papers in each semester are devoted to the study of particular Historical phases in the historical events along with the study of a few major works by some master Historians of that period. These not only help the students to understand a historical period better, but also reduce the load of study in the concerned area.

Knowledge of the Development of Historical perspective:

While pursuing Honors course of studies in History it is mandatory that a student develops proper knowledge of the historical events. In this sphere also the present syllabus appears to be illuminating, as it provides the students with standard and up to date knowledge of historical events, impact, war and history, result. The students may acquire knowledge of the historical events of Ancient, Medieval, Modern and European history in new aspects.

Development of the Historical Perspectives:

The current syllabus is well chosen to represent different events from different angles. They are not only meant to make the students familiar with the dominant events of different ages, but also to open out new perspectives, the student may acquire a knowledge of the changing nature of politics or kingdoms of the changing times.

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Name of the Programme	Year of Introduction	Status of Implementation in CBCS Curriculum(YES/NO)	Programme Outcomes	Course Outcomes
Honours in Mathematics	**2018-19**	YES	The students will gather the concepts for understanding the fundamental axioms and ability to develop ideas based on Real analysis, Complex Analysis, Classical Algebra, Abstract Algebra, Linear Algebra, Differential calculus, Integral Calculus, Analytical Geometry of two and three dimensions, Ordinary and Partial Differentia equations, Vector Calculus and Vector Integration, Metric spaces, Topology, Logic and Sets, Graph Theory, Linear programming, probability and statistics .The said programme makes the students eligible for pursuing higher education in mathematics and they can sit for job oriented competitive examinations.	MTMH-HCC-I(Semester 1) ➢ Eligible for finding Arc length of a curve, area of the region bounded by a given curve, Surface area and Volume of revolution by a curve about a given axis, techniques of sketching conics. ➢ Eligible for derivation of reduction formulae of some special functions. ➢ Eligible for calculating , application of Leibnitz rule and L'Hospital's rule in business, economics and life sciences. ➢ Eilgible in various concepts and applications of two and three dimensions geometry. ➢ Eligible for acquiring the knowledge about differential equations and its real life application.
				MTMH-HCC-II(Semester 1) ➢ Students will be able to calculate n^{th} roots of unity and apply D'Moivre's theorem. ➢ Students will acquire knowledge on theory of equations and it's applications. ➢ Students will be able to solve various inequalities and apply them on different problems. ➢ Students will have a clear concept on functions, relations, well-ordering principle, division algorithm, principle of induction and their applications. ➢ Students will be able to determine rank of

			a matrix and its application on solving system of linear equations. ➢ Students will acquire knowledge on eigen values and eigen vectors. ➢ Students will be acquainted with linear transformations and related problems.
			<u>GE : Geometry, Calculus and Differential Equations (Semester 1)</u> ➢ Eligible for finding Arc length of a curve, area of the region bounded by a given curve, Surface area and Volume of revolution by a curve about a given axis, techniques of sketching conics ➢ Eligible for derivation of reduction formulae of some special functions ➢ Eligible for calculating , application of Leibnitz rule and L'Hospital's rule in business, economics and life sciences. ➢ Eilgible in various concepts and applications of two and three dimensions geometry.
			<u>MTMH-HCC-III(Semester 2)</u> ➢ Students will gather an elaborate knoeledge on real number system with special emphasis on completeness property of R, Archimedean property, density of rational numbers in R, Bolzano-Weierstrass theorem , Heine-Borel theorem. ➢ Students will be able to understand sequence of real numbers and its different properties. ➢ Skill of determining convergence of infinite series of real numbers will be developed.
			<u>MTMH-HCC-IV(Semester 2)</u> ➢ Students will acquire knowledge on solving linear homogeneous and non-homogeneous equations of higher order with constant co-efficients, Wronskian,

			method of undetermined co-efficients, method of variation of parameters.
			➢ Students will learn basic theory of linear system in normal form, two equations in two unknown function.
			➢ Students will gather knowledge how to apply vector triple product, vector calculus and vector integration.
			GE : Algebra (Semester 2) ➢ Students will be able to calculate n^{th} roots of unity and apply D'Moivre's theorem. ➢ Students will acquire knowledge on theory of equations and it's applications. ➢ Students will be able to solve various inequalities and apply them on different problems. ➢ Students will have a clear concept on functions, relations, well-ordering principle, division algorithm, principle of induction and their applications. ➢ Students will be able to determine rank of a matrix and its application on solving system of linear equations. ➢ Students will acquire knowledge on eigen values and eigen vectors.
			MTMH-HCC-V (Semester 3) ➢ Students will learn the concepts of limit and continuity of realn functions. ➢ Students will acquire knowledge on differentiability of functions in R and application of Rolle's theorem, Mean value theorem, Intermediate value peroperty of derivatives, Darboux theorem. ➢ Students will be able to derive Taylor's series and maclaurin's series expansion of some functions. ➢ Students will be able to explore concepts of metric spaces.
			MTMH-HCC-VI (Semester 3)

			- Students will be able to define group and can give examples of groups, specially permutation group, symmetries of a square, dihedral group, quaternion group. - Students will also learn different elementary properties of group theory. - Students will be able to describe subgroup, cyclic group, cosets, normal subgroup, quotient group and can solve problems applying above mentioned concepts.
			MTMH-HCC-VII (Semester 3) - Students will acquire a very clear knowledge on Riemann Integrations - Students will learn sequence series of functions. - Students will be able to solve different Power series.
			SEC-1 LOGIC AND SETS (Semester 3) - Students will gather a very clear concept of set theory and its various properties. - Students will learn different logical approaches.
			GE-Algebra (Semester 3) - Students will be able to calculate n^{th} roots of unity and apply D'Moivre's theorem. - Students will acquire knowledge on theory of equations and it's applications. - Students will be able to solve various inequalities and apply them on different problems. - Students will have a clear concept on functions, relations, well-ordering principle, division algorithm, principle of induction and their applications. - Students will be able to determine rank of a matrix and its application on solving system of linear equations. - Students will acquire knowledge on eigen values and eigen vectors.

			. **MTMH-HCC-VIII (Semester 4)** ➢ Students will be able to solve problems on calculus of several variables. ➢ Students will be able to calculate double and triple integrals. ➢ Students will gather knowledge on vector analysis and its various applications.
			MTMH-HCC-IX (Semester 4) ➢ Students will acquire knowledge on ring theory. ➢ Students will have a clear knowledge on vector spaces and its applications. ➢ Students will be able to calculate problems on linear transformations.
			MTMH-HCC-X (Semester 4) ➢ Students will have deeper knowledge on metric spaces, specially on continuous mapping, compactness, connectedness, homeomorphism and its applications. ➢ Students will learn complex analysis and its applications.
			SEC II (Semester 4) ➢ Students will acquire knowledge on different concepts of graph theory and its applications. ➢ Students will learn to solve Travelling salesman's problems. ➢ Students will be eligible to write Dijkstra's algorithm, Warshall algorithm.
			GE-Group Theory **(Semester 4)** ➢ Students will be able to define group and can give examples of groups, specially permutation group, symmetries of a square, dihedral group, quaternion group. ➢ Students will also learn different elementary properties of group theory. ➢ Students will be able to describe subgroup, cyclic group, cosets, normal

			subgroup, quotient group and can solve problems applying above mentioned concepts.
			### MTMH-HCC-XI (Semester 5) ➤ Students will be eligible to explain automorphism of groups and solve related problems. ➤ Students will know about Characteristic subgroups, Commutator subgroups and their properties. ➤ Students will know about direct product of groups and can solve related problems. ➤ Students will acquire knowledge on group action and can apply it to solve various problems on group theory.
			### MTMH-HCC-XII (Semester 5) ➤ Students will eligible to write algorithms, can calculate convergence and different types of errors of a given function. ➤ Students will eligible to solve Transcendental and polynomial equation by different methods. ➤ Students will be able to solve system of linear algebraic equations by different methods. ➤ Students will capable of solving problems by applying Lagrange's and Newton's interpolation formula, Finite difference operator, Numerical differentiation based on interpolation methods and finite difference methods. ➤ Students will be eligible in solving numerical integration by various rules.
			### MTMH DSE-I:Linear Programming (Semester 5) ➤ Students will be able to formulate LPP and can solve LPP by graphical method, simplex method, two-phase method, Big-M method. ➤ Students will be able to explain Duality theory, can formulate dual problems and will have a clear concept on economic

			interpolation of the dual. ➢ Students will be eligible in formulating and solving Transportation problems and Assignment problems. ➢ Students will be able to formulate and solve two person zero sum game, graphical solution of game theory, linear programming solution of games.
			MTMH DSE-II:Number Theory (Semester 5) ➢ Students will have concepts on Gaussian integers, Euclidean algorithm , various concepts on gcd, consequences of unique prime factorization and can able to solve Diophantine equations. ➢ Students will be able to solve problems on congruence arithmetic and learn related theorems.
			MTMH-HCC-XIII (Semester 6) ➢ Students will gather knowledge on polynomial ring, prime ideal, maximal ideal, principle ideal, irreducible and prime elements, Eisentein criterion, unique factorization domains, Euclidean domains, Divisibility in integral domains and can solve related problems. ➢ Students will be able to solve problems on dual space, dual basis, double dual, transpose of a linear transformation and its inverse matrix in the dual basis. ➢ Students will be capable of solving problems on annihilators, eigen space of linear operator, the minimal polynomial for a linear operator, diagonalizability, invariant subspaces, Cayley-Hamilton theorem, canonical forms. ➢ Students will gather knowledge on inner product spaces and its various results and applications. ➢ Students will eligible in explaining Self-adjoint operator, Normal operator, Orthogonal projections and Spectral theorem.

			MTMH-HCC-XIV (Semester 6) ➢ Students will able to explain what is partial differential equations, construct it, solve it and give geometrical interpretation of first order equations. ➢ Students will be able to derive heat equation, wave equation, wave equation, Laplace equation; can classify second order linear equation as hyperbolic, parabolic or elliptic; can reduce second order linear equation to canonical form. ➢ Students will be able to solve Cauchy problem of an infinite string, Initial boundary value problem, semi- infinite string with a fixed end as well as with a free end, equations non homogeneous boundary conditions, vibrating string problem, heat conduction problem.
			MATH DSE-III :Point Set Topology (Semester 6) ➢ Students will be eligible in explaining countable and uncountable sets, Schoeder - Bernstein Theorem, Cantor's Theorem, Cardinal numbers and cardinal arithmetic, Continum Hypothesis, Zorn's lemma, Axiom of Choice, Well – ordered sets, Hausdorff's maximal principle, Ordinal numbers. ➢ Students will be able to define topological spaces, can give examples of topological spaces, will have the knowledge on basic concepts on topological spaces with special emphasis on Product topology, Quotient topology, Metric topology, Baire-Category theorem. ➢ Students will gather knowledge on Connectedness, Compoact spaces and its various applications. ➢
			MATH DSE – IV : Theory of Equations (Semester 6) ➢ Students will be able to represent polynomial graphically, calculate maximum and minimum values of a polynomial, finding nature of roots by

| | | | | applying Descarte's rule of signs, solve problems on relation between roots and coefficients, of equations. |
| | | | | ➤ Students will be eligible in solving problems on symmetric functions of roots, Transformation of equations, solution of reciprocal and binomial equations, algebraic solution of the cubic and biquadratic equations. |

Programme and Course outcomes for B.Sc Programme course in Mathematics as per CBCS Syllabus:

Name of the Programme	Year of Introduction	Status of Implementation in CBCS Curriculum(YES/NO)	Programme Outcomes	Course Outcomes
B.Sc. Mathematics Programme course	2018-19	YES	The programme makes the students eligible for pursuing higher education in mathematics and they can sit for job oriented competitive examinations.	DSC1(SEMESTER 1): ➤ Eligible for finding Arc length of a curve, area of the region bounded by a given curve, Surface area and Volume of revolution by a curve about a given axis, techniques of sketching conics. ➤ Eligible for derivation of reduction formulae of some special functions. ➤ Eligible for calculating , application of Leibnitz rule and L'Hospital's rule in business, economics and life sciences. ➤ Eilgible in various concepts and applications of two and three dimensions geometry.
				DSC2(SEMESTER 2): ➤ Students will be able to calculate n^{th} roots of unity and apply D'Moivre's theorem. ➤ Students will acquire knowledge on theory of equations and it's applications. ➤ Students will be able to solve various inequalities and apply them on different problems. ➤ Students will have a clear

				concept on functions, relations, well-ordering principle, division algorithm, principle of induction and their applications. ➢ Students will be able to determine rank of a matrix and its application on solving system of linear equations. ➢ Students will acquire knowledge on eigen values and eigen vectors.
				DSC3(SEMESTER 3): ➢ Students will gather an elaborate knoeledge on real number system with special emphasis on completeness property of R, Archimedean property, density of rational numbers in R, Bolzano-Weierstrass theorem , Heine-Borel theorem. ➢ Students will be able to understand sequence of real numbers and its different properties. ➢ Skill of determining convergence of infinite series of real numbers will be developed.
				MATHPSEC-Logic and Sets(SEMESTER 3): ➢ Students will gather a very clear concept of set theory and its various properties. ➢ Students will learn different logical approaches.
				DSC4(SEMESTER 4): ➢ Students will acquire knowledge on solving linear homogeneous and non-homogeneous equations of higher order with constant co-efficients, Wronskian, method of undetermined co-efficients,

				method of variation of parameters. ➤ Students will learn basic theory of linear system in normal form, two equations in two unknown function. ➤ Students will gather knowledge how to apply vector triple product, vector calculus and vector integration.
				MATHPSEC-Theory of Equations (SEMESTER 4): ➤ Students will be able to represent polynomial graphically, calculate maximum and minimum values of a polynomial, finding nature of roots by applying Descarte's rule of signs, solve problems on relation between roots and coefficients, of equations. ➤ Students will be eligible in solving problems on symmetric functions of roots, Transformation of equations, solution of reciprocal and binomial equations, algebraic solution of the cubic and biquadratic equations.
				DSE1-Group Theory and Linear Algebra(SEMESTER 5): ➤ Students will be able to define group and can give examples of groups, specially permutation group, symmetries of a square, dihedral group, quaternion group. ➤ Students will also learn different elementary properties of group theory. ➤ Students will be able to describe subgroup, cyclic group,coests and normal subgroups.

				➤ Students will be able to define vector spaces, subspaces, quotient spaces, basis and dimension of subspaces and can solve related problems.
				MATHPSEC-Probability and Statistics (SEMESTER 5): ➤ Students will be able to define the definition of probability using the concepts of random experiment, sample space and can solve on related problems. ➤ Students will be able to define one and two dimensional distribution function, density functions using random variables and can solve various related problems. ➤ Students will be able to define one and two expectation, moment generating function, correlation coefficients, joint density functions, calculation of covariance, linear regression using joint random variables and can solve various related problems. ➤ Students will be able to gather the knowledge about Chebyshev's inequality, weak and strong law of large number, central limit theorem and can solve various related problems.
				DSE2-Linear Programming Problems(SEMESTER 6): ➤ Students will be able to formulate LPP and can solve LPP by graphical method, simplex method, two-phase method, Big-M method. ➤ Students will be able to explain Duality theory, can formulate dual problems and will have a clear concept on economic interpolation of the dual.

				➢ Students will be eligible in formulating and solving Transportation problems and Assignment problems. ➢ Students will be able to formulate and solve two person zero sum game, graphical solution of game theory, linear programming solution of games.
				MATHPSEC-Graph Theory (SEMESTER 6): ➢ Students will acquire knowledge on different concepts of graph theory and its applications. ➢ Students will be eligible to write Dijkstra's algorithm, Warshall algorithm.

Course Outcome under CBCS
Philosophy (Honours)

CC-1: Indian Philosophy

This paper begins with basic concepts of Indian Philosophy and then provides the students with the knowledge of different schools of Indian Philosophy, such as Carvaka Philosophy, Jaina Philosophy, Baudha Philosophy, Nyaya Philosophy, Advaita and Ramanuja Philosophy.

CC-2: Western Logic 1

This paper begins with the basic logical concepts. Here students learn Aristotolian logic, logic of compound propositions, Proving validity, formal proofs and Reductio Ad Absurdum, Induction per simple enumeration, Argument by analogy and Appraising analogical arguments. This course enhances the logical skills of the students.

CC-3 Western Philosophy I

This paper teaches the students about prominent Greek Philosophers, such, Socrates, Plato and Aristotle. Students also learn about modern western philosophers, Descartes, Spinoza and Leibiniz.

CC-4: Ethics

Unit I of the paper teaches the students about Western ethics and from Unit II students learns about Indian ethics.

CC-5: Indian Philosophy II

From this paper, students learn about Vaisesika Philosophy, Samkhya philosophy, yoga Philosophy Mimamsa Philosophy and some concepts of Advaita and Visistadvaita philosophy.

CC-6: Western Philosophy II

This paper provides students with the knowledge of the philosophy of Locke, Berkeley, Hume and Kant. This is the part of the history of philosophy.

CC-7: Western Logic II

Students learn from this paper about the predicate logic, Shaffer's stroke function, CNF and DNF, Truth-tree Method, Mill's Method, Science and Hypothesis and Probability.

Skill Enhancement Course (SEC: Paper 1): Basics of Counselling:

Introduction to Counselling, Mental health, Academic health, Patient-physician relationship along with smother topics are included in the syllabus. Students are immensely benefited from this course.

Skill Enhancement Course (SEC: Paper II

This course develops philosophical skills among the students. This course helps students to gain philosophical and logical skills.

CC-8: Psychology

This course provides the basics of psychology and helps them gain the knowledge of our mental world.

CC-9: Philosophy of Religion

Religion is an essential part of our life. This course help students think and learn about religion on the basis of logic. Logical thinking about religion help understand religion properly.

CC-10: Social and political philosophy

This course deals with basic concepts of social and political ideas and their significance for our life. This course includes both Indian and western concept about society and politics.

CC-11: Tarkasamgraha with Dipika

This Text provides the knowledge about Indian Epistemology and Logic.

CC-12: Analytic Philosophy:

Text: John Hospers: *An Introduction to Philosophical Analysis.*

Students learn about analytic philosophy by reading this book.

CC-13: Analytic Philosophy

Text: Russell: *The Problems of Philosophy*

This text book make aware of the basic problems of philosophy.

CC-14: Applied Ethics

This paper deals with Environmental Ethics, Human Rights, Euthanasia, Suicide, Abortion, Feminism and other important topics.

Discipline Specific Course I (DSE-I)

Text: An Enquiry Concerning Human Understanding

Or

Text: Gita

Discipline Specific Course 2 (DSE-2)

Text: *Philosophy of Mind* by Jerome Shaffer.

Or

The Problems of Philosophy by Bertrand Russell

DSE-3 : Feminist Philosophy

DSE-4: *Contemporary Indian Philosophy*

Generic Elective Course for Semester I/III

Fundamentals of Indian Philosophy

Generic Elective Course for II/IV

Western Logic.

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Course outcome

Program Course

Discipline Specific course (DSC)

DSC 1-Paper 1: Fundamentals of Indian Philosophy

This Paper provides the students with the knowledge of basic idea about Indian Philosophical schools.

DSC 1: Paper 2: Western Logic

This paper teaches about the basic concepts of Western Logic.

DSC 1: Paper 3: Western Epistemology and Metaphysics

Students can learn about theories of the origins of knowledge, realism, idealism, causality and mind-body problem etc.

DSC 1: Paper4: Western Ethics

This paper provides the knowledge of the basic concepts and theories of moral philosophy.

SEC1, Paper-1 Basics of Counselling gives the knowledge of basic counselling skills.

SEC1 Paper-2: Critical Thinking: This Paper helps philosophy students to think critically on any DSE Paper1: Psychology or philosophy of Religion.

GE 1, Paper 1: Fundamentals of Indian Philosophy.

COURSE OUTCOME

DEPARTMENT OF PHYSICAL EDUCATION, SUKANTA MAHAVIDYALAYA

By Course outcomes(CO) we mean the brief statement describing significance and learning that students will achieve and can reliably demonstrate at the end of a course i.e. after completing a paper (whether it is PROG./GE). These relate to the skills, knowledge, and behavior that students acquire in their curriculum through the course. The knowledge they will gain should be related to skill development, i.e., writing skill, skill of analytical thinking, critical thinking, problem solving. And then how these skills may be used to get different kind of jobs.

Sukanta Mahavidyalaya is affiliated to University of North Bengal. It follows the curriculum and syllabusframed by the University of North Bengal.

The CO statements are defined by considering the syllabus covered in each module of a course. By using the action verbs of learning levels, COs will be designed. Generally, four to five course outcome may be specified for each course base on its weights. It is a very important parameter for NAAC.

The final version of Course Outcomes will be communicated to students, guardians and alumni for their awareness in four ways. It will be uploaded in departmental page of college website. COs are available online in each departmental page in college website (**Error! Hyperlink reference not valid.**gmail.com), whichwill help the students to compare different COs before admission. Side by side COs will be also available in departmental notice board. Dept. teachers will also demonstrate students during the progression of course.

Table 1: Methods of communication of Course outcome to students, parents and alumni

How Published?	Where Published?	How Disseminated
Print in paper	Department Notice boards	Self-reading by students, parents and alumni
Online	Under Department tab of college Website	Available for Self-reading in public domain

Table 2: Course Outcomes, **Program:** B. A. (General)**, Program code: PEDN**

S.No	Course	Semester	Course Code	Credit	Marks	Course outcome	Skill Development related to employability and Entrepreneurship development
1		1	DSC-PE-1	6	75	After completion of this course, students will Apply knowledge of physical education, growth and development, play, sports and games knowledge, history of physical education and yoga to explain aim and objectives of physical education. Use an understanding of history of yoga, Astanga yoga to effectively know about yoga in everyday life, further study in Physical Education.	The course focuses to develop the basic knowledge in physical education. The basic knowledge and conception of physical education is essential to understand the higher level Games and Sports. The content of course is also important to qualify the NET, SET, and other job oriented examinations for Physical education students.
2	PHYSICAL EDUCATION (theory)	2	DSC-PE-2	6	75	Having successfully completed this course student will learn Management of Physical Education & Sports.	Basic knowledge of Management is essential to realize the higher physical education to draw the fixtures in the Tournaments. The content of course is also important to qualifythe SSC, PSC, NET, SET, and other job oriented examinations for Physics students.
3	PHYSICAL EDUCATION (Theory)	3	DSC-PE-3 & SEC-PE-1	6	75	Completion of this course will enable the students to: Know the basics of anatomy, physiology, exercise physiology, musculo-skeletal system, circulatory system, respiratorysystem. Use an understanding Gymnastics effectively, further study in Physical Education.	The basic knowledge in anatomy physiology to know at higher level. The content of course is also important to qualify the SSC, PSC, NET, SET and other job oriented examinations for Physics students.

4	PHYSICAL EDUCATION(practical)	4	DSC-PE-4 & SEC-PE-2	6	75	After completion of this course will enable the Students to: Know the basics of Health, Health Education,personal hygiene, health problems-prevention and control, physical fitness and wellness & First Aid Management. They will also experience about Balanced Diet. On completion of this course students will have hands of experience to perform starting, finishing, relay race, long jump, high jump, shot-put, discuss throw, javelin throw They willbe have the concepts of track and field events.	Basic knowledge of health education is essential to realize the higher physical education. The content of course is also important to qualifythe SSC, PSC, NET, SET, and other job oriented examinations for Physics students. Developed physical fitness through track and field event. The knowledge is essential for the experiment of higher physical education research.
5	PHYSICAL EDUCATION(Theory)	5	DSE-PE-1, GE-PE-1 & SEC-PE-3	6	75	On completion of this course students will be able to understand about Tests, Measurements and Evaluation in Physical Education. Or, students will be able to understand about Sports Training. Also know about Modern Trends in Physical Education and Sports Sciences. Students also have the knowledge about Archery, Combative Sports and Adventure Sports.	Learning Tests, measurements and Evaluations, students can apply their knowledge for Higher Studies & Research work in Physical Education. The content of course is also important to qualify the NET, SET, PSC and other job oriented examinations for Physical education students.
6	PHYSICAL EDUCATION (Practical)	6	DSE-PE-2, GE-PE-2 & SEC-PE-4	6	75	On completion of this course students will be able to understand psychology, learning, learning curve, motivation, instinct, and emotion, stress, personality and sociological aspects etc. Or completion of this course students will be able to understand Kinesiology and Biomechanics. On completion of this course students will have hands of Experience to perform gymnastics, yogasana.They will be have the concepts of asana,pranayam, surya namaskar etc	Learning and psychological factors is building block to understand the psychology for physical education students of at higher level. The content of course is also important to qualify the NET, SET, and otherjob oriented examinations for Physical education students. Learning Kinesiology & Biomechanics, student's can gather knowledge about motion, C.G. Axis, Planes, Kinematics, Kinetics etc. which they can apply for their Higher Studies & Research work in Physical Education. The content of course is also important to qualify the NET, SET, PSC and other job oriented examinations for Physical education students Developing the skills & techniques by Practicing the Ball Games like Football, handball Basketball, Volleyball, Netball & Throwball.

Programme Outcomes of B.A (GENERAL) PHYSICAL EDUCATION

1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

4. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

5. Effective Citizenship: Demonstrate empathetic social concern and equity-centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

6. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

7. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

8. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-longlearning in the broadest context socio-technological changes.

Programme Specific Outcomes (PSO) B.A. (General) Physical Education

1. Students will acquire a comprehensive knowledge and sound understanding of fundamentals of Physical Education.

2. Students will develop practical, theoretical skills in Physical Education.

3. Students will be prepared to acquire a range of general skills, to specific skills to communicate with society effectively and learn independently.

4. Students will acquire a job efficiently in diverse fields such as B.P.Ed, M.P.Ed, SSC, PSC, NET, SET, ETC.

Sukanta Mahavidyalaya

Dhupguri, Jalpaiguri, West Bengal

Department of Physics

Programme Offered

1. **B. Sc. Honours in Physics**
2. **B.Sc. Programme Course in Physics**

Choice-Based Credit System
Introduced from the Academic Session 2018-2019
(University of North Bengal)

Credit Distribution across Courses

Course Type	Total Papers	Credits	
		Theory + Practical	Theory*
Core Course	14	14*4 =56 14*2 =28	14*5 =70 14*1=14
Discipline Specific Electives	4	4*4=16 4*2=8	4*5=20 4*1=4
Generic Electives	4	4*4=16 4*2=8	4*5=20 4*1=4
Ability Enhancement Language Courses	2	2*2=4	2*2=4
Ability Enhancement Language Courses	2	2*2=4	2*2=4

Details of Semester wise distribution of courses

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course–I(AECC -I)	English communication / Environmental Science	2
	Core course-I	Mathematical Physics-I	4
	Core course–I Practical	Mathematical Physics-I Lab	2
	Core course–II	Mechanics	4
	Core course–II Practical	Mechanics Lab	2
	Genetic Elective–1	Mechanics/Thermal Physics and Statistical Mechanics (Any one)	4
	Generic Elective–1 Practical	Mechanics Lab	2
	Programme Course: DSC-1	Mechanics	4
	Programme Course: DSC-1-Practical	Mechanics Lab	2
II	Ability Enhancement Compulsory Course–II(AECC -II)	English communication / Environmental Science	2
	Core course–III	Electricity and Magnetism	4
	Core course–III Practical	Electricity and Magnetism Lab	2
	Core course–IV	Waves and Optics	4
	Core course–IV Practical	Waves and Optics Lab	2
	Generic Elective–2t	Electricity and Magnetism/Wave optics (Any one)	4
	Generic Elective–2Practical	Electricity and Magnetism Lab/Wave optics Lab(Any one)	2
	Programme Course: DSC-2	Electricity and Magnetism	4
	Programme Course: DSC-2-Practical	Electricity and Magnetism Lab	2
III	Core course- V	Mathematical Physics-II	4
	Core course -v Practical	Mathematical Physics-II Lab	2
	Core course- VI	Thermal Physics	4
	Core course-VI Practical	Thermal Physics Lab	2
	Core course–VII	Digital Systems and Applications	4
	Core course–VII Practical	Digital Systems and Applications Lab	2

	Skill Enhancement Course–1	Computational Physics/Electrical circuits and Network (Any one)	2
	Generic Elective–3	Thermal Physics and Statistical Mechanics/ Mechanics(Any one)	4
	Generic Elective–3 Practical	Thermal Physics and Statistical Mechanics Lab/Mechanics Lab(Any one)	2
	Programme Course: DSC-3	Thermal Physics and Statistical Mechanics	4
	Programme Course: DSC-2-Practical	Thermal Physics and Statistical Mechanics Lab	2
	Programme Course: SEC	Computational Physics/Electrical circuits and Network(Any one)	2
IV	Core course–VIII	Mathematical Physics III	4
	Core course–VIII Practical	Mathematical Physics-III Lab	2
	Core course–IX	Elements of Modern Physics	4
	Core course–IX Practical	Elements of Modern Physics Lab	2
	Core course–X	Analog Systems and Applications	4
	Core course–X Practical	Analog Systems & Applications Lab	2
	Skill Enhancement Course-2	Basic Instrumentation Skills/ Renewable energy and Energy harvesting(Any one)	2
	Generic Elective–4	Wave optics/Electricity and Magnetism(Any one)	4
	Generic Elective–4 Practical	Wave optics Lab/Electricity and Magnetism Lab(Any one)	2
	Programme Course: DSC-4	Waves and optics	4
	Programme Course: DSC-4-Practical	Waves and optics Lab/	2
	Programme Course: SEC	Basic Instrumentation Skills/ Renewable energy and Energy harvesting(Any one)	2
V	Core course–XI	Quantum Mechanics and Applications	4
	Core course–XI Practical	Quantum Mechanics andApplications Lab	2
	Core course–XII	Solid State Physics	4
	Core course–XII Practical	Solid State Physics Lab	2
	Discipline Specific Elective–1	Nano-materials and Applications/ Advanced Mathematical Physics I(any one)	4
	Discipline Specific Elective–1Practical	Nano-materials and Applications Lab/ Advanced Mathematical Physics I Lab (any one)	2
	Discipline Specific Elective–2	Applied Dynamics/Atmospheric Physics	4
	Discipline Specific Elective–2 Practical	Applied Dynamics Lab/Atmospheric Physics Lab	2

		Programme Course: DSE 1	Elements of Modern Physics / Nuclear and Particle Physics (any one)	6
		Programme Course: SEC	Basic Instrumentation Skills/ Renewable energy and Energy harvesting (Any one)	2
VI		Core course–XIII	Electromagnetic Theory	4
		Core course–XIII Practical	Electromagnetic Theory Lab	2
		Core course–XIV	Statistical Mechanics4	4
		Core course–XIV Practical	Statistical Mechanics Lab	2
		Discipline Specific Elective–3	Astrophysics and Astronomy/ Advanced Mathematical Physics-II (any one)	6
		Discipline Specific Elective–4	Nuclear and Particle Physics / Classical Dynamics (any one)	6
		Programme Course: DSE 2	Solid State Physics/ Quantum Mechanics (any one)	4
		Programme Course: DSE 2 Practical	Solid State Physics Lab/ Quantum Mechanics Lab (any one)	2
		Programme Course: SEC	Basic Instrumentation Skills/ Renewable energy and Energy harvesting (Any one)	2

<center>SEMESTER-I</center>

Core Subjects Syllabus

CoreT1–MathematicalPhysics
Teacher's Name: Dr. Apurba Barman
MathematicalPhysics   **4 Credits**
Calculus

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for InitialValue Problems. Particular Integral.Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using LagrangeMultipliers.

Vector Calculus

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Orthogonal Curvilinear Coordinates

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Introduction to probability

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

Dirac Delta function and its properties

Definition ofDirac delta function. Representation as limit of a Gaussian function and rectangular function.Properties of Dirac delta function.

Reference Books

1.Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

2.An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning

3.Differential Equations, George F. Simmons, 2007, McGraw Hill. Mathematical Tools for Physics, James Nearing2010, Dover Publications.

3.Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book

4.Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012,   JonesandBartlett Learning.

5.Mathematical Physics, Goswami, 1st edition, Cengage Learning

6.Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press.

7.Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India..

8.Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.

9.Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.

CoreP1–Mathematical Physics Lab

Teacher's Name: Dr. Apurba Barman

Mathematical Physics   2 credits

Introduction and Overview

Computer architecture and organization, memory and Input/output devices

Basics of scientific computing

Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterativemethods

Errors and error Analysis

Truncation and round off errors, Absolute and relative errors, Floating point computations.

Introduction to plotting graphs with Gnuplot

Basic 2D and 3D graph plotting -plotting functions and data files, fitting data using gnuplot'sfit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.

Introduction to programming in Python/Fortran/C/C++:

Introduction to programming, constants, variables and data types, dynamical typing, operators and expressions, modules, I/O statements, iterables, compound statements, indentation in python, the if-elif-else block, for and while loops, nested compound statements, lists, tuples, dictionaries and strings, basic ideas of object oriented programming.

Programs:

Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search Renewable energy

Random number generation

Area of circle, area of square, volume of sphere, value of pi (π)

Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods

Solution in optics.Of linear and quadratic equation,solving

Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolationEvaluation of trigonometric functions e.g. sin θ, cos θ, tan θ, etc.

Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method

      Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop

Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods

First order differential equation

Radioactive decay

Current in RC, LC circuits with DC source

Newton's law of cooling

Classical equations of motion

Attempt following problems using RK 4 order method

$$I = I_2 \left(\frac{sin\alpha}{\alpha} \right)$$

Solve the coupled differential equations

$$\frac{dy}{dx} = y + x - \frac{x^3}{3}, \qquad \frac{dy}{dx} = -x$$

$$\frac{dx}{dt} = y + x - \frac{x3}{3}; \frac{dy}{dx} = -x$$

For four initial conditions x(0) = 0, y(0) = -1, -2, -3, -4.

Plot x vs y for each of the four initial conditions on the same screen for 0≤ t ≤15

The differential equation describing the motion of a pendulum is.

$$; \frac{d^2\theta}{dt^2=} = -sin\theta.$$

The pendulum is released from rest at an angular displacement, i. e. $\theta(0) = $, and $\theta'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5 \& 1.0$ and plot θ as a function of time in the range $0 \leq t \leq 8\pi$.

Also plot the analytic solution valid for small θ $\sin\theta = \theta$.

Refer

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.⌐
2. Learning with Python-how to think like a computer scientist, J. Elkner, C. Meyer, and A. Downey,

3. Introduction to computation and programming using Python, J. Guttag, 2013, Prentice Hall

4. Effective Computation in Physics-Field guide to research with Python, A. Scopatz and K.D. Huff, 2015, O'
5. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning. Numerical Analysis, K.E. Atkinson, 3 rd Edn . , 2007, Wiley India Edition.⌐
6. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.⁻
7. An Introduction to computational Physics, T.Pang, 2nd Edn., 2006,Cambridge Univ. P
8. Computational Physics, Darren Walker, 1st Edn., 2015, Scientific Inter

CoreT2–Mechanics

Teacher's Name: Jiban Kumar Ray

Mechanics
4 Credits

Fundamentals of Dynamics

Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum.Impulse.

Work and Energy

Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Qualitative study of one dimensional motion from potential energy curves. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Collisions

Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Rotational Dynamics

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Elasticity

Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Fluid Motion

Kinematics of Moving Fluids: Poiseuille'sEquation for Flow of a Liquid through a Capillary Tube.

Gravitation and Central Force Motion

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due tospherical shell and solid sphere.Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system(GPS).

Oscillations

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Non-Inertial Systems:

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Special Theory of Relativity

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

Reference Book:

1. ¬An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973,McGraw-Hill.
2. Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, TataMcGraw-Hill.
3.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, CengageLearning.
5.
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley andSons.
7.

Additional Books for Reference

8. Company Limited,2000
9. ¬University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley

10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGrawHill.

CoreP2– Mechanics Lab

Teacher's Name: Jiban Kumar Ray

Mechanics   2 Credits

General Topic

Discussion on random errors in observations.

List of Practical

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.

2. To study the random error in observations.

3. To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c)Modulus of rigidity.

4. To determine the Moment of Inertia of aFlywheel.

5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille'smethod).

6. To determine the Young's Modulus of a Wire by Optical LeverMethod.

7. To determine the Modulus of Rigidity of a Wire by Maxwell'sneedle.

8. To determine the elastic Constants of a wire by Searle'smethod.

9. To determine the value of g using BarPendulum.

10. To determine the value of 'g' using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint, H.T. Workshop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann EducationalPublishers
3. A Text Book of Practic
4. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt.Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge UniversityPress.

GE T1 - Mechanics

Teacher's Name: Mr. Amit Basak

Mechanics   4
Credits

Vectors

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.

Laws of Motion

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion Angular velocity and angular momentum. Torque. Conservation of angular momentum.

Gravitation

Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts

Oscillations

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Elasticity Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and << by Searles method.

Special Theory of Relativity

Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation.

Relativistic addition of velocities.

Reference Books

1) ⌐ University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
2) ⌐ Mechanics Berkeley Physics, v.1: Charles Kittel, et.al. 2007, Tata McGraw-Hill. Renewable energy
3)   – Resnick, Halliday &Walker 9/e, 2010, Wiley
4)   ng Mechanics, Basudeb Bhattacharya, 2 nd edn., 2015, Oxford University Press
5)

GE P1 – Mechanics Lab

Teacher's Name: Mr. Amit Basak

Mechanics
2Credits

List of Practical

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 study the Motion of a Spring and calculate (a) Spring Constant, (b) g.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985,
   Heinemann Educational Publishers.

3. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal,
   New Delhi.

PHYSICS-DSC 1 A: MECHANICS

Teachers Name: Mr. Jiban Kumar Ray

MECHANICS   4 Credits

Vectors:

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Ordinary Differential Equations:

1 st order homogeneous differential equations. 2 nd order homogeneous differential equations with constant coefficients.

Laws of Motion:

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

Momentum and Energy:

Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

Rotational Motion:

Angular velocity and angular momentum. Torque. Conservation of angular momentum.

Gravitation:

Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Oscillations:

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

Elasticity:

Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio- Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia - method

Special Theory of Relativity:

Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities

Reference Books:

1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison- Wesley
2. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw- Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. Engineering Mechanics, Basudeb Bhattacharya, 2 nd edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PHYSICS DSC 1A LAB: MECHANICS Lab

Teachers Name: Mr. Jiban Kumar Ray

2 Credits

List of prctical

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

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.

ㄱ2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann Educational Publishers.

ㄱ 3. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

ㄱ 4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11 th Edition, 2011, Kitab Mahal, New Delhi.

SEMESTER-II

CoreT3-Electricity and Magnetism

Teacher's Name: Dr. Apurba Barman

Electricity and Magnetism   4 Credits

Electric Field and Electric Potential:

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electro1static energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Uniqueness theorem (statement). Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Dielectric Properties of Matter:

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

Magnetic Field

Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).Ampere's Circuital Law and its application to (1) infinite straight wire, (2) Infinite planar surface current, and(3) Solenoid. Properties of B: curl and divergence. Axial vector property of B and its consequences. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter

Magnetization vector (M). MagneticIntensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

Electromagnetic Induction

Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current

Electrical CircuitsAC Circuits:

Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit

Network theorems

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits Note: For the sake of brevity, details of ballistic galvanometer may be omitted from the theory course. Some part of the theory may be needed for the experiments, but this can be covered as part of Practical.

Reference Books

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TataMcGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-HillEducation
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, BenjaminCummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford UniversityPress.
6. Electricity and Magnetism, J.H.Fewkes &J.Yarwood. Vol. I, 1991, Oxford Univ.Press.

CoreP3–Electricity and & Magnetism Lab

Teacher's Name: Dr. Apurba Barman

Electricity and Magnetism   2 Credits

General topic

Use a Multimeterfor measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.

List of Practicals

1.To study the characteristics of a series RCCircuit.1

2.To determine an unknown Low Resistance usingPotentiometer.

3.To determine an unknown Low Resistance using Carey Foster'sBridge.

4.To determine the resistance of a galvanometer using Thomson'smethod.

5.Measurement of field strength B and its variation in a solenoid (determinedB/dx)

6.To verify the Thevenin and Nortontheorems.

7.To verify the Superposition, and Maximum power transfertheorems.

8.To determine self-inductance of a coil by Anderson'sbridge.

9.To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Bandwidth.

10.To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.

Reference Books

1. AdvancedPracticalPhysicsforstudents,B.L.FlintandH.T.Worsnop,1971,AsiaPublishingHouse1
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning.
5. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

CoreT4-Waves and Optics

Teacher's Name:Miss. Susmita Basak

Waves and Optics   4 Credits

Superposition of Collinear Harmonic oscillations

Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies(Beats).

Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Superposition of two perpendicular Harmonic Oscillations

Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

Wave Motion

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves

Velocity of Waves

Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

Wave Optics

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

Interference

Division of amplitude and wavefront. 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.

Interferometer

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength,(3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Diffraction and Holography

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Holography:

Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, TataMcGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981,McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn.,1999, PergamonPress.
4. Optics, Ajoy Ghatak, 2008, Tata McGrawHill
5. ThePhysicsofVibrationsandWaves,H.J.Pain,2013,JohnWileyandSons.
6. ThePhysicsofWavesandOscillations,N.K.Bajaj,1998,TataMcGrawHill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

CoreP4–Wave and Optics Lab

Teacher's Name: Miss. Susmita Basak

Wave and Optics   2 Credits

List of Practical

1. To determine the frequency of an electric tuning fork by Melde's experiment   and verify $\lambda 2$–T law.

2. To investigate themotion of coupledoscillators.

3. To study LissajousFigures.

4. Familiarization with: Schuster`s focusing; determination of angle ofprism.

5. To determine refractive index of the Material of a prism using sodiumsource.

6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

7. To determine the wavelength of sodium source using Michelson'sinterferometer.

8. To determine wavelength of sodium light using FresnelBiprism.

9.To determine wavelength of sodium light using Newton'sRings.

10.To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-

shaped Film.

11.To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.

12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop,1971,AsiaPublishingHouse
2. A Text Book of Practical Physics, I. Prakash &Ramakrishna, 11th Ed., 2011, KitabMahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, VaniPub.

GE T2 - Electricity and Magnetism

Teacher's Name: Amit Basak

Electricity and Magnetism   4 Credits

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 and Stoke's theorem of vectors (statement only).

Electrostatics

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. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Magnetism

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials:

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility.

Brief introduction of dia-, para-and ferro- magnetic materials.

Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell`s equations and Electromagnetic wave propagation:

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

GE P2 – Electricity and Magnetism Lab

Teacher's Name: Amit Basak

Electricity and Magnetism   2 Credits

List of Practical

1) To use a Multimeter for measuring

a) Resistances

b) AC and DC Voltages

c) DC Current

d) Checking electrical fuses

2) To compare capacitances using De'Sauty's bridge.

3) Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)

4) To study the Characteristics of a Series RC Circuit.

5) To study a series LCR circuit LCR circuit and determine its

    a) Resonant frequency

b) Quality factor

6) To study a parallel LCR circuit and determine its:

    a) Anti-resonant frequency and

    b) Quality factor Q

7) To determine a Low Resistance by Carey Foster's Bridge.

8) To verify the Thevenin and Norton theorems

9) To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985,Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

PHYSICS-DSC 2A: ELECTRICITY AND MAGNETISM

Teacher's Name: Mr. Amit Basak

ELECTRICITY AND MAGNETISM   4 Credits

Vector Analysis:

Review of vector algebra (Scalar and Vector product), gradient, ivergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss- divergence theorem and Stoke's theorem of vectors (statement only).

Electrostatics:

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. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Magnetism:

Magnetostatics: Biot-Savart's law & its applications- straight conductor, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic

susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual

inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell`s equations and Electromagnetic wave propagation:

Equation of continuity of current,Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field,electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

PHYSICS DSC 2A- LAB: ELECTRICITY AND MAGNETISM LAB

Teacher's Name: Mr. Amit Basak

2 Credits

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

2) To compare capacitances using De'Sauty's bridge.

3) Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).

4) To study the Characteristics of a Series RC Circuit.

5) To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor

6) To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q

7) To determine a Low Resistance by Carey Foster's Bridge.

8) To verify the Thevenin and Norton theorem

9) To verify the Superposition, and Maximum Power Transfer Theorem

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11 th Edition, 2011, Kitab Mahal, New Delhi.

3. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann   Educational Publishers

SEMESTER-III

CoreT5-Mathematical   Physics-II

Teacher's Name: Dr. Apurba Barman

Mathematical Physics –II   4 Credits

Fourier Series

Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sineand cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.

Frobenius Method and Special Functions

Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($Jo(x)$ and $J1(x)$) and Orthogonality.

Some Special Integrals

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Variational calculus in physic

Functionals. Basic ideas of functionals. Extremization of action as a basic principle in mechanics. Lagrangian fomulation. Euler's equations of motion for simple systems: harmonics oscillators, simple pendulum, spherical pendulum, coupled oscillators. Cyclic coordinates. Symmetries and conservation laws. Legendre transformations and the Hamiltonian formulation of mechanics. Canonical equations of motion. Applications to simple systems.

Partial Differential Equations

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of astretched string, rectangular and circular membranes. Diffusion Equation.

Reference Books

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.⌐
2. Fourier Analysisby M.R. Spiegel, 2004, Tata McGraw-
3.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.⌐
6. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press⌐
7. Mathematical methods for Scientists & Engineers, D.A.
8. Mathematical Physics, P. K. Chattopadhyay, 2014, New Academic science

CoreP5–Mathematical PhysicsII Lab

Teacher's Name: Dr. Apurba Barman

Mathematical Physics II   2 Credits

Introduction to Numerical computation using numpy and scipy

Introduction to the python numpy module. Arrays in numpy, array operations, array item selection, slicing, shaping arrays. Basic linear algebra using the linalg submodule. Introduction to online graph plotting using matplotlib. Introduction to the scipy module. Uses in optimization and solution of differential equations.Introduction to OCTAVE(if time permits)

Curve fitting, Least square fit, Goodness of fit, standard deviation

Ohms law to calculate R, Hooke's law to calculate spring constant

Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors,eigen values problem Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)

Generation of Special functions using User defined functions

 Generating and plotting Legendre Polynomials Generating and plotting Bessel function

Solution of ODE First OrderDifferential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed differencemethodFirst order differential equation

1.Radioactivedecay

2.Current in RC, LC circuits with DCsource

3.Newton's law of cooling

4.Classical equations of motion Second order Differential Equation

5.Harmonic oscillator (nofriction)

6.Damped Harmonicoscillator

7.Overdamped

8.Criticaldamped

9.Oscillatory

10.Forced Harmonicoscillator

11.Transientand

12.Steady statesolution

13.Apply above to LCR circuits

14. Solve $x^2 \frac{d^2 y}{dx^2} - 4x(1+x)\frac{dy}{dx} + 2(1+x)y - x^3$ with the boundary condition at x=1,

15. $y= \frac{1}{2}e^2, \frac{dy}{dx} = \frac{-8}{2}e^2 - 0.5$, in the range $1 \le x \le 3$. Plot y and $\frac{dy}{dx}$ against x in the given range in the same graph.

Partial differential equations

1.Waveequation

2.Heatequation

3.Poissonequation

4.Laplaceequation

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd

2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press

3.

4. Computational Physics, D.Walker, 1st Edn., 2015, Scientific

5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and

6. Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández.

CoreT6-Thermal Physics

Teacher's Name: Miss. Susmita Basak/ Mr. Jiban Kumar Ray

Thermal Physics   4 Credits

Introduction to Thermodynamic

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of

Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence.

Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

Thermodynamic Potentials

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Maxwell's Thermodynamic Relations

Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation,(2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real Gases:

Behavior of Real Gases: Deviations from the Ideal Gas Equation. The VirialEquation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling

Reference Books

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill

3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford UniversityPress
6. Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

CoreP6–Thermal Physics Lab

Teacher's Name: Miss. Susmita Basak/ Mr. Jiban Kumar Ray

Thermal Physics   2 Credits

List of Practical

1.To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flowmethod.

2.To determine the Coefficient of Thermal Conductivity of Cu by Searle'sApparatus.

3.To determine the Coefficient of Thermal Conductivity of Cu by Angstrom'sMethod.

4.To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's discmethod.

5.To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).

6.To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its TwoJunctions.

7.To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, KitabMahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub

CoreT7-Digital Systems and Applications

Teacher's Name: Miss. Susmita Basak

Digital Systems and Applications   4 Credits

Integrated Circuits

Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.

Digital Circuits :

Difference between Analog and Digital Circuits.

Binary Numbers.

Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.

Boolean algebra

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Data processing circuits

Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Circuits

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.

Sequential Circuits:

SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop

Timers

IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.

Shift registers

Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers(only up to 4 bits).

Counters

(4 bits)Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Computer Organization

Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization &addressing. Memory Interfacing. Memory Map.

1. Digital Principles and Applications, A.P. Malvino, D. P. Leach andSaha, 7th Ed., 2011, Tata

2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt.Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tat

4. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHILearning
5.
6. Digital Electronics, Subrata Ghoshal

7.

8. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

CoreP7–Digital Systems and Applications Lab

Teacher's Name: Miss. Susmita Basak

Digital Systems and Applications   2 Credits

List of Practical

1.To measure (a) Voltage, and (b) Timeperiod of a periodic waveform usingCRO.

2.To test a Diode and Transistor using aMultimeter.

3.To design a switch (NOT gate) using atransistor.

4.To verify and design AND, OR, NOT and XOR gates using NANDgates.

5.To design a combinational logic system for a specified TruthTable.

6.To convert a Boolean expression into logic circuit and design it using logic gate Ics.

7.To minimize a given logic circuit.

8.Half Adder, Full Adder and 4-bit binary Adder

.9.Half Subtractor, Full Subtractor, Adder-Subtractorusing Full Adder IC.

10.To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NANDgates.

11.To build JK Master-slave flip-flop using Flip-Flop Ics

12.To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.

13.Tomakea4-bitShiftRegister(serialandparallel)usingD-type/JKFlip-Flop Ics.

14.To design an astable multivibrator of given specifications using 555Timer.

15.To design a monostable multivibrator of given specifications using 555Timer.

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.⌐
2. BasicElectronics:Atextlabmanual,P.B.Zbar,A.P.Malvino,M.A.Miller,1994,Mc-GrawHill

SEC T2 – Electrical Circuits and Networks

Teacher's Name:Miss. Susmita Basak

Electrical Circuits and Network Skills   2 Credits

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.

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.

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.

Generators and Transformers

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

Electric Motors

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

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

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)

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.

Reference Books

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

GE T1 - Mechanics

Teacher's Name: Mr. Jiban Kumar Ray

Mechanics   4 Credits

Vectors

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constantcoefficients.

Laws of Motion

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and EnergyConservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational MotionAngular velocity and angular momentum. Torque. Conservation of angular momentum.

Gravitation

Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts.

Oscillations

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

Elasticity

Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and $\ll$ by Searles method.

Special Theory of Relativity

Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation.

Relativistic addition of velocities.

Reference Books

1. ⌐ University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley

2007, Tata McGraw-Hill.

– Resnick, Halliday &Walker 9/e, 2010, Wiley

4. Engineering Mechanics, Basudeb Bhattacharya, 2 nd edn., 2015, Oxford University Press

GE P1 – Mechanics Lab

Teacher's Name: Mr. Jiban Kumar Ray / Mr. Amit Basak

Mechanics   2 Credits

List of Practical

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 study the Motion of a Spring and calculate (a) Spring Constant, (b) g.

1.Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.

2.Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

3.Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.

4.A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal,New Delhi.

PHYSICS-DSC 3A: THERMAL PHYSICS AND STATISTICAL MECHANICS

Teacher's Name: Miss. Susmita Basak

THERMAL PHYSICS AND STATISTICAL MECHANICS
4Credits

Laws of Thermodynamics:

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law

and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of FirstLaw: General Relation between C P & C V , Work Done during Isothermal and Adiabatic Processes,

Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy,

Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature

diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamic Potentials:

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for $(C_P - C_V)$, C_P/C_V, TdS equations.

Kinetic Theory of Gases:

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases

Theory of Radiation:

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

Statistical Mechanics:

Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics – Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Reference Books:

1.   Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2.   ⌐ A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3.   1956, Courier Dover Publications.
4.   ⌐ Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5.   ⌐ Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
6.   Thomson Brooks/Cole.
7.   ⌐ Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.

PHYSICS LAB-DSC 3A LAB:

THERMAL PHYSICS AND STATISTICAL MECHANICS

Teacher's Name: Miss. Susmita Basak   2 Credits

List of practical

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

Reference Books:

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

SEC T2 – Electrical Circuits and Networks

Teacher's Name: Susmita Basak/ Mr. Jiban Kumar Ray

Electrical Circuits and Network Skills   2 Credits

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.

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.

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.

Generators and Transformers

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

Electric Motor

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

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

Electrical Protectio

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)

Electrical Wiri

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.

Reference Books

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. - A K Theraja
3. - M G Say ELBS Edn

SEMESTER-IV

CoreT8-Mathematical Physics-III

Teacher's Name: Mr. Amit BAsak

Mathematical Physics III   4 Credits

Complex Analysis

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

Integrals Transforms

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

Matrices

Addition and Multiplication of Matrices. Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Trace of a Matrix. InnerProduct

Eigen-values and Eigenvectors

Cayley-Hamiliton Theorem. Diagonalization of Matrices. Solutions of Coupled Linear Ordinary Differential Equations. Functions of a Matrix.

Reference Books

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge UniversityPress
2. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, DoverPublications
3. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ.Press
4. Complex Variables, A.K. Kapoor, 2014, Cambridge Univ.Press
5. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
6. First course in complex analysis with applications,D.G.ZillandP.D.Shanahan,1940,Jones & Bartlett

CoreP8–Mathematical PhysicsIII Lab

Teacher's Name: Mr. Amit Basak

Mathematical Physics III   2 Credits

List of Practical

1. Solve differential equations:

   $$\frac{dy}{dx} = e^{-x} \text{ with } y = 0 \text{ for } x = 0$$

   $$\frac{dy}{dx} + e^{-x} = x^2$$

   $$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$$

   $$\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$$

2. Dirac Delta Function:

3. Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$, for σ=1, .1, .01 and show it tends to 5

4. Fourier Series Program to sum $\sum_{n=1}^{\infty}(.2)^n$ Evaluate the Fourier coefficients of a given periodic function (square wave)

5. Frobenius method and Special functions:

6. Show recursion relation

   $$\int_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$$
   Plot $P_n(x), j_v(x)$

1. Solve differential equations:

$$\frac{dy}{dx} = e^{-x} \text{ with } y = 0 \text{ for } x = 0$$

$$\frac{dy}{dx} + e^{-x} = x^2$$

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$$

$$\frac{d^4y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$$

2. Dirac Delta Function:

3. Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$, for σ=1, .1, .01 and show it tends to 5

4. Fourier Series Program to sum $\sum_{n=1}^{\infty}(.2)^n$ Evaluate the Fourier coefficients of a given periodic function (square wave)

5. Frobenius method and Special functions:

6. Show recursion relation

$$\int_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$$
Plot $P_n(x)$, $j_v(x)$

7. Calculationoferrorforeachdatapointofobservationsrecordedinexperimentsdoneinprevioussemesters (choose any two).

8. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computerprogram.

9. Evaluation of trigonometric functions e.g. sin θ, Given Bessel's function at N points find its value at an intermediate point.

Complex analysis: Integrate $1/(x_2+2)$ numerically and check with computer integration

10. Compute the nth roots of unity for n = 2, 3, and 4.

11. Find the two square rootof−5+12j.

12. Integral transform: FFT of e^{-x^2}

Reference Books

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed.,2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and
4. Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN:978-3319067896

5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press

CoreT9-Elements of Modern Physics

Teacher"s Name :Mr. Jiban Kumar Ray

Elements of Modern Physics   4 Credits
Unit 1

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

Unit 2

Position measurement-gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle usinguncertainty principle; Energy-time uncertainty principle-application to virtual particles and range of an interaction.Two slit interference experiment with photons, atoms and particles; linearsuperposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Unit 3

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.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, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Unit 4

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay-energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.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 driving stellar energy (brief qualitativediscussions).

Lasers:

Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.

Reference Books

1. Concepts of Modern Physics, Arthur Beiser, 2002,McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGrawHill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, PearsonEducation.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGrawHill
6. QuantumMechanics:Theory&Applications,A.K.Ghatak&S.Lokanathan,2004,Macmillan

Additional Books for Reference

1. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHILearning.
2. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co.Ltd.
3. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-HillCo.
4. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of PhysicsPub.
5. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGrawHill

CoreP9–Elementsof Modern Physics Lab

Teacher's Name: Mr. Jiban Kumar Ray

Electrical Circuits and Network Skills   2 Credits

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.

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.

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.

Generators and Transformers

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

Electric Motor

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

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

Electrical Protectio

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)

Electrical Wiri

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.

Reference Books

4.   A text book in Electrical Technology - B L Theraja - S Chand & Co.
5.   - A K Theraja
6.   - M G Say ELBS Edn

Elements of Modern Physics   2 Credits

List of Practical

1. Measurement of Planck's constant using black body radiation and photo-detector

2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light

3. To determine work function of material of filament of directly heated vacuum diode. 4. To determine the Planck's constant using LEDs of at least 4 different colours.

5. To determine the wavelength of H-alpha emission line of Hydrogen atom.

6. To determine the ionization potential ofmercury.

7. To determine the absorption lines in the rotational spectrum of Iodinevapour.

8. To determine the value of e/m by (a) Magnetic focusing or (b) Barmagnet.

9. To setup the Millikan oil drop apparatus and determine the charge of anelectron.

10. To show the tunneling effect in tunnel diode using I-Vcharacteristics.

11. To determine the wavelength of laser source using diffraction of singleslit.

12. To determine the wavelength of laser source using diffraction of double slits.

13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

ReferenceBooks

1. Advanced Practical Physics for students, B.L.FlintandH.T.Worsnop,1971,AsiaPublishingHouse
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann EducationalPublishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,KitabMaha

CoreT10-Analog Systems and Applications

Teacher's Name: Miss. Susmita Basak

Analog Systems and Applications   4 Credits

Semiconductor Diodes

P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

Two-terminal Devices and their Applications

Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filterZener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and(3) Solar Cell.

Bipolar Junction transistors

n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and SaturationRegions.

Field Effect transistors

Basic principle of operations only

Amplifiers

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameters, Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers. Frequency response of a CE amplifier.Coupled Amplifier: Twostage RC-coupled amplifier.

Feedback in Amplifiers:

Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

Sinusoidal Oscillators:

Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator,determination of Frequency. Hartley & Colpitts oscillators.

Operational Amplifiers (Black Box approach):

Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.Applications of Op-Amps: Linear -(1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear–(1) inverting and non-inverting comparators, (2) Schmidt triggers.

Conversion:

Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, PrenticeHall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHILearning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, PrenticeHall
6. Microelectroniccircuits,A.S.Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford UniversityPress.
7. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008,Springer
8. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, WileyIndia Microelectronic Circuits, M.H. Rashid, 2nd Edition, CengageLearning
9. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

CoreP10–Analog Systems and Applications Lab

Teacher's Name: Miss. Susmita Basak

Analog Systems and Applications   2 Credits

List of Practical

1.To study V-I characteristics of PN junction diode, and Light emittingdiode.

2.To study the V-I characteristics of a Zener diode and its use as voltageregulator.

3.Study of V-I & power curves of solar cells, and find maximum power point &efficiency.

4.To study the characteristics of a Bipolar Junction Transistor in CE configuration.

5.To study the various biasing configurations of BJT for normal class A operation.

6.To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.

7.To study the frequency response of voltage gain of a RC-coupled transistor amplifier.

8.To design a Wien bridge oscillator for given frequency using an op-amp.

9.To design a phase shift oscillator of given specifications using BJT.

10.To study the Colpitt`soscillator.

11.To design a digital to analog converter (DAC) of given specifications.

12.To study the analog to digital convertor (ADC)IC.

13.To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain

14.To design inverting amplifier using Op-amp (741,351) and study its frequency response

15.To design non-inverting amplifier using Op-amp (741,351) & study its frequency response

16.To study the zero-crossing detector and comparator

17.To add two dc voltages using Op-amp in inverting and non-inverting mode

18.To design a precision Differential amplifier of given I/O specification using Op-amp.

19.To investigate the use of an op-amp as anIntegrator.

20.To investigate the use of an op-amp as a Differentiator.

21.To design a circuit to simulate the solution of a 1st/2nd order differential equation.

Reference Books

1. Basic Electronics: Atextlabmanual,P.B.Zbar,A.P.Malvino,M.A.Miller,1994,Mc-
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, PrenticeHall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-
4. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009,Pearson

SEC T4 – Renewable Energy and Energy Harvesting

Teacher's Name: Miss. Susmita Basak

Renewable Energy and Energy Harvesting   2 Credits

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 system s,OceanThermal

Energy Conversion, solar energy, biomass, biochemical conversion, bio gas generation, geothermal energy tidal

energy, Hydroelectricity.

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.

Wind Energy harvesting

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Powerelectronic interfaces, and grid interconnection topologies.

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

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

Electromagnetic Energy Harvesting

1. Linear generators, physics mathematical models, recent applications

2. Carbon captured technologies, cell, batteries, power consumption

3. Environmental issues and Renewable sources of energy, sustainability.

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

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

GE T2 - Electricity and Magnetism

Teacher's Name: Mr. Amit Basak

Electricity and Magnetism   4 Credits

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 and Stoke's theorem of vectors (statement only).

Electrostatics

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. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Magnetism

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials:

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility.

Brief introduction of dia-, para-and ferro- magnetic materials.

Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell`s equations and Electromagnetic wave propagation:

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books

1.Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education

2. Electricity & Magnetism, J.II. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press⁻

3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.

4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

GE P2 – Electricity and Magnetism Lab

Teacher's Name: Mr. Amit Basak

Electricity and Magnetism   2 Credits

List of Practical

1) To use a Multimeter for measuring

a) Resistances

b) AC and DC Voltages

c) DC Current

d) Checking electrical fuses

2) To compare capacitances using De'Sauty's bridge.

3) Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)

4) To study the Characteristics of a Series RC Circuit.

5) To study a series LCR circuit LCR circuit and determine its

    a) Resonant frequency

    b) Quality factor

6) To study a parallel LCR circuit and determine its:

    a) Anti-resonant frequency and

    b) Quality factor Q

7) To determine a Low Resistance by Carey Foster's Bridge.

8) To verify the Thevenin and Norton theorems

9) To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985,Heinemann Educational Publishers

3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal

4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

PHYSICS-DSC 4A: WAVES AND OPTICS

Teacher's Name :Miss. Susmita Basak

(Credits: Theory-04, Practicals-02)

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1)Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats) Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods.

Lissajous Figures with equal an unequal frequency and their uses.

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem- Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels -Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time – Acoustic aspects of halls and auditoria.

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference: Interference: Division of amplitude and division of wavefront. 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: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & 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.

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Reference Books:

1.   Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2.
3.   Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4.   University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley

PHYSICS LAB-DSC 4A LAB: WAVES AND OPTICS

Teacher's Name :Miss. Susmita Basak

List of practical   2 Credits

1. To investigate the motion of coupled oscillators

2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify

   $\lambda 2 - T$ Law.

3. To study Lissajous Figures

4. Familiarization with Schuster`s focussing; determination of angle of prism.

5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).

6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.

7. To determine Dispersive Power of the Material of a given Prism using Mercury Light

8. To determine the value of Cauchy Constants of a material of a prism.

9. To determine the Resolving Power of a Prism.

10. To determine wavelength of sodium light using Fresnel Biprism.

11. To determine wavelength of sodium light using Newton's Rings.

12. To determine the wavelength of Laser light using Diffraction of Single Slit.

13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating

14. To determine the Resolving Power of a Plane Diffraction Grating.

15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Reference Books:

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

SEC T4 – Renewable Energy and Energy Harvesting

Teacher's Name: Miss. Susmita Basak

Renewable Energy and Energy Harvesting   2 Credits

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 system s,OceanThermal

Energy Conversion, solar energy, biomass, biochemical conversion, bio gas generation, geothermal energy tidal

energy, Hydroelectricity.

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.

Wind Energy harvesting

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Powerelectronic interfaces, and grid interconnection topologies.

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

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

Electromagnetic Energy Harvesting

1. Linear generators, physics mathematical models, recent applications

2. Carbon captured technologies, cell, batteries, power consumption

3. Environmental issues and Renewable sources of energy, sustainability.

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

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

SEMESTER-V

CoreT11-Quantum   Mechanics and   Applications

Teacher's Name: Miss. Susmita Basak

Quantum Mechanics and Applications   4 Credits

Schrodinger Equation

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. Eigen-values and Eigen-functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigen-values; expansion of an arbitrary wave-function as a linear combination of energy eigen-functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave-function; Position-momentum uncertainty principle.

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 eigen-functions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

Quantum theory of hydrogen-like atoms

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wave-functions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d shells.

Atoms in Electric & 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.Atoms in External Magnetic FieldsNormal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Many electron atoms

Pauli's Exclusion Principle. Symmetric & 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. Hund'sRule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Naetc.).

Reference Books

1. A Text book of Quantum Mechanics,P.M.MathewsandK.Venkatesan,2ndEd., 2010,

2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002,Wiley.Γ

3. Quantum

4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning ofIndia.

5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and BartlettLearning.‾

6. Quantum Mechanics: Foundations & Applications, Arn

7. QuantumMechanics for Scientists & Engineers,D.A.B.Miller,2008,CambridgeUniversityPress

Additional Books forReference

1. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons,Inc. ⌐
2. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education ⌐
3. Quantum Mechanics, Walter Greiner, 4th Edn., 2001,Springer

CoreP11–Quantum Mechanics and ApplicationsLab

Teacher's Name: Miss. Susmita Basak

Quantum Mechanics and Applications   2 Credits

List of Practical

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

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

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take e = 3.795 (eVÅ)1/2, ħc = 1973 (eVÅ) and m = 0.511x106eV/c2.

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

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

Where 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 = 0.511x106eV/c2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 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:

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

For the an-harmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

For the an-harmonic oscillator potential for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100

MeV fm-2, b = 0, 10, 30 MeV fm-3In these units, cℏ = 197.3 MeV fm. 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:

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

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

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

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: m = 940x106eV/C2, D = 0.755501 eV, α = 1.44, ro= 0.131349 Å

Laboratory Based Equipments:

3.Study of Electron spin resonance-determine magnetic field as a function of the resonancefrequency

4.Study of Zeeman effect: with external magnetic field; Hyperfinesplitting

5.To show the tunneling effect in tunnel diode using I-Vcharacteristics.

6.Quantum efficiency of CCDs

Reference Books

1. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, ⌐Cambridge Univ.Press
2. SimulationofODE/PDEModelswithMATLAB®,OCTAVEandSCILAB:Scientific&Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springe

CoreT12-Solid State Physics

Teacher's Name: Dr. Apurba Barman

Solid State Physics   4 Credits

Crystal StructureSolids:

Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis –Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

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, T3 law

Magnetic Properties of Matter

Dia-, Para-, Ferri-and Ferromagnetic Materials. Classical Langevin Theory of dia–and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Dielectric Properties of Materials

Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes.

Ferroelectric Properties of Materials

Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.

Elementary band theory

Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.

Superconductivity

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt.Ltd.⌐
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning⁻
5. Solid-state Physics, H. Ibach
6.
7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
8.

CoreP12–Solid State Physics Lab

Teacher's Name: Dr. Apurba Barman

Solid State Physics   2 Credits

List of Practical

1.Measurement of susceptibility of paramagnetic solution (Quinck`s TubeMethod)

2.To measure the Magnetic susceptibility ofSolids.

3.To determine the Coupling Coefficient of a Piezoelectriccrystal.

4.To measure the Dielectric Constant of a dielectric Materials withfrequency

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 usingSPR

7.To study the PE Hysteresis loop of a FerroelectricCrystal.

8.To draw the BH curve of Fe using Solenoid & determine energy loss fromHysteresis.

9.To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 1500C) and to determine its bandgap.

10.To determine the Hall coefficient of a semiconductorsample.

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted

3. A Text Book ofPractical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall ofIndia

DSE T1 - Advanced Mathematical Physics I

Teacher's Name : Mr. Amit Basak

Advanced Mathematical Physics   4 Credits

Laplace Transform

Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.

Linear Vector Spaces

Abstract Systems. Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

Inner products. Gram-Schmidt orthogonalization. Orthogonal and unitary transformations and their matrix representations.

Cartesian Tensors

Transformation of Co-ordinates. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti- symmetric Tensors. Invariant Tensors: Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors. Vector Algebra and Calculus using Cartesian Tensors: Scalar and Vector Products, Scalar and Vector Triple Products. Differentiation. Gradient, Divergence and Curl of Tensor Fields. Vector Identities. Tensorial Formulation of Analytical Solid Geometry: Equation of a Line. Angle Between Lines. Projection of a Line on another Line. Condition for Two Lines to be Coplanar. Foot of the Perpendicular from a Point on a Line. Rotation Tensor (No Derivation). Isotropic Tensors. Tensorial Character of Physical Quantities. Moment of Inertia Tensor. Stress and Strain Tensors: Symmetric Nature. Elasticity Tensor. Generalized Hooke's Law.

General Tensors

Transformation of Co-ordinates. Minkowski Space. Contravariant & Covariant Vectors. Contravariant, Covariant and Mixed Tensors. Kronecker Delta and Permutation Tensors. Algebra of Tensors. Sum, Difference & Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Metric Tensor.

Reference Books

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, 1970, Elsevier.
3. Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press
4. Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
5. Linear Algebra, W. Cheney, E.W.Cheney & D.R.Kincaid, 2012, Jones & Bartlett Learning
6. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
7. Mathematical Methods for Physicis & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed., 2006,
   Cambridge University Press

DSE P1 – Advanced Mathematical Physics I Lab

Teacher's Name : Mr. Amit Basak

Advanced Mathematical Physics I   2 Credits

List of Practical

1. Linear algebra:

2. Multiplication of two 3 x 3 matrices.

3. Eigenvalue and eigenvectors of

4. Orthogonal polynomials as eigen-functions of Hermitian differential operators.

5. Determination of the principal axes of moment of inertia through diagonalization.

6. Vector space of wave functions in Quantum Mechanics: Position and momentum differential operators and their commutator, wave functions for stationary states as eigen-functions of Hermitian differential operator.

7. Lagrangian formulation in Classical Mechanics with constraints.

8. Study of geodesics in Euclidean and other spaces (surface of a sphere, etc).

9. Estimation of ground state energy and wave function of a quantum system.

Reference Books

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

DSE T3 - Classical Dynamics

Teacher's Name : Mr. Jiban Kumar Ray

Classical Dynamics   6 Credits

Classical Mechanics of Point Particles

Review of Newtonian Mechanics; Application to the motion of a charge particle in external electric and

magnetic fields- motion in uniform electric field, magnetic field- gyroradius and gyrofrequency, motion in

crossed electric and magnetic fields. Generalized coordinates and velocities,

Recap of Lagrangian and Hamiltonian mechanics. Applications: Hamiltonian for a harmonic oscillator, solution of Hamilton's equation for Simple Harmonic Oscillations; particle in a central force field- conservation of angular momentum and energy. Effective potential. The Laplace-Runge-Lenz vector.

Small Amplitude Oscillations

Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.

Special Theory of Relativity

Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction and twin paradox. Four-vectors: space-like, time-like and light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energymomentum relation. Doppler effect from a four-vector

perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle.

Fluid Dynamics

Density ρ and pressure P in a fluid, an element of fluid and its velocity, continuity equation and mass

conservation, stream-lined motion, laminar flow, Poiseuille's equation for flow of a liquid through a pipe,

Navier-Stokes equation, qualitative description of turbulence, Reynolds number.

Reference Books

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
4. The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier.
5. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
6. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
7. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
8. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
9. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

PHYSICS-DSE: APPLIED DYNAMICS

Teacher's Name : Mr.Jiban Kumar Ray

(Credits: Theory-04, Practicals-02)

Recapitulation of Classical Mechanics:

(a) Newton's laws of motion, phase portraits.

(b) Equilibrium and stability; expansion of the potential energy around a minimum; small amplitude oscillations about the minimum; normal modes of oscillations with example of different coupled mass-spring configurations.

(c) Hamilton's equations of motion in a potential, stability problems analysis through Hamiltonian approach.   \

Introduction to Dynamical Systems:

(a) General idea of dynamical system, order of dynamical system, continuous and discrete, rheonomous and autonomous systems.

(b) The idea of phase space, flows and trajectories, sketching flows and trajectories in phase space; sketching variables as functions of time. Phase Space analysis of simple dynamical systems: the free particle, particle under uniform gravity, simple and damped harmonic oscillator, illustrative examples from other discipline such as population model, predator prey model etc.

(c) Flows on the line, fixed points, attractors and stability, graphical analysis, linear stability analysis.

(d) Flows on the Circle: Possibility of oscillations, examples of damped and driven pendulums.

(e) Discrete dynamical systems; maps; the logistic map; stability; cobweb iteration; fixed points.

Introduction to Chaos and Fractals:

(a) Chaos in nonlinear finite-difference equations- Logistic map;

(b) Dynamics from time series. Parameter dependence- steady, periodic and chaos states.

(c) Defining chaos- aperiodic, bounded, deterministic and sensitive dependence on initial conditions. Different routes to chaos: Period-doubling, quasi-periodic, intermittency. (Qualitativideas only).

(d) Nonlinear time series analysis and chaos characterization: Detecting chaos from return map; Power spectrum, autocorrelation, Lyapunov exponent, correlation dimension.

(e) Self similarity and fractal geometry: Fractals in nature – trees, coastlines, earthquakes, etc. Need for fractal dimension to describe self-similar structure. Deterministic fractal vs. Self-similar fractal structure.

Introduction to Fluid Dynamics:

Definition of a fluid – shear stress; concept of fluid element or fluid parcel; Fluid properties; Kinematics of Moving Fluids; stream, path and streak lines; Idea of compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Reynold's number. Euler's Equation. Bernoulli's Theorem. Navier-Stokes' equation (no derivation) and its significance.

1. Classical Mechanics, H.Goldstein, C.P. Poole, and J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics, P.S. Joag, and N.C. Rana, 1st Edn., McGraw Hall.
3. Classical Dynamics of Particles and Systems, S.T. Thornton and J. B. Marion, Cengage Learning
4. Nonlinear Dynamics and Chaos, S.H. Strogatz, Levant Books, Kolkata, 2007
5. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
6. Chaos: An Introduction to Dynamical Systems, K.T. Alligood, T.D. Sauer, J.A. Yorke, Springer

7. Chaos and Nonlinear Dynamics, R.C. Hilborn, Oxford.
8. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge Univ. Press, 2002
9. Fluid Mechanics, 2nd Edition, L. D. Landau and E. M. Lifshitz, Pergamon Press, Oxford

PHYSICS PRACTICAL-DSE LAB: APPLIED DYNAMICS

Teacher's Name: Mr. Jiban Kumar Ray

Practicals: 02 Credits

Computation and visualization using Python / SciLab / C / Fortran etc.:

1. To study the dynamics of coupled oscillators /pendulums and to study the effect of variation of coupling coefficient.

2. To study the dynamics of coupled damped oscillators and to study the effect of variation of the coupling and damping coefficients.

3. To study the dynamics of various continuous nonlinear systems (like Lorenz system, Rossler system, Duffing oscillator, Van der Pol oscillator, etc.). Study the parameter dependence of the attractor. Also study the sensitive dependence on the initial condition in the chaotic regime.

4. To study predator-prey dynamics using Lotka-Volterra equations (population equilibrium and stability of the fixed points)

$$\dot{x} = \alpha x - \beta xy$$

$$\dot{y} = \delta xy - \gamma y$$

5. To study the dynamics of maps and to obtain their bifurcation diagrams (like Logistic map, Henon map, Duffing map)

6. Computationally visualize the Sierpinski gasket.

7. Computationally visualize the fractal fern (For example Barnsley's Fern corresponding to the transformations given below):

$$f_1(x,y) = \begin{bmatrix} 0 & 0 \\ 0 & 0.16 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}, 1\% probability$$

$$f_2(x,y) = \begin{bmatrix} 0.85 & 0.04 \\ -0.04 & 0.85 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0 \\ 1.6 \end{bmatrix}, 85\% probability$$

$$f_3(x,y) = \begin{bmatrix} 0.2 & -0.26 \\ 0.23 & 0.22 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0 \\ 1.6 \end{bmatrix}, 7\% probability$$

$$f_4(x,y) = \begin{bmatrix} -0.15 & 0.28 \\ 0.26 & 0.24 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 0 \\ 0.44 \end{bmatrix}, 7\% probability$$

Reference Books

1. ⍰ Nonlinear Dynamics and Chaos, Steven H. Strogatz, Levant Books, Kolkata, 2007
2. ⍰ Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
3. on Scientific Programming with Python, H. P. Langtangen, Springer
4. ⍰ Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and
5. Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer
6. ISBN: 978-3319067896
7. -1479203444
8. ⍰ Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

PHYSICS-DSE: Atmospheric Physics

Teacher's Name: Mr. Jiban Kumar Ray

Credits: Theory-04   Practicals-02

General features of Earth's atmosphere:

Thermal structure of the Earth's Atmosphere, Ionosphere, Composition of atmosphere, Hydrostatic equation, Atmospheric Thermodynamics, Greenhouse effect and effective temperature of Earth, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze andland breeze.Instruments for meteorological observations, including 52RS/RW,meteorological processes and different systems, fronts, Cyclones and anticyclones, thunderstorms.

Atmospheric Dynamics:

Scale analysis, Fundamental forces, Basic conservation laws, The Vectorial form of the momentum equation in rotating coordinate system, scale analysis of equation of motion, Applications of the basic equations, Circulations and vorticity, Atmospheric oscillations, Mesoscale circulations, The general circulations, Tropical dynamics.

Atmospheric Waves:

Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration

Atmospheric Radar and Lidar:

Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena,Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.

Atmospheric Aerosols:

Spectral distribution of the solar radiation,Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars.

Reference Books:•

1. Fundamental of Atmospheric Physics –Murry L Salby; Academic Press, Vol 61, 1996
2. The Physics of Atmosphere –John T. Houghton; Cambridge University press; 3rdedn.2002.
3. An Introduction to dynamic meteorology –James R Holton; Academic Press, 2004
4. Radar for meteorological and atmospheric observations –S Fukao and K Hamazu, Springer Japan, 2014

PRACTICALS-DSELAB: Atmospheric Physics

Teacher's Name: Mr.Jiban Kumar Ray

2 Credits

1.Numerical Simulation for atmospheric waves using dispersion relations 2.Atmospheric gravity waves (b)Kelvin waves (c) Rossby waves, and mountain waves

3.Offline and online processing of radar data (a) VHF radar, (b) X-band radar, and

(c) UHF radar

4.Offline and online processing of LIDAR data

5.Radiosonde data and its interpretation in terms of atmospheric parameters using vertical profiles in different regions of the globe. 6.Handling of satellite data and plotting of atmospheric parameters using radio occultation technique

7.Time series analysis of temperature using long term data over metropolitan cities in India –an approach to understand the climate change

Reference Books:

1. Fundamental of Atmospheric Physics –Murry L Salby; Academic Press, Vol 61, 1996
2. The Physics of Atmosphere –J.T. Houghton; Cambridge Univ. Press; 3rdedn.2002.
3. An Introduction to dynamic meteorology –James R Holton; Academic Press, 2004
4. Radar for meteorological and atmospheric observations –S Fukao and K Hamazu

PHYSICS PROGRAM COURSE

DSE: ELEMENTS OF MODERN PHYSICS

Teacher's Name :Mr. Amit Basak

Credits: Theory-05   Tutorials-01

Planck's quantum, Planck's constant and light as a collection of photons;Planck's law of Black Body radiation with deduction;Photo-electric effect,Compton scattering, Raman scattering or Raman Effect.De Broglie wavelengthand matter waves; Davisson-Germer experime

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.

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using

uncertainty principle; Energy-timeuncertainty principle.

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

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

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

Particle Accelerators: Linear accelerators, Cyclotron, Synchrotrons

Detectors for Nuclear radiation: Gas detectors, Ionization chamber and GM counter

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-   -
e   -ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission -nature of fragments and emission of neutrons. Nuclear reactor: slow neutronsinteracting with Uranium 235; Fusion and thermonuclear reactions.

Lasers: Einstein's A and B coefficients, metastable states, Spontaneous andStimulated emissions, Optical pumping and Population inversion.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
6. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

SEC T2 – Electrical Circuits and Networks

Teacher's Name: Miss. Susmita Basak

Electrical Circuits and Network Skills   2 Credits

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.

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.

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.

Generators and Transformers

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

Electric Motor

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

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

Electrical Protectio

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)

Electrical Wiri

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.

Reference Books

7. A text book in Electrical Technology - B L Theraja - S Chand & Co.
8.   - A K Theraja
9.   - M G Say ELBS Edn

SEMESTER-VI

CoreT13-Electromagnetic Theory

Teacher's Name: Mr. Jiban Kumar Ray

Electromagnetic Theory   4 Credits

Maxwell Equations

Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

EM Wave Propagation in Unbounded Media

Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through diluteplasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

EM Wave in Bounded Media

Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescentwaves. Metallic reflection (normalIncidence)

Polarization of Electromagnetic Waves

Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

Wave guides

Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.

Optical Fibres

Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, BenjaminCummings.
2. Optics, E. Hecht, 2016,Pearson.
3. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford UniversityPress.
4. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
5. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGrawHill
6. Electromagnetic field Theory, R.S. Ksh
7. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGrawHill.

8. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Additional Books forReference

1. Electromagnetic Fields & Waves
2. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGrawHill.⌐
3. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004,Cambridge University press

CoreP13–Electromagnetic Theory Lab

Teacher's Name: Mr. Jiban Kumar Ray

Electromagnetic Theory   2 Credits

List of Practical

1.To verify the law of Malus for plane polarized light.

2.To determine the specific rotation of sugar solution using Polarimeter.

3.To analyze elliptically polarized Light by using a Babinet's compensator.

4.To study dependence of radiation on angle for a simple Dipole antenna.

5.To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonicgrating.

6.To study the reflection, refraction of microwaves

7.To study Polarization and double slit interference in microwaves.

8.To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.

9.To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.

10.To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.

11.To verify the Stefan`s law of radiation and to determine Stefan'sconstant.

12.To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted

3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010,Springer

CoreT14–Statistical Mechanics

Teacher's Name: Dr. Apurba Barman

Statistical Mechanics **4 Credits**

Classical Statistical Mechanics

Macrostate & Microstate, Elementary Concept of Ensemble, Microcanonical ensemble, Phase Space, Entropy and Thermodynamic Probability, Canonical ensemble, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) –Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. Grand canonical ensemble and chemical potential.

Classical Theory of Radiation

Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's IonizationFormula. Rayleigh-Jean's Law. Ultraviolet Catastrophe

Quantum Theory of Radiation

Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.

Bose-Einstein Statistics:

B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.

Fermi-Dirac Statistics:

Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly DegenerateFermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.

ReferenceBooks

1. Statisticcal Mechanics,R.K.Pathria,ButterworthHeinemann:2ndEd.,1996,Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, TataMcGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, PrenticeHall
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986,Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009,Springer
6. An Introduction to Statistical Mechanics &Thermodynamics,R.H.Swendsen,2012,Oxford Press
7. Statistical Mechanics –an elementary outline, A. Lahiri, 2008, UniversitiesPress

CoreP14–Statistical Mechanics Lab

Teacher's Name: Dr. Apurba Barman

Statistical Mechanics   2 Credits

List of Practical

1.Computational analysis of the behaviour of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initialconditions:

   a.Study of local number density in the equilibrium state

  (i) average; (ii)fluctuations

  b. Study of transient behaviour of the system (approach toequilibrium)

  c. Relationship of large N and the arrow oft ime

  d. Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity

    distribution

  e. Computation and study of mean molecular speed and its dependence on particle mass

  f. Computation of fraction of molecules in an ideal gas having speed near the most probable speed

2. Computation of the partition function $Z(<)$ for examples of systems with a finite number of single particle levels (e.g.,

  2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and

  Bose-Einsteinstatistics:

   a.Study of how $ZN(V, T)$, average energy $<E>$, energy fluctuation ΔE, specific heat at constant volume Cv, depend

   upon the temperature T, total number of particles N and the spectrum of single particlestates.

   b. Ratios of occupation numbers of various states for the systems consideredabove

   c. Computation of physical quantities at large and small temperature T and comparison of various statistics at large

   and small temperatureT.

3.Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and

  lowtemperature.

4.Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for

  high temperature and low temperature and compare them for these two cases.

5.Plot the following functions with energy at differenttemperatures

  a.Maxwell-Boltzmanndistribution

  b.Fermi-Dirac distribution

c.Bose-Einsteindistribution

1. Elementary Numerical Analysis, K.E.Atkinson, 3 rd Edn . 20 07 , Wiley
2. IndiaEdition⌐ Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford
3. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford Unive
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009,Springer⌐
6. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik,
7. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and EngineeringApplications:A.VandeWouwer,P.Saucez,C.V.Fernández.2014Springer ISBN:978-33190678

DSE T2 - Advanced Mathematical Physics II

Teacher's Name: Mr. Amit Basak

Advanced Mathematical Physics II

6 Credits

Calculus of Variations:

Variational Calculus: Recapitulation of the Variational Principle, Euler-Lagrange's Equations of Motion Euler angles, spherical top and symmetric top. Symmetry and conservation laws. Canonical Pair of Variables. Definition of Generalized Force: Definition of Hamiltonian (Legendre Transformation). Hamilton's Principle. Poisson Brackets and their properties. Canonical transformations. Action-angle variables for simple systems.

Group Theory

Review of sets, Mapping and Binary Operations, Relation, Types of Relations.

Groups: Elementary properties of groups, uniqueness of solution, Subgroup, Centre of a group, Co-sets of a

subgroup, cyclic group, Permutation/Transformation. Homomorphism and Isomorphism of group. Normal and

conjugate subgroups, Completeness and Kernel.

Some special groups with operators. Matrix Representations: Reducible and Irreducible representations. Schur's

lemma. Orthogonality theorems. Character tables and their uses. Application to small vibrations.

Advanced Probability Theory:

Fundamental Probability Theorems. Conditional Probability, Bayes' Theorem, Repeated Trials, Binomial and

Multinomial expansions. Random Variables and probability distributions, Expectation and Variance, Special

Probability distributions: The binomial distribution, The poisson distribution, Continuous distribution: The

Gaussian (or normal) distribution, The principle of least squares.

Reference Books

1. Mathematical Methods for Physicists: Weber and Arfken, 2005, Academic Press.
2. Mathematical Methods for Physicists: A Concise Introduction: Tai L. Chow, 2000, Cambridge Univ. Press.
3. Elements of Group Theory for Physicists by A. W. Joshi, 1997, John Wiley.
4. Group Theory and its Applications to Physical Problems by Morton Hamermesh, 1989, Dover
5. Introduction to Mathematical Physics: Methods & Concepts: Chun Wa Wong, 2012, Oxford University Press
6. Introduction to Mathematical Probability, J. V. Uspensky, 1937, Mc Graw-Hill.

DSE T5 - Nuclear and Particle Physics

Teacher's Name : Mr. Jiban Kumar Ray/ Mr. Amit Basak

Nuclear and Particle Physics   6 Credits

General Properties of Nuclei

Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), 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 its 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.

Radioactivity decay

(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-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).

Interaction of Nuclear Radiation with matter

Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

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 and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron

detector.

Particle Accelerators

Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Particle physics

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, colour quantum number and gluons.

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 High Energy Physics, D.H. Perkins, Cambridge Univ. Press
- 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)
- Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Acad. Press, Elsevier, 2007
- Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

PHYSICS-DSE: SOLID STATE PHYSICS

Teacher's Name: Dr. Apurba Barman

(Credits: Theory-04, Practical)

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

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.

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons.

Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8 th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2 nd Ed., 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
5. Solid State Physics, Rita John, 2014, McGraw Hill
6. Solid-state Physics, H. Ibach and H Luth, 2009, Springer
7.
8. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

PRACTICALS-DSE LAB: SOLID STATE PHYSICS

Teacher's Name: Dr. Apurba Barman

List of practical

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.To determine the Hall coefficient of a semiconductor sample.

Reference Books

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

SEC T4 – Renewable Energy and Energy Harvesting

Teacher's Name: Miss. Susmita Basak

Renewable Energy and Energy Harvesting   2 Credits

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 system s,OceanThermal

Energy Conversion, solar energy, biomass, biochemical conversion, bio gas generation, geothermal energy tidal

energy, Hydroelectricity.

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.

Wind Energy harvesting

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Powerelectronic interfaces, and grid interconnection topologies.

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

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

Electromagnetic Energy Harvesting

1. Linear generators, physics mathematical models, recent applications

2. Carbon captured technologies, cell, batteries, power consumption

3. Environmental issues and Renewable sources of energy, sustainability.

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

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

Programme Outcomes:

- The knowledge of Physics is very much essential for understanding the development of eco-friendly technologies.

- The course Curricula is designed according to the guidelines of the CBCS Curriculum of the University of North Bengal.

- It provides the basic understanding of Physics and its relative significance in the global scenario, aiding human lives with the progress of technology.

- The course is combined with the development of knowledge and a conceptual understanding about topics which help the stakeholders in higher education, engineering and research.

- Most of the papers of the course are interlinked with laboratory experiments which facilitate dealing with basic instruments, generating practical knowledge with the electrical, electronics and optical instruments, understanding of physical properties of matter etc.

- The Course includes computational facilities for a deeper understanding of the dynamics of theoretical and mathematical physics.

- The skill enhancement course develops the concept of basic building blocks of electronic devices and also encourages learning the necessity of green energy for a better sustenance for human civilization.

- The Curricula trains the students for future research work augmenting the importance of Physics and Engineering in our life.

Programme Specific Outcomes:

1. It provides the basic understanding of Physics and its relative significance in the global scenario, aiding human lives with the progress of technology.

2. Most of the papers of the course are interlinked with laboratory experiments which facilitate dealing with basic instruments, generating practical knowledge with the electrical, electronics and optical instruments, understanding of physical properties of matter etc.

3. The Course includes computational facilities for a deeper understanding of the dynamics of theoretical and mathematical physics.

4. The skill enhancement course develops the concept of basic building blocks of electronic devices and also encourages learning the necessity of green energy for a better sustenance for human civilization.

Course Outcomes:

Semester	Course Code	Course Name	Course Outcomes

SEM-I	CC1: Mathematical Physics-I	Mathematical Physics-I	• Basic understanding in areas like (i) Limits (ii) Continuity (iii) Differentiation (iv) Plotting of functions etc. • Knowledge gain in areas like (i) Vector Calculus (ii) Curvilinear coordinate systems (iii) Dirac-Delta function • It includes introduction to probability • Knowledge gain in (i) Computer organization (ii) Basic scientific computing (iii) Plotting graphs with Gnuplot (iv) Programming using Python etc.
	CC2: Mechanics	Mechanics	• Knowledge gain in Fundamentals of Dynamics such as frame of references, Newton's law of motion, motion of projectile, rocket etc. • Knowledge gain in areas in (i) Work and energy (ii) Collisions (iii) Rotational Dynamics (iv) Elasticity (v) Fluid Motion (vi) Gravitation and Central Force Motion (vii) Oscillations (viii) Non-Inertial Systems etc. • Introduction to Special Theory of Relativity • Knowledge gain in performing experiment to determine spring constant, acceleration due to gravity, MI of fly wheel, viscosity of water, rigidity modulus etc.
	GE1: Mechanics	Mechanics	• Knowledge gain in vectors, ordinary differential equations • Understanding of Newton's law of motion • Knowledge gain in areas in (i) Momentum and energy (ii) Collisions (iii) Rotational Dynamics (iv) Elasticity (v) Gravitation (vi) Oscillations etc. • Introduction to Special Theory of Relativity • Knowledge gain in performing experiment to determine spring constant, acceleration due to gravity, MI of fly wheel, viscosity of water, rigidity

			modulus etc.
	DSC1: Mechanics	Mechanics	• Knowledge gain in vectors, ordinary differential equations • Understanding of Newton's law of motion • Knowledge gain in areas in (i) Momentum and energy (ii) Collisions (iii) Rotational Dynamics (iv) Elasticity (v) Gravitation (vi) Oscillations etc. • Introduction to Special Theory of Relativity • Knowledge gain in performing experiment to determine spring constant, acceleration due to gravity, MI of fly wheel, viscosity of water, rigidity modulus etc.
SEM-II	CC3: Electricity and Magnetism	Electricity and Magnetism	• Develop ideas about electric field, magnetic field and electric potential. • Basic understanding of dielectric properties of matter. • Knowledge gain in magnetics properties of matter, electromagnetic induction, electrical circuits, network analysis etc. • Handling of electrical instruments such as multimeter, capacitor, CRO, resistance, inductor etc. • Performing experiments to understand RC circuit, LCR circuit, Anderson's bridge etc.
	CC4: Waves and Optics	Waves and Optics	• Knowledge gain in areas like (i) Harmonic Oscillations (ii) Wave Motion (iii) Velocity of waves (iv) Superposition of Harmonic Waves • Develop ideas about Wave Optics, Holography • Knowledge gain in areas like (i) Interference (ii) Diffraction • Knowledge gain in handling optical instruments like (i) Prism (ii) Grating (iii) Spherometer (iv)

			Travelling Microscope etc. • Perform experiments to study Lissajous Figures • Perform experiments to determine various quantity like (i) angle of prism (ii) refractive index of the Material of a prism (iii) wavelength of sodium source (iv) dispersive power and resolving power of a plane diffraction grating
	GE2: Electricity and Magnetism	Electricity and Magnetism	• Basic understanding of vector analysis which includes (i) Review of vector algebra (Scalar and Vector product), (ii)gradient, (iii) divergence, (iv) Curl, (v) Vector Integration, (vi) Gauss-divergence theorem (vii) Stoke's theorem of vectors • Develop ideas about electric field, magnetic field and electric potential. • Knowledge gain in electromagnetic induction • Knowledge gain in Maxwell`s equations and Electromagnetic wave propagation • Handling of electrical instruments such as multimeter, capacitor, CRO, resistance, inductor etc. • Performing experiments to understand RC circuit, LCR circuit, Carey Foster's Bridge etc.
	DSC2: Electricity and Magnetism	Electricity and Magnetism	• Basic understanding of vector analysis which includes (i) Review of vector algebra (Scalar and Vector product), (ii)gradient, (iii) divergence, (iv) Curl, (v) Vector Integration, (vi) Gauss-divergence theorem (vii) Stoke's theorem of vectors • Develop ideas about electric field, magnetic field and electric potential. • Knowledge gain in electromagnetic induction • Knowledge gain in Maxwell`s equations and Electromagnetic wave propagation • Handling of electrical instruments such as multimeter, capacitor, CRO, resistance, inductor

			etc.
			• Performing experiments to understand RC circuit, LCR circuit, Carey Foster's Bridge etc.
SEM-III	CC5: Mathematical Physics-II	Mathematical Physics-II	• Knowledge gain in areas (i) Fourier Series (ii) Frobenius Method and Special Functions (iii) Beta and Gamma Functions (iv) Variational calculus in physics (v) Partial Differential Equations and applications • Introduction to the Numerical computation using numpy and scipy • Knowledge gain in Curve fitting, Least square fit, Goodness of fit, standard deviation • Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems are learned • Solution of ODE First Order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method using python are learned
	CC6: Thermal Physics	Thermal Physics	• Knowledge gain in Zeroth and First Law of Thermodynamics, Second Law of Thermodynamics, Entropy • Thermodynamic Potentials, Maxwell's Thermodynamic Relations, Kinetic Theory of Gases are learned • Performing experiments to determine (i) Mechanical Equivalent of Heat (ii) Planck's constant using black body radiation (iii) the coefficient of thermal conductivity (iv) the coefficient of thermal conductivity of a bad conductor (v) the temperature co-efficient of resistance by Platinum resistance thermometer

			• Study of the variation of thermos-emf across two junctions of a thermocouple with temperature
	CC7: Digital Systems and Applications	Digital Systems and Applications	• Integrated Circuits, Digital Circuits, Boolean algebra, Data processing circuits are learned • Knowledge gain in Timers, Shift registers, Counters, Computer Organization • Test of a Diode and Transistor using a Multimeter is learned • Conversion of Boolean expression into logic circuit and design it using logic gate ICs is learned • Verify and design AND, OR, NOT and XOR gates using NAND gates is learned • Half Adder, Full Adder and 4-bit binary Adder is learned
	GE: Mechanics	Mechanics	• Knowledge gain in vectors, ordinary differential equations • Understanding of Newton's law of motion • Knowledge gain in areas in (i) Momentum and energy (ii) Collisions (iii) Rotational Dynamics (iv) Elasticity (v) Gravitation (vi) Oscillations etc. • Introduction to Special Theory of Relativity • Knowledge gain in performing experiment to determine spring constant, acceleration due to gravity, MI of fly wheel, viscosity of water, rigidity modulus etc.
	DSC3: THERMAL PHYSICS AND STATISTICAL MECHANICS	THERMAL PHYSICS AND STATISTICAL MECHANICS	• Knowledge gain in areas: (i) Thermodynamic Description of system (ii) Thermodynamic Potentials (iii) Kinetic Theory of Gases (iv) Theory of Radiation (v) Statistical Mechanics • Performing experiments to determine (i) Mechanical Equivalent of Heat (ii) Planck's constant using black body radiation (iii) the

			coefficient of thermal conductivity (iv) the coefficient of thermal conductivity of a bad conductor (v) the temperature co-efficient of resistance by Platinum resistance thermometer • Study of the variation of thermos-emf across two junctions of a thermocouple with temperature
	SEC1: Electrical Circuits andNetworks	Electrical Circuits andNetworks	• Knowledge gain in areas (i) Basic Electricity Principles (ii) Understanding Electrical Circuits (iii) Electrical Drawing and Symbols (iv) Generators and Transformers (v) Electric Motors (vi) Solid-State Devices (vii) Electrical Protection (viii) Electrical Wiring
SEM-IV	CC8: Mathematical Physics-III	Mathematical Physics-II	• Knowledge gain in areas of complex analysis like (i) Complex Numbers and their Graphical Representation (ii) Functions of Complex Variables (iii) analytic functions (iv) Singular functions etc. • Concepts in matrices, Eigen-values and Eigenvectors problems • Knowledge gain in Fourier Transform to solve one dimensional (i) Wave equation (ii) Diffusion/Heat Flow Equation • Knowledge gain in python programing to compute (i) Differential equations (ii) Dirac-Delta function (iii) Fourier series (iv) Complex roots etc.
	CC9: Elements of Modern Physics	Elements of Modern Physics	• Knowledge gain in areas like (i) black body Radiation (ii) Photo-electric effect (iii) Compton scattering (iv) Wave description of particles (v) Group and Phase velocities • Knowledge gain in (i) Two slit interference experiment with photons (ii) Schrodinger equation (iii) wave function (iv) probability current densities • Knowledge gain in (i) Atomic and nuclear physics

			(ii) Radioactivity (iii) Fission and fusion (iv) Lasers • Perform experiments to determine Planck's constant, work function of material, wavelength of H-alpha emission line, ionization potential of mercury, tunneling effect in tunnel diode, the wavelength of laser source etc.
	CC10: Analog Systems and Applications	Analog Systems and Applications	• Knowledge gain in areas like (i) Semiconductor Diodes (ii) Two-terminal Devices and their Applications (iii) Bipolar Junction transistors (iv) Field Effect transistors (v) Amplifiers • Knowledge gain in handling experiments to study (i) V-I characteristics of PN junction diode, (ii) he V-I characteristics of a Zener diode and its use as voltage regulator (iii) V-I and power curves of solar cells (iv) CE transistor amplifier (v) Op-amp
	DSC4: Waves and Optics	Waves and Optics	• Knowledge gain in areas like (i) Harmonic Oscillations (ii) Wave Motion (iii) Velocity of waves (iv) Superposition of Harmonic Waves (v) Fluids • Develop ideas about Wave Optics • Knowledge gain in areas like (i) Interference (ii) Diffraction (iii) Polarization (iv) Michelson's Interferometer • Knowledge gain in handling optical instruments like (i) Prism (ii) Grating (iii) Spherometer (iv) Travelling Microscope etc. • Perform experiments to study Lissajous Figures • Perform experiments to determine various quantity like (i) angle of prism (ii) refractive index of the Material of a prism (iii) wavelength of sodium source (iv) dispersive power and resolving power of a plane diffraction grating
	SEC2: RENEWABLE	RENEWABLE	• Knowledge gain about Fossil fuels and Alternate

	ENERGY AND ENERGY HARVESTING	ENERGY AND ENERGY HARVESTING	Sources of energy. • Understanding the energy crisis. • Understanding importance of renewable energy. • Knowledge gain about Solar energy and its usefulness. • Knowledge gain about Wind Energy harvesting and its usefulness. • Knowledge gain about Ocean Energy. • Knowledge gain about Geothermal Energy and Hydro Energy. • Knowledge gain about Piezoelectric Energy harvesting. • Knowledge gain about Electromagnetic Energy Harvesting
	GE2: Electricity and Magnetism	Electricity and Magnetism	• Basic understanding of vector analysis which includes (i) Review of vector algebra (Scalar and Vector product), (ii)gradient, (iii) divergence, (iv) Curl, (v) Vector Integration, (vi) Gauss-divergence theorem (vii) Stoke's theorem of vectors • Develop ideas about electric field, magnetic field and electric potential. • Knowledge gain in electromagnetic induction • Knowledge gain in Maxwell`s equations and Electromagnetic wave propagation • Handling of electrical instruments such as multimeter, capacitor, CRO, resistance, inductor etc. • Performing experiments to understand RC circuit, LCR circuit, Carey Foster's Bridge etc.
		Quantum	Knowledge gained on • General formalism of Quantum Mechanics, mixed states, wave packets, uncertainty relation, representation in quantum mechanics, picture of quantum mechanics, Eigen value problem, matrix mechanics, angular momentum, Zeeman effect, stark effect, • Schrodinger equation, turning points and connection formulae, bound states solution, barrier penetration. • Basic knowledge of Quantum Mechanics is acquired. • Skills and techniques to use Quantum mechanical

				principles in simple and complicated systems.
SEM-V	CC11: Quantum Mechanics	Mechanics		• The basic knowledge to solve 1 dimensional and thereafter 3-dimensional potential problems. • The students after the course are competent enough to use the knowledge of Quantum Mechanics to different Quantum Mechanical systems encountered in different areas of Physics. • They learn to solve the non-relativistic quantum mechanical problem and can demarcate the problems which are quantum mechanical
	CC12: Solid State Physics	Solid State Physics		Knowledge gained 0n • Elementary Crystallography, basis, crystal class and Ewald construction. • Knowledge gained on lattice vibrations and thermal properties and quantization of lattice vibrations, phonon momentum. • Discussion on free electron Fermi gas with Classical free electron theory and Fermi-Dirac probability distribution function is discussed and hence a comprehensive view on Fermi energy is obtained. • Understanding the Dielectric Properties of insulators and ferro-electricity. • Knowledge gained and Understanding the Magnetic properties of solids, Diamagnetism, paramagnetic susceptibility and ferromagnetism is discussed and a quantum picture of Heisenberg exchange energy is covered. • Knowledge gained on Semiconductors and their properties include motion of hole-electron pair-carrier transport equation. • Understanding Superconductivity: Properties of superconductors with discussion on Meissner effect. London's equations are covered and discussion on superconducting magnets is carried out. • Skills gained in crystallography, knowledge on symmetry operations and classification of lattices gives an understanding to define the structure of a crystal. Acquired knowledge on band theory of solid
				• Knowledge gained in areas like (i) Laplace (ii)Linear Vector Spaces (iii) Cartesian Tensors and (iv) General Tensors. • The students acquire skills to apply different mathematical techniques to solve problems in the areas of heat flow, potential theory, elasticity,

	DSE1: Advanced Mathematical Physics I	Advanced Mathematical Physics I	fluid mechanics, electromagnetic theory and quantum mechanics and condensed matter physics. • The students acquire skills to apply different mathematical techniques to a very wide range of natural systems from very simple (like an atom) to very complicated (like an astrophysical object), and try to understand the underlying dynamics of each. Most of these techniques are useful in other scientific and/or technology areas too. • Students gain competence which will enable them to solve problems in many areas of science and engineering. Students are/should be competent enough to solve problems and apply the above-mentioned techniques in areas like Quantum Mechanics, Quantum Field Theory, Astrophysics and Cosmology. They should be able to apply the mathematical techniques even beyond in Chemical, Biological and Geological systems as well as in technology.
	DSE2: Atmospheric Physics	Atmospheric Physics	• Knowledge gained on (i) General features of Earth's atmosphere, (ii)Atmospheric Dynamics, (iii)Atmospheric Waves, (iv)Atmospheric Radar and Lidar and (v)Atmospheric Aerosols • Understanding the importance different layer of atmosphere. • Understanding the Atmospheric Dynamics. • Understanding the principle of Atmospheric Radar and Lidar. • Understanding the usefulness of Atmospheric Radar and Lidar • Understanding the Atmospheric Aerosols. Understanding about pollution.
	DSE1(P): Elements of Modern Physics	Elements of Modern Physics	• Knowledge gain about photo-electric effect, Compton scattering, matter waves, uncertianty principle, schrodinger equation, radioactivity, nuclear model and laser. • Acquired knowledge about quantum nature of light, wave particle dual nature of light. • Understanding the uncertainty principle, • Understanding the different nuclear reactions and their importance
	SEC1: Electrical Circuits and Networks	Electrical Circuits and Networks	• Knowledge gained on (i) Basic Electricity Principles, (ii)Electrical Circuits(iii)Electrical Drawing and Symbols (iv)Generators and Transformers Electric Motor Solid-State Devices and (V)Electrical Protection &Electrical Wiring. • Understanding Electrical Circuits & Electrical Drawing and Symbols.

			• Understanding the working principle electrical motors and generators. • Understanding the working principle Electrical Protection &Electrical Wiring and importance electrical protection.
	CC13: Electromagnetic Theory	Electromagnetic Theory	• Knowledge gain about Maxwell's equations; Gauge transformations Electromagnetic energy, energy density. • Develop ideas about EM wave propagation and polarization. • Basic understanding about wave guides. • Apart from their basic understanding of the subject, the students are efficient enough to solve various unknown problems of electromagnetic theory relevant for competitive examinations
Sem-VI	CC14: Statistical Mechanics	Statistical Mechanics	Knowledge gained about • Basic postulates of classical statistical mechanics; • concepts of microstates, phase-space, partition function and density function; micro-canonical, canonical and grand canonical ensembles; • Maxwell-Boltzmann distribution; connection between statistical mechanics and thermodynamics applications to simple systems. • Quantum statistics; density operator, indistinguishable particles; • Fermi-Dirac and Bose-Einstein distributions; applications -Degenerate Fermi gas, White dwarf system, Saha's ionization formula, • Black-body radiation, Debye's theory of specific heat, Pauli's theory of paramagnetism, Bose-Einstein condensation. • Introductory knowledge of Statistical Mechanics is acquired. Skills of using the statistical principles and applying the techniques learnt thereof to simple thermodynamic systems under equilibrium are developed. • Students are/should be competent enough to connect the principles of statistics with the laws of mechanics, and apply their knowledge to more complicated thermodynamic systems in and beyond the domains of physics (like in chemical, biological, geological systems and in technology), as well as to systems that are not in equilibrium
			Knowledge gained in areas like • Calculus of Variations- Variational principle, Euler-Lagrange Equations of motion, canonical pair of variables, Poisson Brackets. • Knowledge gained and understanding the group theory

	DSE3: Advanced Mathematical Physics-II	Advanced Mathematical Physics-II	• Knowledge gained and understanding the advanced probability theory. • The students acquire skills to apply different mathematical techniques to solve problems in the areas of heat flow, potential theory, elasticity, fluid mechanics, electromagnetic theory and quantum mechanics and condensed matter physics. • The students acquire skills to apply different mathematical techniques to a very wide range of natural systems from very simple (like an atom) to very complicated (like an astrophysical object), and try to understand the underlying dynamics of each. • Most of these techniques are useful in other scientific and/or technology areas too. • Students gain competence which will enable them to solve problems in many areas of science and engineering. • Students are/should be competent enough to solve problems and apply the above-mentioned techniques in areas like Quantum Mechanics, solid state of physics • They should be able to apply the mathematical techniques even beyond in Chemical, Biological and Geological systems as well as in technology
	DSE4: Nuclear And Particle Physics	Nuclear And Particle Physics	Knowledge gained in • Nuclear physics general properties of nuclei, nuclear models. • The different nuclear interactions and the corresponding nuclear potentials and its dependence on the couplings are learned. • Understanding nuclear reactions, interaction of nuclear radiation with matter. • Knowledge acquired detector for nuclear radiations and particle accelerators • Knowledge gained in particle physics. • The knowledge helps to choose for an Advance course in Nuclear and particle Physics. • Understanding of the nucleus at low energy. • Develop basics ideas to solve some of the problems of nuclear physics and their limitations in nature.
			Knowledge gained on • Elementary Crystallography, basis, crystal class and Ewald construction. • Knowledge gained on lattice vibrations and thermal properties and quantization of lattice • Discussion on free electron Fermi gas with Classical free electron theory and Fermi-Dirac

			probability distribution function is discussed and hence a comprehensive view on Fermi energy is obtained.
	DSE1(P): Solid State Physics	Solid State Physics	• Understanding the Dielectric Properties of insulators and ferro-electricity. • Knowledge gained and Understanding the Magnetic properties of solids, Diamagnetism, paramagnetic susceptibility and ferromagnetism is discussed and a quantum picture of Heisenberg exchange energy is covered. • Knowledge gained on Semiconductors and their properties include motion of hole-electron pair-carrier transport equation. • Understanding Superconductivity: Properties of superconductors with discussion on Meissner effect. London's equations are covered and discussion on superconducting magnets is carried out. • Skills gained in crystallography, knowledge on symmetry operations and classification of lattices gives an understanding to define the structure of a crystal. • Acquired knowledge on band theory of solid
	SEC2: RENEWABLE ENERGY AND ENERGY HARVESTING	RENEWABLE ENERGY AND ENERGY HARVESTING	• Knowledge gain about Fossil fuels and Alternate Sources of energy. • Understanding the energy crisis. • Understanding importance of renewable energy. • Knowledge gain about Solar energy and its usefulness. • Knowledge gain about Wind Energy harvesting and its usefulness. • Knowledge gain about Ocean Energy. • Knowledge gain about Geothermal Energy and Hydro Energy. • Knowledge gain about Piezoelectric Energy harvesting. Knowledge gain about Electromagnetic Energy Harvesting

Department of Political Science

PROGRAMME OUTCOMES

After successfully completing B.A.Political Science Programme Students will have

PO-1	In-depth knowledge of Indian Political system, Political thinkers, administrative system
PO-2	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO-3	Skills of working collaboratively in teams and plan as well as manage their workload.
PO-4	Awareness of personal strengths and weaknesses. Will have self-reflection and discipline
PO-5	Elicit views of others, mediate disagreements and help reach conclusions in-group settings.
PO-6	Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO-7	Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PROGRAMME SPECIFIC OUTCOMES

After successfully completing B.A . Political Science Programme Students will have

PSO-1	Ability to discuss about Indian Constitution and Political process.
PSO-2	Ability to discuss Political thinking in western world.
PSO-3	Ability to describe Administrative Process and thinking in western thinking, as well as Indian context
PSO-4	Capacity to analyses Political Theory and its contemporary impact on civilization

COURSE OUTCOMES

After successfully completing this Course, Students will be able to

Semester-I		
Course Code	**Course Name**	**Course Outcomes**
Core-101	**UNDERSTANDING POLITICAL SCIENCE**	• Understanding the meaning and importance of Political Science. • Understanding the sub-disciplines of Political Science. • Understanding key concepts of political science. • Understanding theories of the State: Social Contract, Idealist, Liberal and Neo-liberal, Anarchist
Core-102	**Perspectives on Public Administration**	• Explaining the nature, scope of Public Administration; Politics • Discussing the personnel administration • Discussing Financial Administration, budgetary process in India • Critically examining Administrative Thinkers with focus on Henri Fayol, Max Weber •

Semester-II		
Course Code	**Course Name**	**Course Outcomes**
Core-203	**INDIAN GOVERNMENT AND POLITICS**	• Understanding the making of Indian constitution • Understanding the philosophy of Indian Constitution. • Understanding Fundamental Rights; Fundamental Duties, Directive Principles of State Policy • Understanding critically analyzing legislature, executive and judiciary system of India
Core-204	**Western Political Thought**	• Define Plato`s thinking, like Ideal State & Philosopher King • Interpret Aristotle`s thought on State, Property, Slavery • Describe Machiavelli`s views on Human

		Nature, Religion • Describe Karl Marks theorization on Historical Materialism

Semester-III		
Course Code	**Course Name**	**Course Outcomes**
Core-305	**COMPARATIVE POLITICS**	• Understanding Comparative Politics: development, nature and scope. • Explaining Major governing principles: Constitutionalism; Conventions; Rule of law; • Understanding and critically analyzing the political system of U.K. • Understanding and critically analyzing the political system of U.S.A. • Understanding and Critically analyzing the political system of China • Understanding and Critically analyzing the political system of Switzerland
Core-306	**Public Policy and Administration**	• Explaining the nature, scope of Public Policy • Understanding and Critically analyzing Public Policy in India • Understanding and Critically analyzing Citizen and Administration interface • Explaining the nature, scope of Social Welfare Administration and Policies
Core-307	**Nationalism In India**	• Understanding the Approaches to the Study of Nationalism in India • Understanding Nationalist Politics and Expansion of its Social Base • Explaining the Women's Question: Participation in the National Movement and its Impact

Semester-IV		
Course Code	**Course Name**	**Course Outcomes**
Core-408	**INTRODUCTION TO INTERNATIONAL RELATIONS**	• Understanding Origin and growth of International Relations (IR) – meaning and scope of IR. • Explaining Basic concepts: National Power; National Interest; Balance of Power; Bipolarity • Explaining Major Theories of IR: Realist Theory • Understanding Collective Security: Meaning and Safeguards --Pacific Settlement of International Disputes
Core-409	**Political Sociology**	• Understanding Political Sociology: Nature and Development • Explaining Social stratification and politics: Class, Elite. Caste in India • Understanding Political culture: Types , Influence , Political socialization: Agencies • Explaining Political development, modernisation and social change: Concepts and Theories
Core-410	**Political Theory: Concepts and Debates**	• Understanding Importance of Freedom, Negative Freedom: Liberty, Positive Freedom: Freedom as Emancipation and Development • Understanding Significance of Equality, Formal Equality: Equality of opportunity • Understanding Indispensability of Justice, Procedural Justice, Distributive Justice, Global Justice • Explaining the Universality of Rights, Natural Rights, Moral and Legal Rights, Three Generations of Rights

	Semester-V	
Course Code	**Course Name**	**Course Outcomes**
Core-511	**Understanding Global Politics**	• Explaining evolution of the State System, the concept of Sovereignty • Explaining the Global Economy, Discussing the Bretton Woods Institutions and WTO , Ideological underpinnings , Transnational Economic Actors ,Identity and Culture • Explaining Global Inequalities: Violence: Conflict, War and Terrorism • Explaining Global Environment, Global Civil Society
Core-512	**Indian Political Thought**	• Understanding Ancient Indian Political Thought: Main Features– Contribution of Kautilya, Medieval Political Thought: Main Features. • Explaining Indian Awakening and birth of Modernity: Rammohun and Syed Ahmed Khan • Explaining Ideas of Nationalism: Bankimchandra, Tilak and Rabindranath • Understanding B. R. Ambedkar: on social justice.
Elective-501A	**Party System in India**	• Knowledge gained: About the ideology and the organization of political parties in India and changing party systems. • Skill gained: To study manifestos, organizations and campaign strategies of different political parties and changing part systems in India • Competency gained: To apply the knowledge in understanding and predicting the role of political parties
Elective-502B	**International Organisations**	• Knowledge gained : Understanding the contemporary relevance of the UN and its relationship with other IGOs • Skill gained: to contextualize recent international crises and their resolution. • Competency gained: Faculty to represent the country in diplomatic circles, armed with the proper knowledge of international organizations.

Semester-VI		
Course Code	**Course Name**	**Course Outcomes**
Core-613	**India's Foreign Policy in a Globalised World**	• Knowledge gained : About the bases of power and influences of major powers in global politics • Skill gained : Theoretical and practical insight into the foreign policy making of the major powers • Competency gained: To apply the knowledge to predict the trends and the foreign policy decisions of the major powers
Core-614	**Political Ideology**	• Knowledge gained: Of major modern ideologies and their core assumptions including major ideologues and ideological debates. • Skill gained: To critically engage, understand the contemporary ideologies. • Competency gained: To apply it to understand political realities
Elective-603A	**India and Her Neighbours**	• Understanding the relations of India with neighboring countries. • Evaluating India's relations with Pakistan, Bangladesh, Nepal and Sri Lanka
Elective-604A	**Grass Root Democracy in India**	• Knowledge gained : About rural local self-government and administration in India • Competency gained :To apply the knowledge to grass root level situations • Knowledge gained : About urban local self-government and administration in India • Competency gained: To apply the knowledge to grassroots level situations and design alternatives

Sukanta Mahavidyalaya
Department of Sanskrit
Program Specific and Course Outcomes
Sanskrit (Honours and General)

Program Specific Outcomes(Honours and General):

In IE language group Sanskrit is a very rich language. Through Sanskrit texts students can know about ancient Indian history, culture, social life, religion etc.The academic program of both Honours and General degree courses are so designed that students can achieve not only professional skill but also they can develop a deep understanding of rich heritage and dynamic prevalent scenario of India through various Sanskrit texts. Primarily A certificate/degree is the outcome of the individual program. To be awarded a specific Degree/certificate etc., the students have to demonstrate skills and competencies which are both subject specific as well as generic. After completion of the program students get prepared for further study, employment etc. and they are able to be a good citizen.

Bachelor's degree in Sanskrit is awarded upon completion of six semesters (three full years) of the subject study at the undergraduate level. The learning At the end of the program enables the students to have the academic, behavioral and social competencies as given below:

➢ Basic communication skills in understanding Sanskrit with LSRW (Listening, Speaking, Reading, Writing) capacities.
➢ Articulation of ideas, literary writings, innovations and effective presentation skills in Sanskrit as well as in other native languages and English.
➢ Ability to explore ancient Sciences with confidence.
➢ Skill adaptability in Specific areas.
➢ Competency building to convey the Society at large about Indic knowledge and wisdom.
➢ Usage of Shastric discipline and ancient traditional learning while discriminating others.
➢ Ability to write Devnagari Script which provide paleographical knowledge to read out the script of modern languages like Hindi, Marathi.
➢ Reasonable understanding of multi-disciplinary relevance of literature of Sanskrit like Veda, Grammar, Kavya, Philosophy, Smritisastra, Arthasastra etc.
➢ Develop research aptitude and independent thinking.
➢ Accentuating memory power and concentration in a specific area.
➢ Developing patriotism with a sense of responsibility.
➢ Analyzing social problems and understanding social dynamics.
➢ Develop self confidence in executing and planning.

Course Outcomes (Sanskrit Honourse):

Semester	Course / Paper	Title	Outcomes
1st	CC1	Sanskrit Grammar and Composition	Enhances intellectual ability and memory power.
	CC2	Classical Sanskrit Literature(Poetry)	Gives a brief experience of talent of a classical poet like Kalidasa etc. which has a power to influence to a great extent.
2nd	CC3	Critical Survey of Sanskrit Literature	Gives knowledge of social, cultural, economical and political situations of Classical era.
	CC4	Grammar and Classical Sanskrit Literature	Helps in intellectual and mental development.
3rd	CC5	Gita and Upanishad	Helps in Spiritual upliftment and treats how to live a proper life.
	CC6	Classical Sanskrit Literature(Drama)	Gives an impression of different demeanors of different social characters.
	CC7	Poetics and Literary Criticism	Makes aware of the quality and great knowledge of a poet.
	SEC-1	Translation and Computer Application	Enhances technical skill.
4th	CC8	Indian Social Institutions and Polity	Gives a brief knowledge of ancient Indian Polity which is too relevant to modern age.
	CC9	Indian Epigraphy, Paleography and Manuscriptology	Gives paleographical and epigraphical knowledge to some extent and makes aware of the

			condition and preserving process of ancient Indian texts.
	CC10	Modern Sanskrit Literature and Poetics	Gives information of modern Sanskrit texts and culture.
	SEC-2	Yoga and Upanisad	Introduces Ultimate Knowledge.
5th	CC11	Vedic Hymns and Grammar	Gives sacred feelings and gives an idea of the generous, pious grateful attitude of Vedic Rishis.
	CC12	Ontology and Epistemology	Gives an idea of ontology and epistemology through philosophical aspects to some extent.
	DSE1	Art of Balanced Living OR Trends of Indian Philosophy	Gives an idea to lead a proper life. OR Describes elaborately Indian Philosophy which produces and enhances philosophical thinking.
	DSE2	Philosophy Religion and culture in Sanskrit OR Literary Criticism and History of Sanskrit Poetics	Gives different ideas of Indian culture, religion etc. OR Gives a brief idea of Poetics.
6th	CC13	Sanskrit Grammar and Linguistics	Enhances intellectual ability.
	CC14	Ancient Indian Polity and General Survey of Dharma, Artha and Nitisastra	Gives valuable knowledge of ancient Indian Polity, Religion etc.
	DSE3	Sanskrit Linguistics OR Ethical literature in Sanskrit	Gives scientific knowledge of Language. OR Enhances ethical

	DSE4	Environmental Awareness in Sanskrit Literature OR Fundamentals of Ayurveda	values.
			Makes aware of environmental issues. OR Gives a brief idea of medical Science

Overall Course outcomes: After successful completion of the total course of Honours program in Sanskrit, at first students are able to be an ideal human being or ideal social citizen equipped with actual knowledge, ethical values, great intellect etc. Secondly, they can apply in the field of WBCS etc. and also after post graduation they can apply against teaching posts in schools, Colleges and other educational institutions. Thirdly, through the knowledge of Sanskrit and Devnagari scripts students can get job in various fields.

Course Outcomes(Sanskrit General):

After successful completion of total courses all undergraduate general degree course's students should be able to achieve the following objectives.

- ➢ Students will be able to know ancient Indian history of literature and literary criticism.
- ➢ They will learn about the Indian Philosophy, Religion and Culture in Sanskrit tradition.
- ➢ Through Gita they also develop their personality, self respect etc.
- ➢ Ayurveda will help them to know about the ancient Indian medical science.
- ➢ Introducing with computer application they can develop their technical skill.
- ➢ The students will able to learn Yoga, their cocept, features etc.
- ➢ Grammar is an important part of the language. Having some knowledge of it students can make sentences Sentence in Sanskrit Language.
- ➢ After completion of the course students can apply for various jobs through the certificate.

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Name of the Program	Year of Publication	Status of Implementation in CBCS Curriculum (Yes/No)	Program Outcome	Course Outcome
Sociology Program	2018-19	Yes	This Program will help you to understand the society at large, institutions, social ethics, values, norms, social cohesion, social interaction, structural components of society, broader theoretical perspectives regarding social class, social stratification, social evolution, Religion, media, population growth, visual culture, gender and violence, qualitative and quantitative research method in sociology.	GE-01a. To familiarize students with the nature of structured gendered violence, situated violence and harassment in the workplace, and sexual and domestic violence within the family sometimes by intimate partners or outside personnel. This will also be addressing violence and policies to fight against it. GE-02 b. To make the students understand about the demographic transition, population growth, fertility, mortality, fecundity, Malthusian and post-Malthusian and Marxist Theory. To

				acknowledge the policies of population control.
				DSC-1- The readers will get knowledge about the origin and development of sociology as a discipline, the difference between sociology with other sciences, and relevant sociological concepts like social status, groups, social roles, norms, values, culture, community, and associations. The agencies of social control and changes, the process of socialization.
				DSC-2- To understand sociology from Indian perspectives, social institutions, and practices. This paper highlights on the role of family, marriage, and kinship within

				the society, structural and functional changes with social development. It also focuses on Dalit and Women movement in Indian society and the concept of communalism and secularism. DSC-3- This will help students understand about the classical sociological thinkers and their theoretical orientation regarding social class, division of labor, suicide, Weber's Ideal type, social action and Spencer's social evolution. DSC-4- This course will enhance the knowledge about social research methodology, process and design of research, hypothesis testing,

| | | | | reliability and validity. This will give light on qualitative and quantitative approach of research, methods of data collection, statistical data analysis and ethics of research.

DSE-01.a To make students understand about Sociology of Religion, meaning and scope through the concept of sacred and profane, Rites De passage. Fundamental doctrine, features and influence of Hinduism, Islam, Christianity, Sikhism and Buddhism.

DSE-02 a. – To acknowledge students about various social strata in terms of class, caste, race, power and gender. This course will also highlight factors |
|---|---|---|---|---|

				and forces of poverty in rural and urban India, social mobility and change.
				SEC-01- To emphasize on the interconnection between media and society through Neo-Marxist, Feminist, Interactionist and semiotics theoretical connotation. This will focus on the media representation and audience reception in society at large.
				SEC-02- This course will give light on the visual sociology, simulacrum and visual culture, John Berger's way of seeing. This discourse will stress on inter-textually, discursive formation and power knowledge propagated by Michel Foucault. It will also deal with

				documentary photography, photo journalism, and poster design.

SUKANTA MAHAVIDYALAYA

DEPARTMENT OF BOTANY

COURSE OUTCOME OF B.SC PROGRAM COURSE

NO	SEMISTER	COURSE	COURSE NAME		COURSE OUTCOME
	1st	DSC 1	Biodiversity		ome aspects of biodiversity are instinctively widely valued by people but the more we study biodiversity the more we see that all of it is important – even bugs and bacteria that we can't see or may not like the look of. There are lots of ways that humans depend upon biodiversity and it is vital for us to conserve it. Pollinators such as birds, bees and other insects are estimated to be responsible for a third of the world's crop production. Without pollinators we would not have apples, cherries, blueberries, almonds and many other foods we eat. Agriculture is also reliant upon invertebrates – they help to maintain the health of the soil crops grow in. Soil is teeming with microbes that are vital for liberating nutrients that plants need to grow, which are then also passed to us when we eat them. Life from the oceans provides the main source of animal protein for many people.
	2nd	DSC 2	Plant ecology and plant taxonomy		Global biodiversity is being lost at an unprecedented rate as a result of human activities, and decisions must be taken now to combat this trend. But how do decision-makers decide where to establish protected areas if they don't know what is being protected? How can regulators identify and combat harmful invasive species if they cannot distinguish them from native species? How do developing countries ensure that they reap the benefits of the use of their biological diversity, if they don't know the biological diversity that is being used? Taxonomy provides basic understanding about the components of biodiversity which is necessary for effective decision-making about conservation and sustainable use.
	3th	DSC 3	Plant anatomy and embrology.		• Plant anatomy can provide valuable characteristics in phylogenetic analyses, but these are less frequently acquired today than in the past. However, anatomical features, whether used directly to generate a cladogram or merely traced on an existing cladogram, can give insight into major adaptive shifts.
	4th	DSC 4	Plant physiology		

			and metabolism		Role of Plant Physiology in Knowledge Development Phytochemistry or Plant Chemistry in plant physiology:. It is one of the key knowledge areas in the domain. The plants... Cellular Processes:. The subject aims at developing knowledge in the domain of chemical and biological processes in the... ...
	5th	DSE 1	Economic botany and plant biotechnology Industrial and environmental microbiology Analytical techniques in plant science		an economic perspective, plant biotechnology offers significant potential for the seed, agrochemical, food processing, specialty chemical and pharmaceutical industries to develop new products and manufacturing processes. We can say then that environmental microorganisms , have a polluting or environmental decontamination function, are present in all environments; and that environmental Analytical Methods in Plant Science Photosynthetic organisms build complex organic molecules from simple inorganic compounds, using sunlight as an energy source. As primary producers, plants and algae are essential participants of complex ecosystems.
	6th		Economic botany and plant biotechnology Industrial and environmental microbiology Analytical techniques in plant science		an economic perspective, plant biotechnology offers significant potential for the seed, agrochemical, food processing, specialty chemical and pharmaceutical industries to develop new products and manufacturing processes. We can say then that environmental microorganisms , have a polluting or environmental decontamination function, are present in all environments; and that environmental Analytical Methods in Plant Science Photosynthetic organisms build complex organic molecules from simple inorganic compounds, using sunlight as an energy source. As primary producers, plants and algae are essential participants of complex ecosystems.